UNDERSTANDING SOCIOECONOMIC INEQUALITIES IN CERVICAL SCREENING

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I, Elaine Douglas, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Abstract

Incidence of cervical cancer has fallen dramatically since the introduction of the NHS Cervical Cancer Screening Programme, yet this largely preventable disease disproportionately affects women of lower socioeconomic status (SES). This thesis set out to explore the evidence for, and possible mechanisms of, socioeconomic inequalities in cervical screening uptake in England.

Studies 1-3 were cross-sectional observational studies exploring the relationship between routinely collected Primary Care Trust (PCT)-level cervical and breast screening coverage and area-level deprivation, and testing for associations between population- and programme-delivery characteristics and cervical screening coverage. Study 4 used semi-structured qualitative interviews to explore the views of health professionals on the factors that support or hinder cervical screening uptake. Study 5 used cross-sectional observational survey data to assess whether perceived benefits of cervical screening explained the association between SES and screening attendance. Study 6 was a cross-sectional, observational analysis of the relationship between colposcopy attendance and area deprivation.

Analysis of variance showed no significant reduction in cervical screening inequalities from 2007-12 but an improvement in breast screening coverage among lower SES women. Regression analyses revealed that population factors explained more of the variation in PCT-level cervical screening coverage than did programme-delivery factors. Health professionals considered programme-specific factors to support, and population factors to hinder, cervical screening participation. Women from lower SES backgrounds were more sceptical about the benefits of cervical screening but these beliefs explained little of the variance in screening attendance. Logistic regression analysis demonstrated that although colposcopy attendance was high, it was lower in income-deprived areas.

This thesis demonstrated persistent SES inequalities in cervical screening attendance despite efforts to address the problem, and delayed uptake of colposcopy among women living in deprived areas. The work points strongly to the influence of population factors in explaining variation in cervical screening in women of all ages. Programme-delivery factors were also important for screening uptake in younger women. Some PCTs (now CCGs), were identified as exemplars of good practice and others as requiring further support. Women of lower SES delay attendance at colposcopy appointments, but earlier attendance may be achieved with support.

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Table of Contents

List of Tables

List of Figures

List of Funnel Plots

Chapter 1: Background to Socioeconomic Inequalities in Cervical Cancer

1.1 Overview

Socioeconomic inequalities in health are not new. Nor, sadly, are they old news. While the understanding of socioeconomic inequalities in health has evolved considerably over the years, their resolution is problematic. For developed countries at least, the threat of infectious disease such as cholera and typhoid has largely been eradicated and is an indication of the potential for successful outcomes. Health improvements in communicable diseases have been attributed to the introduction of vaccination programmes or other prevention programmes, rendering some diseases technically preventable. However, chronic diseases, such as heart disease and cancer, now pose significant health problems and are often graded by socioeconomic status.

Globally, cervical cancer is the fourth most common cancer in women (Ferlay et al., 2014). It is the most common cancer in women in developing countries, but the sixth most common cancer in women in Europe overall, and the twelfth most common cancer in women in the UK. The reduced burden of cervical cancer is associated with the availability of preventative health programmes such as cervical screening and Human Papillomavirus (HPV) immunisation (Kesic et al., 2012). Successive UK governments have pledged to reduce avoidable cancer deaths (Department of Health, 2000; Dept of Health, 2011). The National Health Service Cervical Screening Programme (NHSCSP) was implemented in the UK in 1988 and, more recently, the HPV Vaccination Programme was introduced. While cervical cancer incidence and mortality rates have fallen and survival has increased, around 800 women still die from this preventable disease in England every year (Trent Cancer Registry et al., 2012), and a disproportionate percentage of these women are of lower socioeconomic status (Baker and Middleton, 2003).

This thesis sought to ascertain the current status of socioeconomic inequalities in attendance at cervical screening and at colposcopy (where further diagnostic tests or treatment are carried out, if required), and explored the factors associated with cervical screening attendance in order to contribute to policy recommendations to reduce avoidable deaths of cervical cancer.

In this chapter, socioeconomic inequalities in health and socioeconomic inequalities in cancer will be introduced, including a section on the development of relevant UK policies. Finally, more detailed information will be provided on the specific evidence for socioeconomic inequalities in cervical cancer in the UK, the pathways to such inequalities and the available means to prevent cervical cancer.

1.1.1 Socioeconomic Inequalities in Health

Lower life expectancy and a higher prevalence of disease is consistently seen in people with fewer social and economic resources (Wilkinson and Marmot, 2003). At higher socio-economic levels health is considerably better, indicating what is known as a social gradient in health. Ever expanding evidence of health inequalities is reported across and between countries, indicating that health inequalities may narrow or widen over time or place. Such wide disparities in life expectancy and disease indicate that poor health outcomes are not in themselves inevitable (Marmot, 2005). This indicates that we can do something about health inequalities.

Both financial and psychosocial factors contribute to poorer health outcomes (Wilkinson and Marmot, 2003). The specific disadvantage experienced by individuals and communities may relate to a wide variety of factors including poverty (or relatively less material wealth), lower levels of education, poor quality housing or stressful life circumstances. This indicates that these wider social issues should be taken into consideration when evaluating health inequalities. Improving health across the population, therefore, not only needs to extend beyond health policy, but also requires action on the social factors that support, or suppress, health and wellbeing overall.

Understanding socioeconomic inequalities in health is complex. The approach that researchers have taken has changed over the years, and each approach has offered new forms of knowledge. Adler and Stewart's (2010) five eras of health inequalities research provide a useful overview of health inequalities research. These will now be discussed.

The first era of health inequalities research was often limited by its concept of the relationship between socioeconomic status and health (Adler and Stewart, 2010). The idea that social factors may contribute to socioeconomic inequalities in health was evident in work by Farr and Durkheim in the first era of health inequalities research. However, research, particularly in the USA, considered socioeconomic status almost as a binary concept, rich versus poor, where a poverty level was drawn and ill-health was seen to be more common beneath it. Research largely failed to associate socioeconomic status with other confounding factors such as ethnic differences, level of education or employment status, although it may independently associate these with poor health outcomes.

The second era, the era in which Adler and Stewart believe health inequalities research really began, is where an appreciation that disease often has an inverse, linear association with socioeconomic status (SES) evolved. SES and health were now considered on a continuum, rather than as binary concepts or measures. A classic, pioneering example of social gradients in health was found in the Whitehall studies where the prevalence of angina and symptoms of chronic bronchitis were found to increase in a linear association with lower socioeconomic status (Marmot et al., 1991). Social gradients in health have continued to be documented and are evident across and within many countries in the world, both developed and developing, and across many diseases, both infectious and non-communicable (Wilkinson and Pickett, 2010). However, the strength and pattern of the social gradient may differ according to the health outcome (Adler and Stewart, 2010). The work of this second era continues to have contemporary relevance to the identification and status of inequalities in health, and can therefore be seen to continue in tandem with subsequent eras.

The third era began to address the mechanisms by which SES affects health, or what was termed as, ‘how does socioeconomic status get under the skin?’ Explanations have included the significance of material resources on health and psychosocial factors, and how these may lead to differential access to health care, exposure to risk factors (including stress) and health-related behaviours.

The fourth era broadened to extend the focus from mechanisms operating at the individual level to addressing mechanisms that operate at the neighbourhood or community level. The key distinction of this work was in the identification of the means by which characteristics of the neighbourhood or community affect health, rather than assuming, as is more traditionally the case, that the characteristics of the neighbourhood are merely a proxy of the characteristics of the people living there. In this fourth era, the effect of place is in itself a contributory factor to social patterns in health. Examples of such research address the effects of living in areas where tobacco/alcohol products and fast food outlets are prolific while affordable, healthy foods or safe environments for exercise are scarce. This provides a means to understand how individual health behaviours may be constrained or supported by the characteristics of the neighbourhood in which people live or work. This innovative research area has moved beyond addressing the main effects of neighbourhood factors on health to looking at the effect of a combination of factors and is beginning to address interactions within multilevel analyses.

The fifth era is concerned with how the effects of SES are moderated by a combination of factors. This includes interaction effects of SES and other sociodemographic factors; as well as biology, genetics and the life course. One example of this type of research may be to explore how the effects of SES on health or health behaviours differ among ethnic groups.

Contemporary research on health inequalities may still span several of these eras. Theories of 'absolute deprivation' from the first era have largely been replaced by theories of 'relative deprivation' from the second era. The measurement of social gradients in health outcomes, or health behaviours, continues to be necessary to acknowledge the status of health issues or to ascertain if policies or interventions are having an effect on health inequalities. Work to explore the mechanisms through which SES affects health, the various levels which operationalise these mechanisms and the complex interaction effects is key to our understanding of how health inequalities are manifest and, importantly, how we may intervene to reduce them.

1.1.2 Socioeconomic Inequalities in Cancer Outcomes

Population growth and ageing are estimated to contribute to an increase in the number of cases of cancer in the UK by 55% and 35% for men and women respectively between 2007 and 2030 (Mistry et al., 2011). Incidence and mortality rates are particularly high for breast, colorectal and lung cancer (Ferlay et al., 2014). Since the 1980s, perhaps even earlier, the UK has had higher mortality rates for the most common cancers than other European countries, which suggests that these deaths are avoidable (Ferlay et al., 2014).

In England, socioeconomic variation in cancer incidence is found across a number of different cancer sites (NCIN, 2008). Generally, people of lower socioeconomic status have higher incidence of cancer of the head and neck, lung, stomach, liver and cervix; although in breast cancer and malignant melanoma of the skin incidence has been found to be higher in people of higher socioeconomic status (Shack et al., 2008). The variation in cancer incidence may be attributable to environmental or lifestyle factors, differences in health-seeking behaviour or access to healthcare services. For example, people in lower socioeconomic groups are more likely to smoke and this has been associated with higher incidence of lung cancer (Soerjomataram et al., 2011). Conversely, women of higher socioeconomic groups may be more likely to use hormone replacement therapy, have fewer children, and have children at a later stage and these factors have been associated with higher incidence of breast cancer (Shack et al., 2008).

The overall mortality rates for cancer can be viewed in three ways: expected mortality; excess mortality and avoidable deaths (Ellis et al., 2012). Expected mortality is derived from the number of all-cause deaths in the general population. Excess mortality is estimated as survival from cancer after adjustment for other causes of death (the relative survival approach). Avoidable deaths are the proportion of deaths that would not occur if the relative survival for all socioeconomic groups were equal to the least deprived group. This is also known as the cancer ‘survival gap’. The cancer ‘survival gap’ is longstanding and has been evidenced using a multitude of SES measures (Woods et al., 2006). A study of the 21 most common cancers in England found that improvement in survival rates lead to a reduction in the number of avoidable deaths from cancer over the period 1996 to 2006 (Ellis et al., 2012). However, there had been no discernible reduction in the ‘survival gap’ between the most and least deprived groups, which indicates that those of lower socioeconomic status are not yet benefitting from improvements in survival. The cancer ‘survival gap’ may be attributable to a differential stage at diagnosis, which may lead to delayed treatment or differential access to treatment, but this, where evidenced, may vary according to the cancer site (Woods et al., 2006).

1.1.3 Health Policy

In this section, I will provide an overview of the development of public health policy in the UK and then move on to health policy specifically focused on cancer.

Public health policy to address health inequalities

A full review, or analyses of the effect of these policies, is beyond the scope of this thesis but it is hoped that this section will provide a flavour of how public health policy on health inequalities has developed over the years with the advent of successive governments.

Health inequalities and policy have been intertwined in the UK since at least the 19th century (Oliver, 2008). Edwin Chadwick, a social reformer, undertook an independent inquiry into sanitation to produce a report entitled The Sanitary Condition of the Labouring Population of Great Britain in 1842. The report concluded that damp, dirty and overcrowded living conditions contributed to disease and early death in deprived areas. While this report informed the 1848 Public Health Act, specific healthcare policies were not to advance for a further 100 years when the National Health Service was introduced in 1948. It was assumed that universal health care would resolve health inequalities and this contributed to the virtual removal of health inequalities from the health policy agenda for many years.

The Black Report (1980)

It was not until the 1970s that concern about health inequalities returned to political circles resulting in the commissioning of the Black Report (Macintyre, 1997). The Black Report, published in 1980, reported that people of lower social class were more likely to experience poor health and that the gap in reported health outcomes between the higher and lower social classes was widening. The report presented four hypotheses for health inequalities: artefact; natural/social selection; materialist/structural; and cultural/behavioural ("The Black Report," 1981). The artefact hypothesis suggested that if a relationship exists between class and mortality it is purely an artefact of measurement, and that the magnitude of difference across social class vary according to the unit of measurement. The natural/social selection hypothesis suggested that health determines social class. The materialist/structural hypothesis suggested that material, physical and psychosocial characteristics of class structure provided at least a partial, if not complete, explanation for observed health inequalities. And finally, the cultural/behavioural hypothesis suggested that health behaviours, good and bad, are socially patterned and hence contribute to observed health inequalities. The strengths and weaknesses of these differing theories of the cause of health inequalities continue to be widely discussed (Macintyre, 1997), and dependent upon the favoured view of the government of the time may affect its adoption or direction of public health policy.

The Black Report's recommendations for health and social policy included: children to have a better start in life, health to be promoted through improved education and prevention, and an anti-poverty strategy. It advocated the use of research to promote better understanding of health behaviours (smoking, diet, exercise, etc.), the development of social and health indicators and better understanding of the effects of social factors on health over time and place.

Acheson Report (1988)

Unfortunately, the Conservative government did not support action on the Black Report recommendations, and it was not until the Labour government regained power in 1997 that a further inquiry into health inequalities was commissioned. This culminated in the publication of the Acheson Report in 1988, sometimes referred to as the 'second Black Report'. The Acheson Report essentially picked up on the available evidence in the intervening period since the publication of the Black Report (late 1970s – late 1990s) and concluded that socioeconomic inequalities in health remained a significant problem, and that inequalities in health between the most and least deprived had actually widened. Of its recommendations three were identified as key: 1) all policies that are likely to affect health should be considered in relation to their effect on health inequalities, 2) priority should be given to families with children, and 3) action on income inequalities and improving the living standards of the most deprived (Acheson, 1998). The report was largely welcomed. Although, its critics suggested it failed to prioritise its recommendations, that it included recommendations that were either too vague or too specific to implement, and it lacked evidence on the cost-effectiveness of proposed policies. The Acheson Report has been considered to have affected policy in four key ways: the creation of new policies to tackle health inequalities; the incorporation of health inequality approach to existing policies; the promotion of a favourable political climate in which to tackle health inequalities; and as a reference to examine health inequalities policies (Exworthy, Blane, & Marmot, 2003).

Fair Society, Healthy Lives (2010)

Fair Society, Healthy Lives: The Strategic Review of Health Inequalities in England post 2010, is the output of a review commissioned by the Secretary of State for Health in 2008 to apply the recommendations of the World Health Organisation Commission on the Social Determinants of Health (CSDH) to a strategic plan for England (Marmot Review, 2010). The CSDH's three principal recommendations: 1) to improve everyday living conditions in which people are born into, grow, live and work, 2) to address the unequal distribution of money, power and resources across age, gender and ethnicity, and across and between countries, 3) to seek greater understanding of health inequalities through regular measurement of the scale of the problem and the potential impact of policy and action (Marmot et al., 2008). The tasks set out by the strategic review were broadly to accrue the relevant and available evidence to guide policy and action. This included the need to demonstrate how the evidence could be put into action, to recommend further objectives and measures to improve infant mortality and life expectancy and, finally, to contribute to the development of a post-2010 strategy to reduce health inequalities. The report reiterated the CSDH's view that health inequalities are the product of social inequalities, and therefore action for health should consider the social determinants of health – what is considered an 'upstream' approach to health inequalities. It also underlined the concept of 'proportionate universalism' – that the social gradient in health, where people with greater social disadvantage have poorer health, cannot be reduced by purely focusing upon the most deprived, but that the balance of invested energy and resource are proportionate to the level of disadvantage. Among the report's recommendations for policy objectives were action to enable people of all ages to have control over their lives and to achieve their potential, to create fair employment and good work practices, to create healthy and sustainable places for people to live and to place focus on the prevention of ill-health (Marmot Review, 2010).

Healthy People, Healthy Lives (2011)

When the coalition government was elected in 2010 they responded to the Fair Society, Healthy Lives report with the publication their own White Paper entitled Healthy Lives, Healthy People: Our Strategy for Public Health in England (Dept of Health, 2010a). Its approach to health inequalities highlighted lifestyle-driven health behaviours and the empowerment of individuals to make healthy choices – what may be considered a 'downstream' approach to health inequalities. It also proposed the establishment of Public Health England (PHE) as an integrated public health service that would, in its words, give local government and local communities the responsibility and funding to improve health in their local areas.

Summary of Public Health Policy to address socioeconomic inequalities

In this brief history of public health policy development in the UK, it is interesting that the introduction of the National Health Service in 1948 was considered the solution to inequalities in health. On the face of it, it may have appeared logical that health care, free at the point of access for all, would suffice. However, the Black Report opened the door to the sheer complexity of health inequalities. In this respect, we can begin to understand that while free access to health care dealt with an important barrier, it fell short of addressing other socially patterned barriers to good health, including the need to tackle the causes of ill-health, and therefore the social determinants of health. Unfortunately, the Black Report did not appear to have affected policy and it was the Acheson Report that brought the issue back into the political arena, to consider potential pathways from socioeconomic inequalities to population health and to recommend action for change. The Fair Society, Health Lives (2010) report placed its focus on 'upstream' approaches to health inequalities – the need to tackle the wider social and structural factors. The Healthy People, Healthy Lives (2011) report placed its focus on 'downstream' approaches – the need to address lifestyle factors and a focus upon individual choice. In this respect, the political will of the incumbent government has appeared to guide the policy of the day, although it is likely that both approaches are valid and necessary (Bosma, 2014).

Health policy to address socioeconomic inequalities in cancer

In this section I will move onto a discussion of some of the key health policies that have addressed concerns about rising cancer incidence and poor cancer outcomes, as well as socioeconomic inequalities in cancer.

Calman-Hine Report (1995)

Concerns about the human and economic cost of cancer led to the establishment of the Expert Advisory Group on Cancer (EAGC) by the Chief Medical Officers for England and Wales, Dr Kenneth Calman and Dr Deirdre Hine (Calman and Hine, 1995). The EAGC produced a report entitled A Policy Framework for Commissioning Cancer Services, more commonly known as the Calman-Hine Report. The policy framework was set up in response to rising cancer incidence and poor survival rates in England and Wales. There had been a steady recognition of geographical variation in cancer outcomes and emerging evidence that cancer survival in the UK was worse than in other European countries (Berrino et al., 1999, 1995). The Calman-Hine report indicated that survival rates may be associated with socioeconomic status, but a lack of robust evidence, particularly a dearth of population-based studies, made it difficult for any real conclusion to be drawn at that time. The Calman-Hine report recommended the establishment of a comprehensive cancer service through the integration of three levels of care. Firstly, primary care, then designated cancer units in local hospitals, and finally, designated cancer centres to provide specialist diagnostic and treatment services, including radiotherapy. The report specifically stated that ‘all cancer patients should have access to a uniformly high standard of care’ (Calman and Hine 1995, p22).

NHS Cancer Plan (2000)

The NHS Cancer Plan acknowledged the cancer burden within the UK and set out to save more lives and reduce health inequalities in a strategy which aimed to improve cancer prevention, screening, diagnosis, treatment and care (Department of Health, 2000). The plan aimed to tackle some of the reasons for the occurrence of inequalities. Broadly, these reasons comprised greater exposure to the risk factors that may affect the incidence of cancer; lower awareness of the symptoms of cancer, later presentation to the GP and lower uptake of screening, which may affect the stage of diagnosis of cancer (or precancerous abnormalities); and differential access to cancer treatments, which may affect mortality rates and survival.

In terms of improving prevention of cancer, the NHS Cancer Plan aimed to reduce smoking in disadvantaged groups where smoking rates are higher and to improve diet by increasing the consumption of fruit and vegetables (low-income groups are considered to eat less fruit and vegetables than higher income groups) (Department of Health, 2000).

In terms of cancer screening, the NHS Cancer Plan set out to extend the eligible age criteria for inclusion in the breast screening programme, to use technological advances to improve the cervical screening test (the use of liquid-based cytology, LBC) and to assess the feasibility of introducing a Human Papillomavirus (HPV) test in the future. With specific reference to inequalities in cervical screening, Primary Care Trusts (PCTs) were advised to set up plans to improve cervical screening coverage among deprived and ethnic minority groups. In particular, thirteen health authorities, all in deprived inner city areas, who were identified as having failed to reach the minimum 80% cervical screening coverage, were set specific targets to increase cervical screening coverage. A Health Improvement Programme was set up to support improvements in cervical screening coverage that included workshops and training to share best practice for health professionals and General Practice staff, update contact information on GP registers and local, targeted health support campaigns (Department of Health, 2000).

Inequalities in access to care were supported by Personal Medical Services (PMS) contracts that rewarded GPs for providing services targeted to the needs of the local area, and were considered to be particularly useful in supporting services in more deprived areas (Department of Health, 2000). Improving cervical screening coverage and rapid referrals to hospital were key components of PMS contracts. Further investment in the employment of more healthcare workers, considering the geographical location and availability of healthcare staff, and support of further training were also included in the plan.

The Cancer Reform Strategy (2007)

The Cancer Reform Strategy (2007) was viewed as building on the progress made by the NHS Cancer Plan. It recognised that poor cancer outcomes are experienced by different social groups, including those from socioeconomically deprived communities, ethnic minorities, and people with disabilities. To reduce cancer inequalities overall, its aims continued to be to promote healthy behaviours; increase awareness of cancer prevention and cancer signs and symptoms; improve routes to early diagnosis; and expand available treatments (Department of Health, 2007). However, insufficient evidence on the different forms of inequalities, their causes, and how best to tackle them continued to be a major challenge in the reduction of cancer. A National Cancer Equality Initiative was set up with three key aims: to support data collection thus promoting further understanding of cancer inequalities; to provide support to research activities in order to fill the gaps in current evidence; and to share best practice. The National Cancer Equality Initiative also worked with Strategic Health Authorities (SHAs) and Primary Care Trusts (PCTs) to set specific goals to reduce mortality rates in socioeconomically deprived groups, such as targeting a reduction in smoking and increasing awareness of cancer and the benefits of early detection. These actions would support an increase in screening uptake and encourage earlier presentation with cancer symptoms.

In March 2010, the National Cancer Equality Initiative (NCEI) published its report entitled Reducing cancer inequality: evidence, progress and making it happen (Dept of Health, 2010b). It acknowledged that inequalities continued to occur along the patient pathway from awareness, access to timely diagnoses and treatment, and cancer outcomes in many different groups including socioeconomically deprived groups. It reported on the progress made, in conjunction with the National Cancer Intelligence Network (NCIN), to bring together a wide range of data from multiple sources (including cancer registries, lifestyle and awareness surveys, Hospital Episode Statistics) to provide further evidence of the magnitude and nature of cancer inequalities, and to identify areas where further data were required. The provision of this evidence enabled the NCEI to facilitate events where experts could assess the current known status of cancer inequalities and plan how to tackle cancer inequalities, define areas for further research and ensure that current best practice was implemented within cancer services. It also set out wide-ranging action to promote cancer equality including the acquisition of more data and the launch of the Cancer Patient Experience Survey (to assess the extent to which the experience varies by deprivation, age, gender and ethnicity and so on). Targeted initiatives by the National Awareness and Early Diagnosis Initiative (NAEDI) to raise cancer awareness in groups where later presentation for symptoms is a known problem were also developed. The full extent of the NCEI activities and plans are beyond the scope of this introduction but suffice it to say that initial progress to establish the current status of cancer inequalities and to initiate actions to tackle them are ongoing.

A Department of Health report on the Cancer Reform Strategy, published in November 2010, after the formation of the coalition government in the same year, evaluated three of the Strategy's actions to improve cancer services: improving the quality of information; strengthening commissioning; and making better use of resources (National Audit Office, 2010). While the report acknowledged some achievements of the Cancer Reform Strategy, it was largely critical. It reported that the introduction of the National Cancer Intelligence Network (NCIN) had led to significant improvements in the quality of available data but that gaps and limitations were still evident. The commissioning of services in PCTs were found to have made improvements in the delivery of some cancer services, including improved coverage of cancer screening, but were largely criticised in the report for not making best use of the available information or applying their knowledge to make services more cost effective. Finally, wide variation within and between PCTs from one year to the next in areas such as emergency admissions for cancer and length of stay for cancer patients suggested that improvements to services were possible. The Cancer Reform Strategy would be replaced by the Department of Health's Improving Outcomes: A Strategy for Cancer in 2011 (Dept of Health, 2011).

Improving Outcomes: A Strategy for Cancer (2011)

Improving Outcomes: A Strategy for Cancer was introduced by the incoming coalition government in January 2011 (Dept of Health, 2011). The strategy was enforced by three key principles: to put the patient at the centre of public services by endorsing the *no decision about me without me* principle; to switch the focus from measuring processes *'which do not matter'* (p2, Dept of Health 2011) to delivering improvement; and to give local organisations and professionals the power to improve services for patients and service users. The strategy acknowledged the work of the National Cancer Equality Initiative and supported its work to continue to gather evidence on cancer inequalities, provide advice on action for change and support the dissemination of good practice. Its advisory group was transformed into an implementation advisory group whose purpose was to ensure equality issues are considered in actions to improve outcomes.

In the fourth annual update of the Improving Outcomes: A Strategy for Cancer, progress was reported in its aim to tackle cancer inequalities through targeted interventions to increase cancer awareness or improve screening uptake (Dept of Health et al., 2014). These included the Be Clear on Cancer campaigns that have targeted breast cancer awareness in older women, prostate cancer awareness in black men in London and interventions to improve screening uptake in socioeconomically deprived groups.

Summary of health policy to address socioeconomic inequalities in cancer

The Calman-Hine Report (1995) was pivotal in drawing attention to the need for specific cancer services within health care, and for citing concern about the possibility of socioeconomic inequalities in cancer and the need for further research in this area. By the time of the NHS Cancer Plan (2000) specific strategies were recommended to address the pathways to inequalities in cancer, largely aimed at downstream approaches, such as increasing awareness of cancer symptoms, differential access to cancer treatments and reducing smoking in disadvantaged groups. With regard to cervical cancer, the cancer plan supported technological advances that would improve the screening programme and also advised PCTs to set out plans to address poorer screening coverage. The Cancer Reform Strategy (2007) maintained a commitment to tackling cancer inequalities by setting up the National Care Equality Initiative, addressing the need for more and better information by setting up the National Cancer Intelligence Network and tackling poorer cancer outcomes overall through the National Awareness and Early Diagnosis Initiative. The Improving Outcomes: A Strategy for Cancer (2011) has continued to support the work of the NCEI, has established an implementation advisory group to ensure equality issues are considered in actions to improve cancer outcomes and supported targeted interventions to improve cancer outcomes in disadvantaged groups. Therefore, cancer policy over the years has sought to strengthen the services available to cancer patients and has worked, at least in a downstream capacity, to tackle cancer inequalities.

1.2 Socioeconomic Inequalities in Cervical Cancer

Cervical cancer has both a known aetiology and is preventable, yet inequalities in cervical cancer incidence and mortality are still evident. If risk-related health behaviours can be improved there will be a measurable health impact. This, I believe, makes cervical cancer screening an important area of socioeconomic inequalities research.

The pattern of socioeconomic inequality in cancer varies according to the specific cancer type, the pathways to exposure to its risk factors, its means of prevention (if any), and the routes to timely diagnosis and treatment (Adler and Stewart, 2010). In this section I will briefly introduce cervical cancer and then I will outline the socioeconomic inequalities in cervical cancer outcomes; addressing incidence, mortality and survival. In the subsequent sections I will introduce the potential pathways to socioeconomic inequalities in cervical cancer and then address the available means to prevent it in the UK.

1.2.1 Cervical Cancer

Globally, cervical cancer is the fourth most common cancer in women (age-standardised incidence rates), with the greatest burden of this disease found in developing countries (Ferlay et al., 2014). In the UK, cervical cancer is the 12th most common cancer in women, and the third most common among women aged 15-44 years (ranked using crude incidence rates). Cervical cancer mortality rates in Great Britain (England, Wales & Scotland) exceed European rates with 9% of cervical cancer deaths estimated to be avoidable in the UK if it were to attain the mean European 5-year survival rate (Abdel-Rahman et al., 2009). Nonetheless, around 800 women die from this disease in England every year (NHS Cancer Screening Programme, 2011).

The primary cause of cervical cancer is human papillomavirus (HPV) infection. HPV is a sexually transmitted virus with many genotypes (Castellsagué, 2008; Muñoz et al., 2006). Two high-risk HPV genotypes, HPV-16 and HPV-18, are known to cause around 70% of cervical cancers, with the rest being attributable to other oncogenic types. Cervical cancer has two subtypes: squamous cell carcinoma (cancer that develops in the squamous cells of the cervix); and adenocarcinoma (cancer that develops in the gland cells of the cervix) (Berrington de González et al., 2007). HPV is associated with both subtypes; however squamous cell carcinoma is more common, accounting for around 80% of cervical cancers.

Many women acquire and clear HPV infection without ever being aware of its presence, but persistent high-risk HPV infection can lead to the development of cervical intraepithelial neoplasia (CIN), and without treatment, to invasive cervical cancer. There are four key stages in cervical cancer development: acquiring high-risk HPV infection at the cervical transformation zone; persistent high-risk HPV infection; development of pre cancer, cervical intraepithelial neoplasia (CIN); and progression to invasive cervical cancer (Schiffman et al., 2007). CIN1 denotes mild cell changes in response to HPV infection, and is not considered as pre cancer. CIN2 is considered to have cancer potential and CIN3, also known as carcinoma in situ, denotes severe cell changes, is not considered to be cancer but will result in immediate referral to colposcopy for treatment.

1.2.2 Cervical Cancer Outcomes

Cervical cancer outcomes vary greatly between and within countries according to wealth and are likely to be influenced by both patient and healthcare system factors (Albrow et al., 2012; Brown et al., 1997; Ellis et al., 2012; Singh et al., 2004; Woods et al., 2006). Even in wealthy countries like the UK, where an organised screening programme is free and widely available, there are clear socioeconomic inequalities in cervical cancer. In this section, cervical cancer incidence, mortality and survival rates will be described alongside the current evidence of socioeconomic inequalities in cervical cancer.

<u>Incidence</u>

The overall incidence of cervical cancer in England has decreased by around 30% in the last 20 years, yet the overall downward trend may mask between-group variation in incidence

(Trent Cancer Registry et al., 2012). Sharp falls in age-standardised incidence rates (ASIR) after the establishment of the NHS Cervical Screening Programme (NHSCSP, to be described in further detail later in the chapter) culminated in a drop in ASIR from 15.0 per 100,000 in 1989 to 8.0 in 2004. A spike in cervical cancer incidence between 2008 and 2009 has been attributed to a rise in cervical screening attendance in women overdue for screening around the period of Jade Goody's diagnosis in 2008 and death in 2009 (Lancucki et al., 2012), but a gradual upward trend in cervical cancer incidence has been occurring since 2004.

Regional variation in cervical cancer incidence is found across England. Cancer networks, regional areas responsible for promoting high standards of cancer care services, in the South and East generally have lower than national average incidence rates, whereas cancer networks in the North and Midlands have incidence rates higher than the national average (Trent Cancer Registry et al., 2012). For example, in England in 2005-09, the Age-Standardised Incidence Rate (ASIR) was 8.7 per 100,000, but was 13.9 per 100,000 in the Humber & Yorkshire Coast cancer network (a more deprived area) and only 6.3 per 100,000 in the North West London cancer network (a more affluent area) (Trent Cancer Registry et al., 2012). Similarly, incidence rates for residents in the South and East of England SHAs were lower than the national average incidence rate, and in the North and Midlands SHAs were higher than the national average incidence (Trent Cancer Registry et al., 2012). However, in each SHA the incidence rate fell outside 2 standard deviations (-2 and +2 standard deviations respectively) from the mean incidence. This suggests that there is greater variation in incidence than can be explained by random variation and that there is some unaccounted for variability between SHAs. This is an example of overdispersion. Potential explanations for this unaccounted for variability may include underlying variation in deprivation, or indeed in exposure to risk factors for HPV or uptake of cervical screening.

There is evidence that deprivation does indeed explain some regional variation in incidence. A retrospective time-trend analyses of health authorities in England (using 1999 boundaries) found health authorities with greater deprivation (using the Townsend Index) consistently had higher cervical cancer rates than less deprived health authorities (Baker and Middleton, 2003). The gap in incidence between the most and least deprived health authorities narrowed over the period 1991-97. For the period 2005–09, there was an average incidence rate of 10.4 per 100,000 women in the 30 most deprived PCTs (based on the income domain of IMD 2010) and 7.8 per 100,000 women in the 30 most affluent PCTs across England (Trent Cancer Registry et al., 2012). Further analysis of cervical cancer ASIRs in PCTs in the South East of England found PCTs with greater deprivation (based on the income domain of IMD 2004) had a higher incidence of cervical cancer such that deprivation was moderately associated with incidence (Spearman $r=0.57$, $p < 0.001$) (Currin et al., 2009). Another national comparison of socioeconomic variation in cervical cancer incidence used the woman's postcode at the time of diagnosis (1998-2003) to determine IMD at Lower Super Output Area (LSOA) level and then placed these into national quintiles of deprivation (Shack et al., 2008). This study also found incidence associated with greater deprivation, with a particularly steep rise between the most deprived quintile and the second most deprived.

At the individual level, women of lower occupational class tend to have greater incidence of cervical cancer than women of higher occupational class. Data from the ONS Longitudinal Study (Brown et al., 1997) investigated incidence of cervical cancer from two cohorts: those present and classified by their occupation on the 1971 Census; and those present and classified on the 1981 Census, including those from the 1971 Census who had completed 10 years of follow-up. For the 1971 cohort, the risk ratio (RR) for cervical cancer incidence for manual versus non-manual workers was calculated for three time periods: from 1976-80 RR=1.52 (CI not reported), from 1981-85 RR=1.36 and from 1986-89 RR = 2.09. For the latter time period the risk ratio for cervical cancer was 1.77 (CIs not reported) for the 1981 cohort. Over the total time period, incidence fell for non-manual workers but plateaued for manual workers. To my knowledge, more recent evidence of the association between cervical cancer incidence in England and individual-level SES measures is not available. However, data from the US National Longitudinal Study (using individual-level self-reported SES data from the Social and Economic Supplement to the Census Bureau's Current Population Survey) found evidence to suggest that individual-level SES is an important predictor of cervical cancer incidence in the US (Clegg et al., 2009). Women who had not graduated from high school were more likely to have had cervical cancer than those with at least college education (RR = 3.24, 95% CI: 1.68-6.24). Women with a family income in 1990 of less than $12,500 were more likely to have had cervical cancer than those with a family income in excess of $50,000 (RR=2.96, 95% CI: 1.61-5.43). In conclusion, these studies suggest a consistent association between SES and cervical cancer incidence.

Mortality

Overall, mortality rates have decreased over the last two decades, which has largely been attributed to the introduction of the NHSCSP (Peto et al., 2004). The age-standardised mortality rate (ASMR) for cervical cancer in England was 2.4 per 100,000 in 2008, down from 5.8 per 100,00 in 1989 (Trent Cancer Registry et al., 2012).

Regional variation in cervical cancer is found across England. SHAs and cancer networks have been found to have higher mortality rates in the North and Midlands than in Southern regions (Trent Cancer Registry et al., 2012). As found with incidence rates, there is also a socioeconomic variation in mortality rates across regions.

The aforementioned retrospective time-trends analyses of data from 1991 to 1999 found mortality rates were consistently higher in health authorities in England with greater deprivation (based on the Townsend Index), and remained consistently higher in more deprived populations despite the general downward trend in mortality rates overall (Baker and Middleton, 2003). At PCT level during the period from 2006 to 2010, the age-standardised mortality rate (ASMR) was higher in the 30 most deprived PCTs (3.2 per 100,000 women) and lower in the 30 least deprived PCTs (1.7 per 100,000). The correlation between the proportion of income-deprived people at PCT level and ASMR in England was 0.58 ($p < 0.001$). In conclusion, these studies suggest a consistent association between SES and cervical cancer mortality.

Survival

Overall, survival rates have increased over the last two decades. The one-year survival rate was 84.0% in 1988, based on diagnoses before the NHSCSP was introduced, and increased to 87.5% in 2007-2009 (Quinn et al., 2008; Rachet et al., 2008; Trent Cancer Registry et al., 2012). Five-year relative survival increased from 65.8% for women diagnosed in 1988 to 69.8% between 2003 and 2005 (Trent Cancer Registry et al., 2012).

Differences in survival rates are attributed to the combination of earlier detection through screening and improvements in treatment.

1-year Survival

An analysis of the 10 most common cancers diagnosed over the period 1998-2004 found the gap in one-year and five-year relative survival between Spearhead PCTs (PCTs with higher levels of deprivation) and the rest of England had been reduced for most cancers but not for cervical cancer (Ellis et al., 2009). Delays in presentation and diagnosis are generally considered to contribute to poorer 1-year survival.

In 1996, prior to the implementation of the NHS Cancer Plan (2000), one-year cervical cancer survival for women living in the most affluent quintile (based upon the income domain of the Index of Multiple Deprivation, IMD) was 88.9% and 81.2% for those living in the most deprived quintile (Rachet et al., 2010). In 2006, post-NHS Cancer Plan implementation, the survival rates improved to 90.3% and 84.3% respectively. The gap in one-year survival between the most and least deprived quintiles therefore dropped from 7.7% in 1996 to 6.0% in 2006. However, the latest figures indicate that inequalities in cancer survival have since plateaued (Trent Cancer Registry et al., 2012).

5-year survival

Data from 2004 found 5-year relative survival for cervical cancer was consistently lower in Spearhead PCTs than in other PCTs (Ellis et al., 2009). In the aforementioned analysis of the 10 most common cancers diagnosed over the period 1998–2004, five-year relative survival between Spearhead PCTs (PCTs with higher levels of deprivation) and the rest of England had also been reduced for most cancers but not for cervical cancer.

Summary of Cervical Cancer Outcomes

In conclusion, the evidence presented in this section indicates that socioeconomic inequalities in cervical cancer incidence, mortality and survival remain a problem in the UK. One of the ways in which we can begin to understand socioeconomic inequalities in cervical cancer outcomes is to address the mechanisms by which socioeconomic status (SES) affects health (Adler and Stewart, 2010). These mechanisms include, but are not limited to, biological and psychosocial pathways that link SES and health, equitable access to health care, and variation in health behaviours. Consideration of these different mechanisms opens up different questions. Which biological pathways link socioeconomic status to cervical cancer? If this is a valid pathway, then would we would expect to find socioeconomic variation in cervical cancer risk factors. Is there equitable access to health care? Certainly, in the UK the NHS Cervical Screening Programme is nationally organised and free at the point of access. But do all women, regardless of income, education or social status, participate equally in cervical screening?

In the next section, I will explore if the potential pathways to inequalities in cervical cancer outcomes. This will begin with an exploration of socioeconomic variation in exposure to the risk factors for cervical cancer, followed by an exploration of socioeconomic variation in access to cervical cancer prevention.

1.2.3 Cervical Cancer Risk Factors

As mentioned in the earlier section, sexually transmitted HPV infection is a necessary but not sufficient cause of cervical cancer (Castellsagué, 2008; Muñoz et al., 2006). Pre-cancerous changes, CIN, occur in the presence of persistent infection with high-risk types of HPV. Risk factors for the development of cervical cancer may be categorised as those associated with acquiring high-risk HPV in the first place and with developing persistent HPV infection (Castellsagué, 2008). Persistent high-risk HPV infection can lead to the development of precancerous changes (cervical intraepithelial neoplasia, CIN) and without treatment, this can progress to invasive cervical cancer (Muñoz et al., 2006).

The risk factors, if considered in terms of progression from exposure to high-risk HPV through to the development of cervical cancer, can be viewed in a series of stages. The initial risk factor for cervical cancer originates from behaviours that increase exposure to HPV and then those that increase the likelihood of HPV persistence. Thereafter, poor attendance at cervical screening, or at colposcopy where advised, carry the risk that cervical abnormalities may progress to invasive cervical cancer.

The following section will provide evidence of socioeconomic inequalities in high-risk HPV status, and then explore the evidence of socioeconomic variation in the underlying risk factors for high-risk HPV acquisition and persistence of high-risk HPV infection. The subsequent section will explore evidence for socioeconomic variation in attendance at cervical screening and colposcopy. Late presentation for symptoms of cervical cancer is beyond the scope of this thesis and will, therefore, not be discussed further. The evidence to be discussed in these sections may help to explain the potential pathways in which socioeconomic inequalities in cervical cancer outcomes emerge.

High-Risk HPV status

The British National Survey of Sexual Attitudes and Lifestyles (Natsal) has been carried out in three successive waves: 1990–91 (Natsal-1); 1999-2001 (Natsal-2); and 2010–12 (Natsal-3). The results of these surveys are important as they are national, population-based surveys. A sub-sample of women (aged 16-44 years) were tested for HPV as part of Natsal-3. Those from deprived residential areas had greater odds of testing positive for the virus (OR = 1.40, 95% CI: 1.07–1.84 for women in the most deprived compared with the least deprived quintiles) (Sonnenberg et al., 2013). Further details of findings from Natsal-3 have been reported more recently and provide more details of the association between socioeconomic status and high-risk HPV status in the same sub-sample, as follows (Tanton et al., 2015). When the association between HPV status and deprivation is adjusted for age, the trend for greater odds of testing positive in the most versus least deprived quintiles remained (OR = 1.37, 95% CI = 1.05 - 1.80). Being HPV positive was also found to be associated with social status and housing tenure, but not with academic qualifications, in Natsal-3. However, earlier evidence from Natsal-2, suggested high-risk HPV was not associated with educational status or social class (Johnson et al., 2012). It is not entirely clear why there should be different findings for social class between Natsal-2 and Natsal-3 but the more recent survey on social class shows clear linear trends from high to lower social status. Compared with women in professional and managerial occupations the odds of being high-risk HPV positive were as follows: intermediate occupations (OR = 1.74, 95% CI: 1.21 – 2.52); semi-routine/routine occupations (OR = 1.98, 95% CI: 1.45 – 2.69); full-time student (OR = 2.16, 95% CI: 1.50 – 3.11); and no job/not worked in last 10 years (OR = 2.53, 95% CI: 1.62 – 3.96). For housing tenure, women who rented their property were more likely to be HPV positive than women with a mortgage (OR = 2.13, 95% CI: 1.64 – 2.78) (Tanton et al., 2015).

Other UK studies reporting the association between HPV status and SES have generally recruited participants from within the NHS Cervical Screening Programme. Being high-risk HPV positive was associated with higher educational levels in women with a cervical screening test result indicating borderline/mild dyskaryosis, although the authors acknowledged that women with lower levels of education were under-represented in their study (Maissi et al., 2004). Two studies that recruited from within the NHSCSP in South Wales did not find an association between socioeconomic deprivation (Welsh IMD based on women's postcode) and high-risk HPV status (Hibbitts et al., 2008, 2006). These studies had large sample sizes (total n = 10,000) but participants predominantly lived in more affluent areas. However, the TOMBOLA trial (also conducted within the NHSCSP) found that in the context of women receiving treatment for borderline/mildly abnormal cytology, women aged 20-59 years with university level education were less likely to be high-risk HPV positive than those without a degree (OR = 0.72 ; CI 0.61-0.87) (Cotton et al., 2007).

While the findings for an association between high-risk HPV and measures of SES are mixed, with the exception of Natsal, the studies recruited participants from within the NHS Cervical Screening Programme. This may have biased their results since participation in the cervical screening programme is itself socially graded (Baker and Middleton, 2003; Bang et al., 2012; Sutton and Rutherford, 2005). The Natsal survey findings, which are drawn from a nationally representative UK sample, may provide a more accurate reflection of the general population. The Natsal studies also specifically report findings from women aged 16-44 years who reported at least one sexual partner in the last year, perhaps making these findings more significant since the prevalence of high-risk HPV is greater in younger women (Sargent et al., 2008). On balance, it seems likely that HPV status is socioeconomically graded and therefore may act as one pathway to socioeconomic inequalities in cervical cancer incidence. Now that HPV testing has been introduced into the cervical screening programme (NHS Cervical Screening Programme, 2015) this may change for future generations, and will make further research into this issue more feasible.

Risk Factors for High-risk HPV Acquisition

Since HPV is acquired sexually, some of the risk factors for high-risk HPV acquisition are relate to sexual behaviour. These include early age at first sexual intercourse and number of sexual partners over the life course. Some protection may be offered by the use of barrier methods of contraception, such as condoms.

Age at first sexual intercourse

The risk of acquiring HPV increases with early age at first sexual intercourse (Castellsagué, 2008). This may be due to the greater exposure of the transformation zone to HPV in younger women whose cervix is less mature (Kahn et al., 2002). British case-control studies have found younger age at first intercourse to be associated with an increased risk of cervical cancer with indications that this may influence the progression from HPV infection to development of CIN3 (Deacon et al., 2000). This is supported by findings of an association between cervical cancer and younger age at first sexual intercourse over a variety of settings and time periods (de Sanjosé et al., 1997; Herrero et al., 1990; Illades-Aguiar et al., 2009). A recent paper compared the trends in age at first sexual intercourse for Natsal-1, -2 and -3, and found that successive birth cohorts have higher proportions of women reporting first sexual experience before 16 years of age (Mercer et al., 2013).

Early age at first intercourse is associated with a number of social, economic and educational factors (Hawes et al., 2010; Mercer et al., 2013; NATSAL, 2001; Wight et al., 2008). Natsal measures SES at area-level (IMD) and individual level (social class and highest educational achievement when leaving school). Women from areas with greater deprivation, in manual occupations or with lower levels of education more often reported having had first sexual intercourse under 16 years of age (Mercer et al., 2013). These findings are supported by a literature review of first sexual intercourse in the UK, which predominantly focused on survey research. It found fewer years in education and lower educational qualifications were associated with younger age at first sexual intercourse, and that level of education was a more sensitive SES measure of early sexual behaviour than area-level measures of SES (Hawes et al., 2010). Family difficulties, living with only one or neither natural parent, and living in foster or residential care are all associated with younger age at first sexual intercourse (Hawes et al., 2010). Occupational social class also predicts earlier age at first sexual intercourse in the UK, with fewer women aged 20-24 years in professional or non-manual occupations reporting having had first intercourse under 16 years than women in manual occupations (NATSAL, 2001). Across a range of SES markers, women from less privileged backgrounds seem to become sexually active at a younger age.

Number of sexual partners

Number of sexual partners has been associated with the risk of acquiring HPV infection (Deacon et al., 2000; Yetimalar et al., 2011) and risk of cervical cancer (Green et al., 2003). The risk of high-risk HPV infection increases with the number of lifetime sexual partners in both women and their sexual partners (Kjaer et al., 1997), and when acquiring new sexual partners or with non-monogamous partners (Chelimo et al., 2013). A population-based case control study conducted in England between 1987 and 1993 found, in comparison to women who only had 1 sexual partner, the odds of being HPV positive was higher in those who had between 2 and 5 lifetime sexual partners (OR = 2.28, CI 1.40-3.70) and even higher for 6+ lifetime sexual partners (OR = 3.52, CI 1.84-6.76) (Deacon et al., 2000). In Natsal-3, for women aged 16-44 years, the likelihood of a being high-risk HPV positive was significantly higher for those who reported 2 sexual partners in the past year (OR = 2.18, CI 1.51-3.14) or 3 or more sexual partners in the past year (OR = 3.95, CI 2.87-5.45), compared with having had 0 or 1 sexual partners (Sonnenberg et al., 2013). These findings indicate that the risk of acquiring HPV increases significantly for women who have had two or more sexual partners.

Comparisons of two cohorts of 18–19 year olds in Scotland between 1990 and 2003 found a significant increase in the reported number of sexual partners across the time period, but the increase was not socioeconomically patterned, as measured by either social class (occupation of head of household) and area-level deprivation (Carstairs-Morris Index) (Sweeting et al., 2011). Natsal-3 found women of higher SES (living in less deprived areas, higher occupational social class and more educated) had a greater likelihood of having had ten or more sexual partners over their lifetime (Mercer et al., 2013). To the author's knowledge, there is no other evidence available for the number of sexual partners and SES.

Barrier Methods

Women who use barrier methods of contraception, although they are not completely protected, are less likely to acquire HPV than women using oral contraceptives (Winer et al., 2006). Condom use is associated with reduced transmission and increased clearance of HPV infection and regression of CIN (Bleeker et al., 2003; Castellsagué, 2008; Hogewoning et al., 2003). The use of condoms has increased in the UK over recent decades (Johnson et al., 2001). However, since HPV is transmitted via skin-to-skin contact (Schiffman et al., 2007), condoms do not safeguard against all means of HPV transmission, even if used consistently (Chelimo et al., 2013; Manhart and Koutsky, 2002; Stone et al., 2006).

Natsal-1 did not report on the relationship between condom use and SES, but found that any contraceptive use was positively associated with educational attainment, household social class and area level affluence (Bentley et al., 2009). Natsal-2 found that not using contraception at first intercourse was predicted by younger school leaving age and lower educational attainment (Wellings et al., 2001). These findings suggest that condom use may be less likely in women of lower SES but this remains uncertain.

Risk Factors for Persistent HPV Infection

Once high-risk HPV infection is present, the risk factors for persistent high-risk HPV infection include immune-related disorders, co-infection with other sexually transmitted infections, prolonged use of oral contraceptives, high parity and smoking.

Immune-related disorders

Immune-related disorders increase the risk of persistent HPV infection because they affect the individual's ability to clear the HPV infection (Grulich et al., 2007). HIV/AIDS has been associated with an increased risk of cervical cancer due to immune-suppression (Gallagher et al., 2001). People with other immune-related disorders, and those taking immune-suppressant drugs following organ transplantation, have also been found to be at increased risk of persistent HPV infection (Grulich et al., 2007).

Approximately one-third of the population living with HIV in the UK are women (Health Protection Agency, 2012a). Rates of HIV are higher in more deprived areas (Madden et al., 2011), with clear evidence of a social gradient in HIV prevalence across England and London (Health Protection Agency, 2012a). However, given the relatively low prevalence of HIV (1.0 per 1,000), it is unlikely to make a major contribution to cervical cancer inequalities (Health Protection Agency, 2012a).

Co-infection with other sexually transmitted infections (STI)

Co-infection with other sexually transmitted infections (STI) such as herpes simplex virus type-2 or Chlamydia trachomatis has been identified as a potential co-factors in the progression from HPV infection to the development of cervical cancer (Bosch et al., 2008; Chelimo et al., 2013; Muñoz et al., 2006). This may be due to the additional strain on the immune system to clear multiple infections, leading to prolonged HPV infection (Miller and Ko, 2011). Analysis of data from Genito-Urinary Medicine (GUM) clinics across England in 2012 found chlamydia was the most commonly diagnosed STI, new cases of gonorrhoea increased by 21% since 2011, and genital warts and genital herpes were still common (Health Protection Agency 2013). Sexually transmitted infection is therefore of ongoing concern at a population level.

Further analyses of data from GUM clinics across England found syphilis, gonorrhoea, genital herpes and genital warts to be greater in more deprived areas (the areas were presented in quintiles of deprivation, using Index of Multiple Deprivation based on residential postcode) than less deprived areas (Savage et al., 2011). The contrast in rates of STIs between the most and least deprived was most notable for syphilis and gonorrhoea. People living in areas in the most deprived quintile were five times more likely to have syphilis or gonorrhoea than people in the least deprived quintile. A Health Protection Agency report of sexually transmitted infections in South East England found the rate of STIs (syphilis, gonorrhoea, genital herpes and genital warts) to be almost double for those diagnosed in GUM clinics in the most deprived versus least deprived quintiles (Health Protection Agency, 2012b). When rates of gonorrhoea were analysed separately, they were found to be three times higher in the most deprived quintiles than in the least deprived quintiles.

In a sub-sample of participants in Natsal-3, women who tested positive for chlamydia were more likely to come from deprived than less deprived areas (OR = 4.01, CI: 1.67-9.63)

(Sonnenberg et al., 2013). Socioeconomic variation in prevalence of gonorrhoea and HIV in the same survey could not be reported due to small numbers (Sonnenberg et al., 2013). In Natsal-2, among 18-24 year old women who had first intercourse before 18 years, the likelihood of ever having had an STI did not vary by the socioeconomic status of parents (manual workers OR = 0.98, CI 0.57-1.67 versus non-manual) but did vary according to educational level (left school at 16 year with qualifications OR=0.48 CI 0.25-0.90, left school at 16 years with no qualifications OR = 0.71 CI 0.32-1.60, versus left school at 17+ years) (Wellings et al., 2001), indicating that lower SES may not affect STI infection in this younger sub-sample. Overall, these findings suggest that women of lower SES may be at greater risk of co-infection with other STIs, which could increase the risk of persistent HPV infection.

Prolonged use of oral contraceptives

The hormonal effects of oral contraceptives increase the risk of developing cervical cancer. The mechanism by which oral contraceptives affect progression of HPV infection is unclear (Sasieni, 2007). Potential mechanisms include hormonal effects on HPV, which alter its genetic expression and/or hormonal effects on the cervix, including changes to cervical mucous (Guven et al., 2007), which promote progression from CIN3 to invasive cervical cancer (Sasieni, 2007). A recent re-analysis of 24 international epidemiological studies found that current and recent use of oral contraceptives is associated with the development of CIN3 and invasive cervical cancer, even after taking into account the number of lifetime sexual partners (Appleby et al., 2007). The risk of cervical cancer increased with longer duration of oral contraceptive use and decreased upon cessation of oral contraceptives.

An international meta-analysis, which included data from England, found prolonged oral contraceptive use and number of years in full-time education to be positively associated (Appleby et al., 2007). The use of (any) contraception has been positively associated with a range of SES measures including less deprived areas, higher level of education and higher social class in data collected from Natsal-1 (Bentley et al., 2009). Natsal-2 did not specifically report on prolonged use of hormonal contraception but found use of contraception was positively associated with higher levels of education (Saxena et al., 2006). At the time of writing, Natsal-3 has not reported its findings for use of contraception. These findings tentatively suggest that prolonged use of oral contraceptives may be less prevalent in women of lower SES and this may be protective, rather than a risk factor.

High parity

High parity has long been associated with cervical cancer (Castellsagué, 2008; Castellsagué and Muñoz, 2003). A reanalysis of 25 international epidemiological studies found evidence for the role of parity in the development of cervical cancer after adjusting for other known cofactors such as age at first intercourse and number of sexual partners (International Collaboration of Epidemiological Studies of Cervical Cancer, 2006). The risk ratio for cervical cancer was 1.76 for seven or more full-term pregnancies compared with one to two full-term pregnancies.

Fertility rates are lower in areas with more educated women, possibly due to delay in starting a family (Tromans et al., 2008). Having three or more children is not socially graded by the occupational status of the father (ONS, 2010). However, fertility rates in 2011 were found to be 1.9 children per woman in England and Wales (ONS, 2011a). High parity is not likely to contribute to SES differences in persistent high-risk HPV infection in women in England.

Smoking

Smoking is recognised as a key risk factor for the development of cervical cancer (Deacon et al., 2000; Fonseca-Moutinho, 2011; Green et al., 2003; Winkelstein, 1977) and has also been associated with poorer treatment success (Acladious et al., 2002; Szarewski et al., 1996). Tobacco use is considered to be responsible for 7.2% of cervical cancer incidence in the UK (Parkin et al., 2011). Potential mechanisms for the effect of smoking on the development of cervical cancer include reduced immune response, altered hormonal metabolism and genetic damage by tobacco-related carcinogens (Muñoz et al., 2006). Salient smoking behaviours include smoking status, (current smoker, ex-smoker, never smoked) (Haverkos et al., 2003) and the duration and intensity of smoking (Brinton et al., 1986; Gadducci et al., 2011).

Smoking prevalence has fallen in the UK for many years, but rates are consistently higher among more deprived populations (Hiscock et al., 2012). In 2010, the General Lifestyle Survey (ONS) found smoking prevalence was 31% in households categorised as 'routine occupation', 15% in 'professional' households, and 29% and 21% in unemployed and employed adults respectively ("General Lifestyle Survey," 2012). In 2012, smoking prevalence in the general population in England was 21%; 14.3% for professionals (Social classes A-C1); and 29.6% for manual workers (C2-E) (West and Brown, 2013). Smoking is clearly more common in lower SES groups and is therefore likely to contribute to differential exposure to persistent high-risk HPV infection.

Summary of Evidence for Socioeconomic Inequalities in Cervical Cancer Risk Factors

There is socioeconomic variation in high-risk HPV status, with women of lower socioeconomic status being more likely to be high-risk HPV positive. The risk factors for cervical cancer can be grouped into those that pertain to the acquisition of HPV (early age at first sexual intercourse, number of sexual partners and use of barrier methods, such as condom use) and those that support persistent high-risk HPV infection (immune-related disorders, co-infection with other STIs, prolonged use of oral contraceptives, high parity and smoking).

Evidence for socioeconomic inequalities in the risk factors associated with acquiring HPV is mixed. Younger age at first intercourse has been associated with lower socioeconomic status across a range of markers, including area-level deprivation, individual level social class and education. However, higher SES groups may be associated with a greater number of sexual partners. Evidence on socioeconomic variation in condom use is scarce, although evidence for contraceptive use more broadly indicates that absent or inconsistent use of contraceptives are more prevalent in lower SES women. This would indicate that condom use may be less likely in lower SES women. Overall, women of lower socioeconomic status may be slightly more exposed to the risk factors for acquiring HPV, but some of the SES variation remains unexplained.

Evidence for inequalities in the risk factors associated with prolonged HPV infection is also mixed. With regard to immune-related disorders, there was some evidence that women of lower socioeconomic status may be more likely to be HIV positive, but the low prevalence of HIV in the UK may make it unlikely to have any real effect on HPV persistence at a population level. From the evidence presented, it is likely that women of lower socioeconomic status are more exposed to co-infection with other STIs. However, women of higher SES may be at greater risk of exposure to prolonged use of oral contraceptives. High parity is not likely to affect socioeconomic inequalities in cervical cancer in England. Finally, there appears to be robust evidence that women of lower SES are more likely to smoke. Women of lower SES are therefore likely to have greater exposure to the risk factors for prolonged HPV infection than women of higher SES.

1.2.4 NHS Cervical Screening Programme

The National Health Service Cervical Screening Programme (NHSCSP) was introduced in the UK in 1988. This heralded the advent of a nationally organised programme with routine, individualised invitations to eligible women (Palencia et al., 2010; Weller and Campbell, 2009). Prior to this, cervical screening in England had operated on an ad hoc basis. Cervical screening can detect abnormalities in the cervix in advance of the development of cancer when treatment is less invasive and women have more successful outcomes. The programme has been associated with a reduced risk for both squamous cell carcinoma and adenocarcinoma, although the reduction may be greater for squamous cell carcinoma (Berrington de González et al., 2007). The cervical screening programme was estimated to have prevented around 80% of deaths from cervical cancer since its introduction in an analysis done more than 10 years ago, and there is no reason to expect this to have changed (Peto et al., 2004).

The NHSCSP currently offers 3 yearly screening to women aged 25-49 years, and 5 yearly screening to women aged 50-64 years in England, using a call-recall system (the age-range and screening interval vary slightly in other parts of the UK) (Albrow et al., 2012). The programme aims to achieve 80% coverage for the eligible population. Coverage is defined as the percentage of the eligible population who are adequately screened within a specific time frame. The time frame is adjusted to account for the recommended recall period for younger and older women. For 25-49 year old women, coverage is therefore defined as the percentage of women aged 25-49 years who were adequately screened within the last

3.5 years. This time period is extended to 5 years for coverage of women aged 50-64 years.

The cervical screening test, which involves taking cells from the cervix, is called liquid based cytology. Cervical screening works by detecting cellular abnormalities on the cervix, known as dyskaryosis (Schiffman et al., 2007). The classification of cervical cytology is low-grade dyskaryosis, high-grade dyskaryosis (moderate), high-grade dyskaryosis (severe), high-grade dyskaryosis/?invasive squamous cell carcinoma and ?Glandular neoplasia (NHSCSP, 2013).

Cervical screening traditionally used Papanicolaou smear tests, where cells taken from the cervix were smeared on a glass slide and sent for cytological examination. The sensitivity of cervical smear tests was estimated to be around 76%, although this is highly dependent on repeated screens at regular intervals (Kitchener et al., 2013). Thereafter, liquid-based cytology (LBC) was introduced where cells are brushed from the cervix and directly inserted into a small vial of preservative fluid. This method introduced two key advantages: a reduction in the number of inadequate samples and the ability to test for HPV. A reduction in the number of inadequate samples is beneficial as this means fewer women need to be re-tested. The ability to test for HPV opened the door to a HPV triage protocol. This enabled women with borderline/low-grade dyskaryosis who have a negative high-risk HPV test to return to routine recall. Women found to have both borderline/low-grade dyskaryosis and a positive high-risk HPV test or those with high-grade dyskaryosis or worse are referred to colposcopy, an investigative procedure where diagnosis and, if necessary, treatment are determined (Health and Social Care Information Centre, 2012a). Successful piloting of HPV testing as triage resulted in its adoption in England by late 2011 (Kelly et al., 2011).

A ‘see and treat’ strategy, a single colposcopy appointment that offers further diagnostic procedures, and where appropriate, treatment for CIN has now been adopted in the programme. This can support timely treatment and reduce the risk of patients not returning for a further appointment. Further, using HPV testing as a ‘test of cure’ following treatment for CIN can safely promote an earlier return to routine recall (NHS Cancer Screening Programme, 2011). However, different management policies may be applied that require some women to attend for more than one colposcopy appointment (Sharp et al., 2011).

Socioeconomic inequalities in attendance at cervical screening

In this section, socioeconomic inequalities in the NHS Cervical Screening Programme will be split into evidence that considers area-level and individual-level measures of socioeconomic status. Area- and individual-level measures of SES will be discussed further in the next chapter.

Area-level measures of SES

Lower cervical screening coverage has been found in lower SES areas at general practice, health authority and PCT level. During the period 1991–99, coverage was consistently lower for general practices in health authorities with populations living in areas of greater deprivation (Baker and Middleton, 2003). The gap in screening coverage between the affluent and deprived areas' health authorities over this period fell from 39% in the period 1991–93 to 24% in the period 1997–99, mainly due to a greater improvement in coverage rates in more deprived areas in the mid-to-late 1990s. This may also represent the later adoption of cervical screening in more deprived populations as the practice became more normative. A national cross-sectional study of 26.5 million women analysed coverage for 2008–09 and found socioeconomic inequalities in screening coverage to continue at both PCT and general practice level, using NHSCSP and QOF[1] data respectively (Bang et al., 2012). This indicates that despite a narrowing of the coverage gap in the 1990s socioeconomic inequalities in cervical screening are still evident. This is further supported by a 2009 cross-sectional study of practice level deprivation (an aggregate score of IMD

[1] The Quality Outcome Framework is an annual reward and incentive scheme for GP surgeries in England (Health & Social Care Information Centre, 2014a). It covers five main domains: Clinical; Public Health; Public Health – additional services; Patient Experience; and Quality and Productivity. This includes payments for providing a protocol for the management of cervical screening within the practice (call/recall, exception reporting, monitoring of inadequate sample rates), cervical screening rates of eligible women registered at the practice, system for monitoring cervical screening rates and a policy for auditing its cervical screening service and inadequate screening tests. QOF screening uptake data differs from coverage data because GPs are allowed to exception report some women from attending screening. Screening uptake figures may look proportionately higher using QOF data.

from patients' postcodes) which found an inverse association between cervical screening coverage and deprivation in PCTs in South West England (O'Neill et al., 2009).

A cross-sectional study of over 72,000 women aged 30 and over in a former Manchester health authority found large practice size (greater than 4,000), single handed practice, overseas place of birth, population mobility and deprivation (as measured by Townsend index) were associated with lower cervical screening coverage in a multivariate analyses (Webb et al., 2004). After controlling for practice characteristics, and area and individual level factors, deprivation accounted for 12.8% of the variance in screening attendance ('Ever' versus 'Never Screened') (Webb et al., 2004).

Individual measures of SES

Two national surveys with fieldwork done by ONS in 1999 investigated cervical screening uptake and a range of socioeconomic factors, including age completed full-time education, social class, employment status, car ownership and housing tenure (Sutton and Rutherford, 2005). Of these, only education was a significant predictor of self-reported cervical screening attendance. Similarly, a study using data collected as part of the Office for National Statistics Omnibus Survey in 2005–07 investigated cervical screening uptake and education, social class, housing tenure and household car ownership, of which degree level education was found to be a significant predictor of self-reported screening attendance (Moser et al., 2009). The British Household Panel Survey found adult learning leading to qualifications predicted screening uptake after controlling for income, occupation and social class ($p < 0.001$) (Sabates and Feinstein, 2006).

In summary, socioeconomic variation in cervical screening coverage can be found at both area-level using multiple indicators (IMD, Townsend Index & Carstairs Index) and at an individual level. Education seems to be a particularly sensitive individual level SES indicator of cervical screening uptake. Using occupational social class has produced mixed results but this may be due to differences in its measurement. For example, some surveys have measured a women's social class while others have measured household social class. The national surveys reported in this review have not found housing tenure or car ownership to be useful predictors of screening attendance at an individual level. However, overall screening attendance has been found to be higher in women of higher SES and this is likely to be a significant contributor to socioeconomic inequalities in cervical cancer outcomes.

Socioeconomic inequalities in attendance at colposcopy

Women who receive an abnormal result following cervical screening are invited to colposcopy for diagnoses and, if necessary, treatment. Non-/late-attendance at colposcopy may leave CIN or cervical cancer untreated leading to increased incidence of cervical cancer or detection at a later stage when treatment is more invasive and outcomes less successful. Attendance at colposcopy is, therefore, an essential component of the cervical screening programme.

There is little evidence available on the association between socioeconomic status and colposcopy attendance, which may in part be due to the reporting of colposcopy attendance nationally being at appointment level rather than patient level (Health and Social Care Information Centre, 2012a). An analysis of colposcopy attendance data from a single colposcopy clinic in Newcastle in 1989–90 found women of lower social class or unemployed were more likely to default from attendance (Sanders et al., 1992). A cohort study conducted within a randomised control trial (TOMBOLA) in the NHSCSP over the period 1999–2002, found two significant SES predictors of default from colposcopy attendance in women with low-grade cervical cytology who were referred to immediate colposcopy. The odds of default were increased for women not in paid employment (OR=2.70, CI:1.64–4.43), compared with those working full-time; and were lower in those with some education (OR=0.62 CI:0.41–0.93) or degree-level education (OR=0.40 CI:0.22–0.71), compared with those with no education (Sharp et al., 2012a).

Another arm of the TOMBOLA trial, found that level of education was a significant SES predictor of default from attendance and late attendance at the first (of two) surveillance tests in women with low-grade cervical cytology referred to follow-up cervical screening (Sharp et al., 2012b). The odds of default were decreased for work/college education (OR=0.35 CI: 0.18–0.69) and degree education (OR=0.62 CI: 0.30–1.26). The odds of late attendance decreased from work/college education (OR=0.80 CI: 0.56–1.14) and degree education (OR=0.41 CI: 0.24–0.70). Another UK study which recruited women at an initial referral appointment to colposcopy, found that women who did not return for follow-up treatment were more likely to be unemployed (Orbell et al., 2006).

In summary, evidence of colposcopy attendance is largely based upon studies taking place within a few colposcopy clinics or embedded within a larger randomised control trial. A mixture of area-level and individual-level measures of SES have been used in these studies. Social class, employment status and level of education have found women of lower SES to be at greater risk of default from colposcopy at both initial referral and follow-up for treatment. Given that women referred to colposcopy have already received an abnormal cervical screening result, poorer attendance at colposcopy by women of lower SES is likely to be a contributor to socioeconomic inequalities in cervical cancer incidence. This may be an important mechanism for the observed higher incidence and mortality, and poorer survival rates among women from lower SES backgrounds. Further research in this area would be beneficial.

1.2.5 HPV Vaccination Programme

HPV vaccination now offers a powerful means of preventing the majority of cervical cancers and the vaccine has been approved and implemented in many countries (Cuzick et al., 2010). There are two commercially available vaccines: Cervarix and Gardasil. Cervarix is a bivalent vaccine which covers two high-risk genotypes: HPV-16 and HPV-18, which are respectively found in around 55% and 15% of cervical cancers worldwide. This offers protection from around 70% of HPV infection known to cause cervical cancer. Gardasil also covers low-risk genotypes, HPV-6 and HPV-11, that are associated with genital warts (Cuzick et al., 2010). The vaccination is effective when given prior to first exposure to HPV. So, the programme is targeted to younger girls aged 12-13 years, hopefully in advance of sexual activity.

The NHS HPV Vaccination Programme was introduced in the UK in 2008 as a school-based HPV programme to immunise girls aged 12–13 years, with a ‘catch-up’ programme for young women up to 18 years (Cuzick et al., 2010). Originally the programme required three doses of the vaccination to be administered over a six-month period but this has now been reduced to two doses, with the second dose to be administered within six months to a year from the initial dose (Cancer Research UK, 2014). It has been projected that by 2025, HPV vaccination could reduce cervical cancer incidence in women aged 20–29 years by 63% (Cuzick et al., 2010).

The HPV vaccination programme does not supersede cervical screening, but is an additional means of supporting cervical cancer prevention (Kitchener et al., 2013). It is not clear the duration of protection offered in the current vaccine. Protection may reduce over time; particularly as they become sexually active (Kitchener et al., 2013). The cervical screening programme therefore remains an essential component in this endeavour for the time being as it offers further protection for women who received the HPV vaccine subsequent to exposure to HPV (when its protective effects are reduced) and helps to prevent the 30% of cervical cancer cases caused by HPV variants not covered by the vaccine.

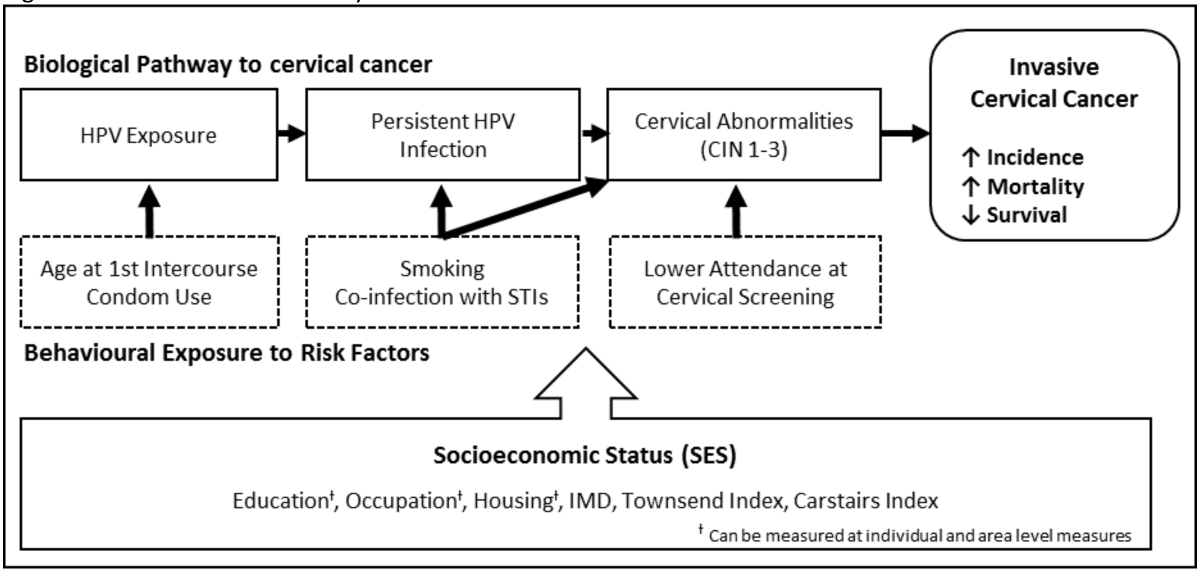
Socioeconomic Inequalities in HPV Vaccination

A feasibility study in England found that HPV vaccination uptake lower in more deprived areas (Roberts et al., 2011). However, encouragingly, since its national implementation, uptake of the routine administration of the HPV vaccine has generally been high (Kumar and Whynes, 2011). Importantly, national figures indicate that uptake is not socially graded (Desai et al., 2010). Its success may be due to the effectiveness of school-based programmes to promote access. However, HPV vaccination uptake has been associated with the cervical screening attendance of the girl's mother, with girls whose mother attended screening more likely to receive all three doses (Spencer et al., 2013). The protection offered by vaccination is limited where the girl has already been exposed to HPV through early sexual intercourse. These findings hint that inequalities in the protection offered by HPV vaccination may become evident over time.

1.2.6 Summary of evidence of socioeconomic inequalities in cervical cancer

Two potential pathways through which socioeconomic status and health may be linked have been explored: socioeconomic variation in exposure to risk factors for the acquisition and persistence of high-risk HPV infection and socioeconomic variation in participation in cervical cancer prevention programmes. The pathways in which socioeconomic status may lead to poorer cervical cancer outcomes are summarised in the Figure 1. This outlines the ways in which socioeconomic variation in exposure to cervical cancer risk factors and participation in the NHS cervical screening programme contribute to socioeconomic inequalities in cervical cancer outcomes.

Figure 1. Socioeconomic Pathways to Cervical Cancer



Chapter 2: Approaches to Understanding Socioeconomic Inequalities

2.1 Introduction

In the previous chapter, I provided a brief background to inequalities in health in general, before focusing upon socioeconomic inequalities in cervical cancer outcomes, and the possible mechanisms through which these inequalities may occur. I discussed the fact that despite some evidence that women of lower socioeconomic status may have greater exposure to some of the risk factors for cervical cancer, this risk should be mitigated if all women attended cervical screening regularly. However, it is evident that inequalities in participation in cervical screening and, potentially, in colposcopy attendance, are also important.

In this chapter, I consider the approach I took to further understanding of socioeconomic inequalities in cervical cancer in my thesis. This will include a discussion of the methodological approaches, both qualitative and quantitative, consideration of how socioeconomic inequalities are measured and a brief introduction to the geography of England and the various measures of SES that are commonly found in the research literature at both an area and individual level.

2.2 The Approach Used in This Thesis

The philosophical and methodological approaches used in this thesis are pragmatic. My approach is pluralist in the sense that it recognises that different research methods answer different research questions and, as such, the different forms of knowledge produced are valid. This, however, does not amount to relativism, where simultaneous forms of knowledge are accepted, it is the pursuit of the particular knowledge deemed to best serve the aims of the studies. And finally, it is action-orientated in so far as I hope to generate new knowledge that may contribute to health policy.

In this section, I will provide an overview of qualitative and quantitative methods and briefly discuss the merits and limitations of each in relation to my pursuit of the understanding of socioeconomic inequalities in cervical cancer.

2.3 Quantitative Research

Quantitative research uses numerical data to quantify the issue under investigation; in this case socioeconomic inequalities. But, how do we measure socioeconomic inequalities? One way to answer this question is to define what we mean by socioeconomic status, and then to address how we use these data to measure socioeconomic inequalities.

Socioeconomic status (SES) is a multi-faceted concept that is indexed and can be measured in a variety of different ways (Donnelly and Gavin, 2011; Quaglia et al., 2012). Researchers may use either individual-level markers of SES, such as level of education or occupation, or area-level markers, such as Index of Multiple Deprivation (IMD) score and Townsend Index (Quaglia et al., 2012).

In this section I will provide more detailed information on the how individual- and area-level SES data may be sourced in England, including an overview of the geographical units in which area-level data may be aggregated, followed by a discussion on the strengths and limitations of individual-level and area-level SES data, and on how individual measures of SES apply to women.

2.3.1 Absolute and Relative Deprivation

Absolute Deprivation

Absolute deprivation theory is based on the premise that exposure to poverty is the primary cause of different health outcomes across SES groups (Ladin et al., 2010). Absolute deprivation relates to exposure to poverty or deprivation and may also be referred to as absolute poverty (Ladin, 2014). In straightforward terms, people who live in absolute deprivation have access to the bare minimum of resources on which to survive, such as food, water, and shelter. Broader definitions of absolute deprivation may also extend to access to other resources, such as healthcare and education. Absolute deprivation implies a division between the poor and the rest of the population that is constant and not subject to change over time or place. However, it is argued that the basic needs of people, that is, what is considered to be 'absolute deprivation' varies according to the societies in which people live, and therefore the concept is flawed (Townsend, 1979). For example, what may be considered absolute deprivation in developed countries like the UK or USA may differ from definitions of absolute deprivation in developing countries. Different standards of absolute deprivation somewhat muddy the waters of the concept, which otherwise may seem straightforward.

Relative Deprivation

Relative deprivation theory addresses the social gradient in health outcomes, where health differentials continue to be evidenced even when basic needs have been met (Ladin et al., 2010). This widens the scope to enable consideration of other factors that contribute to differences in health outcomes to include structural issues such as access to education and healthcare and employment opportunities, to psychosocial issues such as stress and health behaviours. For developed countries, where there are few people who could be considered to live in absolute deprivation, relative deprivation theory can be considered a more appropriate approach to studying socioeconomic inequalities (Marmot, 2005).

2.3.2 Absolute and Relative Inequalities in Health

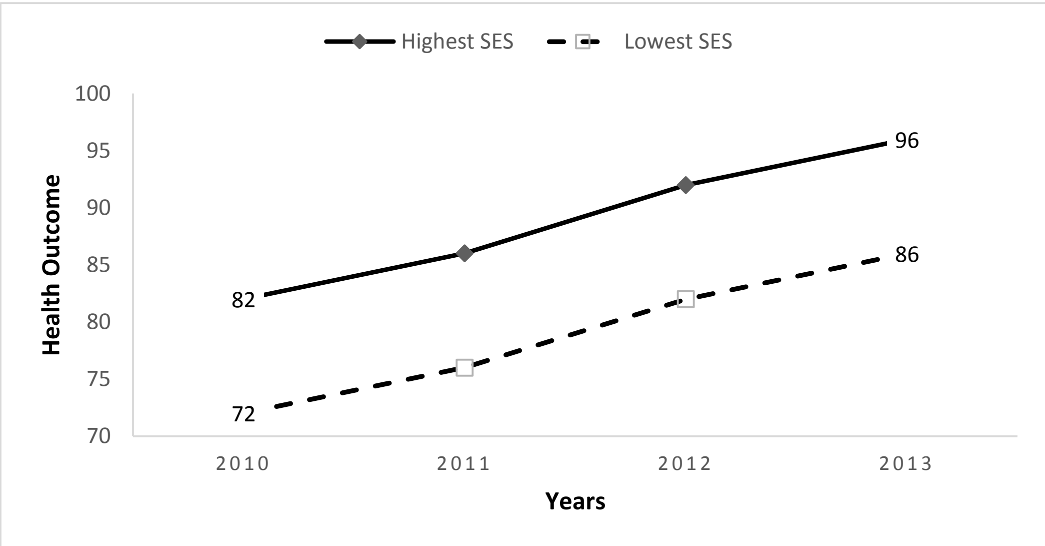
Absolute Inequality

Absolute inequality refers to the actual difference in the rates or percentages of a given outcome measure between the highest and lowest SES group. For example, for cervical screening coverage this could refer to the difference in the percentage coverage between those in the highest SES category and those in the lowest SES category. This would be calculated by subtracting the coverage rate (percentage) in the highest SES category from the coverage rate (percentage) in the lowest SES category. The result of the calculation provides a measure of absolute inequality.

$$Absolute\ Inequality = Rate\ in\ Lowest\ SES\ Category - Rate\ in\ Highest\ SES\ Category$$

Absolute inequalities may also be used to record change over time, where the rate of change for a health outcome in one SES group differs from the other. This may result in a wider or narrower gap between the highest and lowest SES groups over time. However, if the rate of change is the same across both groups, the absolute inequalities between the groups may remain the same, even where there is an overall increase in the outcome over time. See a hypothetical example in Figure 2. The outcome measure (y axis, health outcome, percentage) has increased over time (x axis, period of time, years) for the highest and lowest SES group, yet the absolute inequality remains the same, as the rate of change has been the same in both SES groups. That is, there is an absolute difference of 10% in the outcome measure at the beginning and end of the time period.

Figure 2. Absolute and Relative Inequalities



In the context of public health research, consideration of absolute inequalities of health is useful because it supports understanding of poor health outcomes in the most vulnerable groups and transparently represents the differences between two population sub-groups. An example of absolute inequalities in cervical cancer research includes what is termed the 'deprivation gap in cancer survival' - the difference in relative survival from cervical cancer between the least and most deprived SES groups (Rachet et al., 2010).

Relative Inequality

Relative inequality is commonly reported as a ratio (including odds ratios, risk ratios or rate ratios) or a proportion of a given outcome for an SES category (King et al., 2012). Relative inequality may be calculated as the rate for the lowest SES category divided by the rate of the highest SES category.

$$Relative\ Inequality = \frac{Rate\ in\ Lowest\ SES\ Category}{Rate\ in\ Highest\ SES\ Category}$$

Relative inequalities may change, even where absolute inequalities remain the same. See the hypothetical example in Figure 2. The relative inequality ratio in 2010 is 0.878 (72% / 82%) and in 2013 it is 0.895 (86% / 96%) indicating a slight decrease in relative inequality.

More sophisticated methods of representing health inequalities are available. One example is the Relative Index of Inequality (RII) (Mackenbach and Kunst, 1997). The RII is based on the rates, or ratios, at the extreme points of the social gradient, and therefore does not rely on the mean outcome reported for each SES group. It has the additional advantage of being able to take into account the population size and the relative socioeconomic position between groups. An example of the application of RII within the cancer research literature is a study of cancer risk and cancer incidence in relation to different measures of SES (Spadea et al., 2010b). Specifically, cancer incidence was analysed according to level of education, occupational class, housing, and index of deprivation. The RII was presented as a ratio to provide a method of comparing the association between the different measures of socioeconomic status and cancer incidence. The larger the RII ratio, the greater the disparity between those of the highest and those of the lowest socioeconomic position (Mackenbach and Kunst, 1997).

2.3.3 Individual-level Measures of SES

Whether absolute or relative approaches are taken, SES can be measured at different levels. Individual-level measures of SES include a variety of SES measures that are collated and analysed at individual-level. In the research literature addressing socioeconomic variation in cervical cancer or cervical screening, information on socioeconomic status has been sourced using a variety of methods including national surveys (Moser et al., 2009) and questionnaires (Cotton et al., 2007; Sharp et al., 2012a). The measures generally include income, employment/occupation, social class and housing. There is no single, best measure of SES as each measure has its strengths and limitations (Galobardes et al., 2006).

<u>Income</u>

Income is an indicator of material resource (Galobardes et al., 2006). Health may be promoted by increased wealth through greater access to quality resources (housing and food) and services (education, fitness and leisure). It may be measured as absolute income (continuous variable) or categorised into income brackets. Sometimes household income may be used, rather than individual income. This may be to combat cohort effects, where older women may be more dependent upon a partner's income, and thereby act as a measure of access to wealth.

<u>Education</u>

Education may be considered as an indicator of an individual's employment or income potential and therefore may proximate their access to the material and intellectual resources that support health and well-being. As a measure of SES, it is easy to self-report and is relevant to people no matter their housing or working status. However, it is subject to cohort effects whereby older people, who tended to leave school sooner, are under-represented in higher levels of education. Therefore, education may not be a good marker of SES in older age groups.

However, the measure has no means of determining the quality of education received and therefore this might limit its implications for health literacy (Galobardes et al., 2006). It does allow for international comparisons of SES, which may be more difficult to compare with other SES markers.

<u>Occupation</u>

Occupation may be viewed as a measure of social class. Social class in various forms has been used for many years, however since 2001 the National Statistics New Socioeconomic Classification (NS-SEC) has been used in all official statistics and surveys and is compatible with the European equivalent European Socioeconomic Classification (ESeC) (Office for National Statistics, 2010). The NS-SEC consists of key classes as follows:

1. Higher managerial, administrative and professional occupations
    1.1. Larger employers and higher managerial and administrative occupations
    1.2. Higher professional occupations
2. Lower managerial, administrative and professional occupations
3. Intermediate occupations
4. Small employers and own account workers
5. Lower supervisory and technical occupations
6. Semi-routine occupations
7. Routine occupations
8. Never worked and long-term unemployed

The classifications are sometimes hierarchically categorised into Higher occupation (classes 1 and 2), Intermediate occupations (classes 3 and 4) and Lower occupations (classes 5-7) (Office for National Statistics, 2010). Like income, social class may be measured at individual and household level. The latter may be more applicable to overcome cohort effects in older women (Galobardes et al., 2006).

Housing Tenure and Household Amenities

Housing tenure is another measure of material wealth. Commonly this is categorised according to whether a property is owned (outright or mortgage) or rented (private or social landlord). The validity of these measures may vary across place (urban/rural or differing countries) due to differences in the costs of housing in different locations or across time as a reflection of earning capacity for different cohorts.

Other household amenities such as car ownership may be used as a marker of wealth (Galobardes et al., 2006). This may be dichotomous or, in more recent times, perhaps as a continuous measure of the number of cars owned per household.

2.3.4 Area-level Measures of SES

Area-level, or ecological, measures of SES are also used as measures of SES. Individual-level data, often sourced from the census, may be aggregated into small area data and so on into higher areas and regions. Where an individual's SES is unknown, it may be inferred from the area in which the person lives. This can be particularly useful for research purposes when individual level data are not available or expensive to collect. However, area-level data are subject to the 'ecological fallacy' whereby group inferences should not be assumed to be the same as that of the individual, or indeed may overlook important individual characteristics (Pearce, 2000). Conversely, to inadequately account for population characteristics may be deemed the 'individualistic fallacy' as it may fail to recognise the significance of population-, group- or place-context.

<u>Census</u>

The census is a national survey sent to households in the UK every ten years (ONS 2012a). The information collected enables local and national government to more effectively develop policies, plan public services and allocate funding to local areas. With some caveats regarding occasional changes to definitions or response categories, it is a useful tool to gauge population change over time (ONS, 2012b).

The census provides rich data on a variety of factors including health, social class, employment, education and ethnicity (Geography, 2011; ONS, 2012a). This makes it a useful resource for health inequalities research.

Census data are available for a variety of geographical units (ONS, 2012b). The main geographical areas include output areas and super output areas (discussed in further detail below) but the Office of National Statistics also makes available a variety of other geographies and information on how boundaries may have changed in higher level areas over time. The ONS provide a service called Nomis that enables free access to download data from their website.

While individual data items may be used as specific measures in a given area of interest, census data are commonly used to calculate indices of deprivation based upon a selection of individual items (ONS, 2012c). Indices of deprivation may utilise different socioeconomic measures or may apply different weights to the measures used. Common indices used in England are the English Indices of Deprivation, or Index of Multiple Deprivation, as it is commonly referred to, and the Townsend Index (ONS, 2012c). The Carstairs Index is commonly used in Scotland but has also been adapted to English geographies. Further details of each of these indices are given below.

Index of Multiple Deprivation (IMD)

The Index of Multiple Deprivation (IMD) is a measure of area-level deprivation created and updated by the Department for Communities and Local Government (DCLG) in England (Department for Communities and Local Government, 2011). The IMD comprises seven broad domains: Income; Employment; Health Deprivation and Disability; Education, Skills and Training; Barriers to Housing and Services; Crime; and Living Environment. Each domain has a set of indicators (detailed below) which are then weighted and combined to construct the full IMD (Department for Communities and Local Government, 2011). The data are sourced from Government Departments, including the Department of Work and Pensions, HM Customs and Revenue, the Home Office and census data.

Income Deprivation Domain constitutes 22.5% of the total IMD weight and comprises seven indicators to measure the proportion of the population in an area experiencing deprivation related to low income. These include:

- Adults and children in Income Support families
- Adults and children in Income-based Jobseeker's Allowance families
- Adults and children in Pension Credit (Guarantee) families
- Adults and children in Child Tax Credit families whose income (excluding housing benefits) is below 60% of the median income
- Asylum seekers in England in receipt of subsistence and/or accommodation support
- The proportion of children (0–15 years) living in income deprived households (Income Deprivation Affecting Children Index)

- The proportion of older people (aged 60 years and older) living in income deprived households (Income Deprivation Affecting Older People Index)

Employment Deprivation Domain constitutes 22.5% of the total IMD weight and comprises seven indicators to measure involuntary exclusion from employment by the working age population. The indicators are averaged over four quarters and, unless otherwise indicated relate to women aged 18–59 years and men aged 18–64 years. These include claimants of:

- Jobseeker's Allowance
- Incapacity Benefit
- Severe Disablement Allowance
- Employment Support Allowance
- New Deal (18–24 years)
- New Deal (25 years and older)
- New Deal for Lone Parents (18 years and older)

Health Deprivation and Disability Domain constitutes 13.5% of the total IMD weight and comprises four indicators physical and mental health. These include morbidity, disability and premature mortality, but do not include characteristics of the environment or behaviour that may be associated with future health deprivation:

- Years of potential life lost (age and sex standardised measure of premature death)
- Comparative illness and disability ratio (age and sex standardised measure of morbidity and disability)
- Measures of acute morbidity (age and sex standardised rate of emergency admissions to hospital)
- Proportion of adults under 60 suffering from mood or anxiety disorders

Education, Skills and Training Domain constitutes 13.5% of the total IMD weight and comprises six indicators relating to children and young people and one indicator relating to adults.

The Children and Young People indicators include:

- Average points score of pupils taking English, Maths, and Science Key Stage 2 exams
- Average points score of pupils taking English, Maths, and Science Key Stage 3 exams
- Average capped points score of pupils taking Key Stage 4 (GCSE or equivalent exams)
- Proportion of young people not staying on in school (or non-advanced education) above age 16 years
- Proportion of authorised and unauthorised absences from seconder school
- Proportion of those aged under 21 entering Higher Education

The adult indicator comprises the proportion of adults aged 25–54 with no or low qualifications

Barriers to Housing and Services constitutes 9.3% of the total IMD weight and comprises four indicators relating to geographical barriers and three indicators relating to wider barriers:

The Geographical barriers include:

- Road distance to GP surgery
- Road distance to a supermarket or convenience store
- Road distance to a primary school
- Road distance to a Post Office

The Wider Barriers include:

- Household overcrowding
- Homelessness
- Difficulty of access to owner-occupation (local authority district level)

Crime constitutes 9.3% of the total IMD weight and comprises the rate of four main crime types measured as the number of reported crimes per 1000 population at risk:

- Violence
- Burglary
- Theft
- Criminal damage

Living Environment Deprivation constitutes 9.3% of the total weight of the IMD and measures the quality of individuals' indoor and outdoor surroundings. These include:

- Social and private housing in poor condition
- Houses without central heating
- Air quality
- Road traffic accidents

Townsend Index

The Townsend Index, a measure of material deprivation, is based upon four census-derived indicators (Townsend et al., 1986). These indicators are equally weighted across the index and comprise of the percentages of:

- Persons unemployed
- Households without a car
- Overcrowded households
- Households not owner-occupied

Carstairs Index

The Carstairs Index, is a measure of material deprivation, and is based on four census-derived indicators (Morgan and Baker, 2007). These indicators are not weighted and comprise of the percentages of:

- Persons unemployed
- Households without a car
- Overcrowded households
- Low social class (Social class IV and V)

2.3.5 Geography of England

In this section I will provide relevant details of the geography of England. This is important to understand because the data underlying indices of deprivation are collected and aggregated at area level. Also, health services in England are administered within geographical boundaries which means that responsibility for health, even if overseen at a national level, is held at local area level.

Administrative Geography

Geographically, England comprises nine regions, formerly known as Government Offices for Regions (GORs) (ONS Geography, 2010a). Regions are used for the presentation of area level statistics. The nine regions comprise the North East, North West, Yorkshire and The Humber, East Midlands, West Midlands, East of England, South West, South East and London.

Census Geography

The main areas associated with census geography are output areas (OAs) and super output areas (SOAs) (Geography, 2011). These are the base units for census data. Specifically designed for statistical purposes, SOAs are of equal size and are protected from the boundary changes that may be applied to other geographical areas, such as electoral wards. Lower Super Output Areas (LSOAs) are particularly useful for statistical purposes as they represent relatively small, homogenous areas comprising around 1500 residents and 650 households. This supports the representativeness of individual-level data when aggregated to area-level (ONS, 2011b).

2.3.6 Health Geography

Health geography relates to the structures of the health service and is therefore subject to change (ONS Geography, 2010b). I will now discuss the hierarchical health geographies in place from the late 1990s until 2013, and then the current NHS health geography.

<u>1999–2013 – Strategic Health Authorities (SHA) and Primary Care Organisations (PCO)</u>

Between 1999 and 2013 PCOs were the lowest level of health geography. These were overseen by either Health Authorities (1999–2002) or Strategic Health Authorities (2002–13), which were in turn, respectively under the administration of Regional Offices or Directorates of Health & Social Care. Across the years the number and size of both PCOs and SHAs varied, such that by 2013 when the NHS was most recently restructured there were 151 PCOs, comprising 146 Primary Care Trusts (PCTs) and 5 Care Trusts (ONS Geography, 2010b). PCOs controlled 80% of the NHS budget and commissioned most NHS services (NHS Choices, 2014) . As such, PCOs were responsible for the services within their local area, including cancer screening programmes.

<u>2013 to present – NHS Commissioning Groups and Clinical Commissioning Groups (CCG)</u>

On 1st April 2013, new health geographies in England came into effect (ONS Geography, 2010b). The 151 PCOs were replaced by 211 Clinical Commissioning Groups (CCGs). Many CCGs have the same boundary as the PCOs they replaced, while some other PCTs now comprise two or more CCGs within their boundaries. CCGs are co-terminus with LSOAs. CCGs are overseen by NHS Area Teams and, in turn, NHS Commissioning Groups. Cancer screening is the responsibility of the national office of the NHS Cancer Screening Programmes that is part of Public Health England (PHE), and the commissioning of screening is conducted via 27 area teams known as NHS Commissioning Boards (Cancer Screening, Early Diagnosis and Skin Cancer Prevention Team, 2013).

2.3.7 Strengths and Limitations of SES Measures

Individual-level and Area-level Measures of SES

Individual-level measures of SES may be considered to provide a more accurate analysis of the relationship between socioeconomic status and health since SES data may be directly mapped to health status of the individual. Individual-level measures of SES are sometimes considered to be a more appropriate choice. However, individual level data may be difficult to obtain or may be costly or time consuming to measure at the population level (e.g. using surveys, etc.). For these reasons, area-level measures of SES may be sought as a proxy of individual-level measures of SES.

One of the main strengths of the various area-level indices of deprivation is their ability to comprise a variety of factors that reflect the complexity of deprivation. For the Townsend and Carstairs Indices these include aspects of material deprivation, such as car ownership, household overcrowding, unemployment and, respectively, household ownership or low social class. The IMD is able to extend beyond these factors to include a broader range of factors that also encompass welfare support, health, and geographical and environmental barriers. This makes indices of deprivation valuable tools for identifying areas with specific issues, such as high deprivation or low education (Department for Communities and Local Government, 2011).

Indices of deprivation are limited by the timeframe in which the information is collected. The Townsend Index and Carstairs Index are derived from census data which are collected every 10 years (for example, 1991, 2001, 2011). This may lead to the use of outdated data. The IMD is based upon routinely collected administrative data and is updated periodically to reflect current deprivation levels (for example, 2000, 2004, 2007, 2010) (Department for Communities and Local Government, 2011). The next IMD is due for release in 2015 (Department for Communities and Local Government, 2014).

Caution is advised when using the full IMD to measure effects of deprivation on health, as this may confound, or inflate, the association between deprivation and health. This is because poorer health outcomes, part of the health domain, may be considered to construct a ‘mathematical coupling’ when associated with other health-related data.

Some studies seek to avoid this issue by excluding the health domain from analyses, sometimes by using the income domain only.

Choice of geographic unit may have important implications for how area-level data are analysed and evaluated, and may have implications for concerns regarding the 'ecological fallacy' (Freedman, 1999). Smaller geographic units have been found to demonstrate a stronger association between cancer incidence and socioeconomic status, and, therefore, may be a preferred option, where possible (Donnelly and Gavin, 2011).

In comparison with individual-level measures of SES, area-based measures have been found to underestimate the individual-level association of SES with health outcomes (Galobardes, Shaw, Lawlor, Lynch, & Smith, 2006). Area-level measures may dilute the association between SES and the health outcome due to the variation in the characteristics of the individuals living in the given area. However, as discussed above, this may be mitigated by using small geographical areas with high levels of homogeneity within the resident population. That said, in some instances, it is possible that area-based measures may inflate the association between SES and health since area-based measures inherently include potential independent effects of place (Galobardes, Shaw, Lawlor, Lynch, & Smith, 2006).

In conclusion, individual-level measures of SES are generally considered the preferred option and should be utilised where possible. However, area-level measures offer a broad choice of SES measures to suit a variety of purposes. They can often be easily downloaded from administrative data websites and may be a quicker and cheaper substitute for individual-level measures of SES. However, they are an imperfect measure of SES and, where applied, the interpretation of results should bear in mind the heterogeneity of residents within even relatively small, homogenous areas and the potential for independent effects of place on health outcomes.

Women and Appropriate Measures of SES

As discussed within this section, there are a variety of measures of SES available to choose from. Beyond the pragmatic considerations that often influence the choice of individual-level or area-level SES measure used in any given study, I will now consider the applicability of various SES measures as they apply to women, as well as consider how SES, as indexed in different ways, might operate to affect cervical screening uptake.

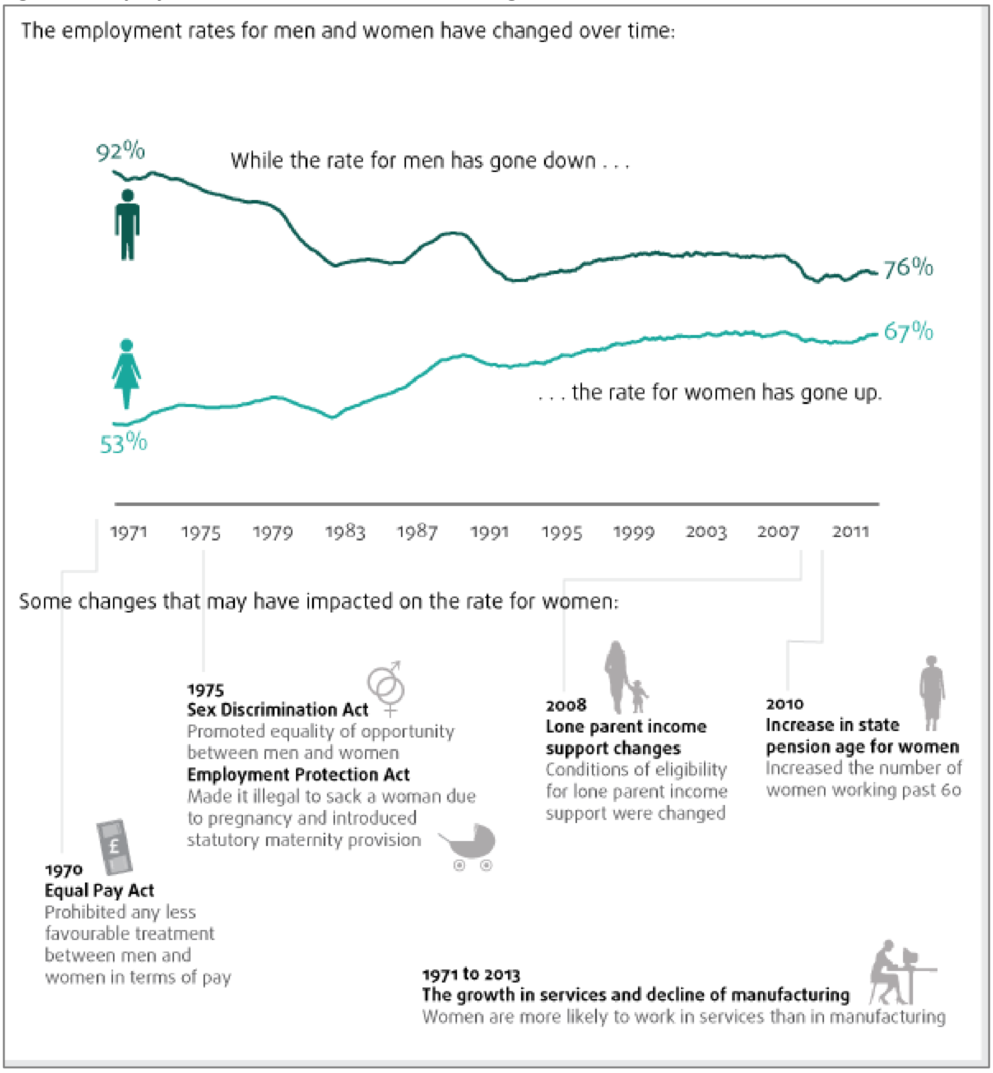
Occupation

The socioeconomic status of a woman has often been determined by the occupation of her husband or male partner. This is because of disparities in opportunity and career progression for women, compared with men, in the workplace. Historically, men, as the 'bread winners', conferred their occupation, and its associated socioeconomic status and income, on the household, and therefore on their wives and children. In some instances, SES determined by the occupation of men, may be an appropriate measure for adult women, but these are likely to be where a household level of SES is appropriate.

The use of a man's occupation as a means of determining a woman's SES may have less relevance in contemporary times, now that women are much more likely to work outside the home (ONS, 2013). Younger women are more likely to have professional careers and relatively greater income in their own right than older women (ONS, 2013). This change has been associated with social and labour market changes over the years that have led to higher employment rates for women. These have been supported by legislative changes, such as the Equal Pay Act (1970), Sex Discrimination Act (1975), Employment Protection Act (1975) and other amendments to benefits and pensions (see Figure 3, reproduced from ONS, 2013). While this may suggest that the use of occupation as a marker of SES for younger women, professional women, or single women, may now be a more accurate reflection of her SES, this may be problematic. Men continue to have higher employment rates and work in occupations which command higher rates of pay than women (ONS, 2013). Further, even where women are employed in professional occupations, they are often subject to the "glass ceiling" effect and may not achieve the promotional opportunities available to their male counterparts (Glass and Cook, 2015). Recent evidence suggests that successful career women in more senior positions receive less support and remain in post for shorter time periods than male peers, meaning that any career advances for women may not translate to the same long term benefits. Also, despite advances in paternity policies, women are still more likely to interrupt their careers to have children or stay at home to look after them (Colette Fagan and Helen

Norman, 2012). Therefore, for married women at least, her partner's occupation may remain a more accurate reflection of their household socioeconomic status, which could be greater than that inferred by her occupation.

Figure 3. Employment rates for men and women, aged 16-64, 1971 to 2013.



However, a woman's individual-level occupational status is key to understanding the employment conditions available to her. In the context of health inequalities research, and in terms of the research questions in this thesis, a woman's occupational status could affect her cervical screening attendance. For example, women who are employed in positions which attract health benefits, such as health insurance or private health care benefits, may find their employers more supportive of the importance of attending cervical screening. Similarly, women in more advantaged employment conditions may have greater autonomy, trust or flexibility with their time, which may also support screening attendance. Conversely, women in less advantaged employment conditions, may find it more difficult to arrange, and subsequently attend, their cervical screening appointments, and may incur a loss of income by doing so. When a woman's occupation is considered within the context of pathways to screening (non) attendance, it may be her individual level occupation that is most important.

Income

Income as a measure of SES can have some of the same issues for women as the occupational measure of SES. That is, for older women in particular, their socioeconomic status may be more appropriately determined by their male partner, as there is a greater likelihood that the primary household income is derived from his salary. Further, given women's career prospects continue to be more limited than men's, this has an effect on the salaried income potential of women (Glass and Cook, 2015).

Women are also more likely than men to be lone parents and are therefore more likely to rely on welfare benefits to support the household income (Evans, 2010). Further, recent changes to welfare benefits also mean that household incomes overall may be even lower for those on benefits now than in previous times. Hence, for some women who are now in low income jobs, they may be no better off than those on welfare benefits in previous years. Therefore, income as a measure of SES over periods of time should be interpreted in light of these potential underlying shifts in net household income.

A woman's income could affect her screening attendance via the associated practicalities of attending screening or in the prioritisation given to screening. For example, women with low income (low paid job or no job) may have difficulty attending screening due to the costs of transport or childcare. Women living in areas with greater deprivation may find their local social networks (neighbours, friends or family living nearby) to be less supportive of their screening attendance. This could potentially be due to lower awareness of cervical screening in more deprived areas (Lostao et al., 2001; Sutton and Rutherford, 2005; Wardle et al., 2004), and therefore less importance being placed on screening attendance. Indeed, cervical screening attendance may be considered as more socially normative in less deprived areas and therefore attending cervical screening attendance is more readily supported. Additionally, women who are worried about their finances may not consider cervical screening (or health in general) to be a priority. These potential pathways to screening non-attendance or screening delay may occur whether the income is measured at individual or household level, as these could both be construed as a measure of the resources available to her.

Education

Education may be particularly relevant to the understanding of health issues as it is likely to affect a woman's occupational status and income, and may also offer other pathways to screening attendance. Educational attainment is associated health literacy which supports the skills to understand health issues, seek help and make health decisions (Nutbeam, 2008). Further, certain health behaviours may be more socially normative in people with higher, rather than lower, levels of education (Sutton & Rutherford, 2005) and therefore may contribute to socioeconomic variation in health outcomes. Therefore, a woman's own level of education may personally affect her health behaviours, and as such, may be considered a particularly useful measure of SES in women.

Education as a measure of SES may differ between older and younger age groups. Older women are generally less well educated and have fewer qualifications than younger women (Finding, 2013). Further, younger women now have greater access to education, and indeed, girls often outperform boys at school examinations. The distribution of the levels of education is likely to differ across younger and older age groups. Therefore education as a marker of SES should be used cautiously if comparing younger and older women.

In terms of education as a pathway to screening attendance, lower levels of education may act to hinder women's attendance at cervical screening via the socially normative practice of a woman's peers. Or conversely, it may support attendance for women with higher levels of education for the same reason. Women with higher levels of education may be exposed to more discussion of cervical screening with their peers due to greater awareness of the cervical screening programme and the value of regular screening. This may support cervical screening attendance through the opportunity to explore the benefits of screening, as well as, the practicalities of attendance.

Strengths and Limitations of Measures of SES for women

Some of the issues raised in this section suggest that household measures may be useful, as women's circumstances are still often strongly associated with their male partner's status (Bartley, 1999). Certainly, these are often used in longitudinal surveys and also in the UK census (Rose and Pevalin, 2005). The use of a household measure, or a family measure, of SES where the household is measured by income of the main breadwinner has been widely accepted because all family members are considered to share those conditions.

The interpretation of some individual-level measures, e.g. level of education, may be problematic when considering health outcomes of women of different age groups. In some instances, it may be suitable to consider household-level measures. The measurement and interpretation of the socioeconomic status of women should consider the appropriateness of the measure to women in general, the possible cohort effects for that measure, and the contemporary differences in women's career opportunities in comparison with men. In health inequalities research, it is the consideration of the SES measure, in the context of the opportunities or pathways that are associated with the health outcome in question, that provides a route to further understanding. Therefore, even where a husband's occupation may conferred on the household, it is the woman's own occupation that will determine the employment conditions that may affect her screening attendance.

It is evident that there are many issues to be considered when choosing a measure of SES for women, and perhaps there is no ideal measure. It is important, therefore, that whichever measure is chosen it is done so while acknowledging not only its limitations but also the pathways by which each SES measure may affect the health behaviour under consideration.

2.3.8 Measuring Socioeconomic Inequalities in Health Outcomes

In quantitative analyses, analysing socioeconomic inequalities in health requires examining the association between the health outcome and a particular measure of SES. This may be a continuous measure or categorised into social groups in some kind of hierarchical format. The strength of the association between the health outcome and the SES measure can then be determined using the appropriate statistical method. The hierarchical format may already be categorised, for example when using social class. This approach was used in a longitudinal study of the Health of the Nation in which age-standardised incidence rates of cervical cancer were found to be significantly higher in manual than non-manual workers (Brown et al., 1997). Continuous measures of SES, such as the percentage of income-deprived people living in LSOAs, may be divided into quintiles from high to low income deprivation. For example, a cross-sectional study of colonoscopy uptake following a positive faecal occult blood test result found people who lived in the less deprived quintiles to be significantly more likely to attend colonoscopy than those living in areas categorised with the most deprived quintile (Morris et al., 2012). Of course, continuous measures of SES do not need to be categorised or preserved to demonstrate the strength of association across the spectrum. This approach was used in a cross-sectional analysis of colorectal screening uptake across England, which found a significant effect of deprivation on the uptake of colorectal screening in people living in areas categorised into quintiles from the most to least deprived.

These are examples of how socioeconomic inequalities in health can be analysed and illustrated, and are important for demonstrating where a problem exists or form the basis for gauging if differences in the strength of the relationship between health and social status may differ over time or place. There is capacity to control for variables that are often confounded with SES, such as ethnicity, to produce complex analyses that may shed light on the role of SES and health outcomes. These examples have focused upon the important upstream factors of SES measures that need to be addressed in order to reduce health inequalities overall, but are sadly lacking in sufficient knowledge of, or political will for, appropriate interventions to act upon them (Marmot Review, 2010).

There are, of course, many other ways in which quantitative research methods can be employed to address downstream factors, including those that may mediate the association between SES and health behaviours. For example, assessing factors that mediate the association between SES and cervical screening participation, such as GP opening hours, may more readily present factors that could form the basis of interventions to improve screening attendance and improve cervical cancer outcomes (Marmot Review, 2010).

2.4 Qualitative Research

In the previous section I discussed the use of quantitative methods in relation to understanding socioeconomic inequalities in cervical screening. Much of the focus was on the measures that may be used to quantify socioeconomic status, and was largely guided by the availability of administrative data. As useful as these measures of socioeconomic status are, there are issues in relation to socioeconomic inequalities in cervical cancer that cannot be explored by these data. For example, in Chapter 1 evidence was presented that suggested cervical screening may be lower in women of lower socioeconomic status, followed by an exploration of the some of the reasons why this may be the case. Broadly, lower cervical screening uptake may be due to issues relating to the women themselves, to the delivery of the screening programme, to the efforts of local health promotion campaigns or, more likely, a combination of all of these. Routine collection of all these types of data is not feasible and, even if it were, it may be difficult to extrapolate the complexity in which different factors contribute to poorer cervical screening attendance. Further, there may be other factors that are not evident in the existing research and, if discoverable, could further understanding of socioeconomic inequalities in cervical cancer. To this end, the use of qualitative research methods offer the opportunity to explore other types of information through, for example, interviews with health professionals within the NHS Cervical Screening Programme.

Qualitative research may not have always received its due respect as a research methodology, with some critics citing it lacks the objective interpretation assumed to be inherent in 'hard' quantitative research methods, although it is well established now and more accepted (Bauer and Gaskell, 2000). Qualitative research has received justifiable criticism of its need to demonstrate reliability and validity; however, this cannot be achieved by transferring the same criteria by which the quantitative research methods are critiqued. In this next section, I will briefly introduce indicators of quality in qualitative research methods.

2.4.1 Validity

Validity may be considered as an indication of how well the research method represents what it is designed to measure (Willig, 2013). Ways in which the validity of qualitative research methods can be supported include the openness of the researcher to allow any assumptions about the meaning of the issue being investigated to be challenged by the participants and/or to invite the participants to comment on the study findings. Higher ecological validity can be achieved by enabling the research to take place in real-world settings where possible.

2.4.2 Reliability

Reliability in research methods is focused upon the replicability of research findings (Willig, 2013). Can the same results be produced on different occasions or with different researchers? The extent to which this can be used as a measure of quality in qualitative research is arguable since the epistemological stance of the researcher and the specific research question guides the analytic enquiry of any data produced from an in-depth interview or focus group study. Therefore, different results may be derived from the same data if the epistemological stance were different. Thus, what may be more important is the transparency of the qualitative research process. Transparency may be improved through reflexivity, a process in which the researcher makes known their own values and assumptions, and acknowledges how this may affect the interpretation of the results. In this way, while other interpretations of the same data may be available, the reader is able to see how the researcher arrived at their interpretation, and in this sense the results may be interpreted as reliable within the constraints of the acknowledged approach. A form of inter-rater reliability can be applied to the analytical process by having more than one researcher code the data, initially independently, and then share and discuss the meanings each have derived in order to provide shared credibility checks.

Chapter 3: Thesis Aims and Research Questions

3.1 Aims

In the Chapter 1, I outlined the evidence for socioeconomic inequalities in cervical cancer incidence, mortality and survival. I then explored if there was evidence of socioeconomic variation in 1) exposure to risk factors and 2) participation in cervical cancer screening. Overall, women of lower SES are more likely to be exposed to some risk factors for the acquisition and persistence of high-risk HPV infection, and this is reflected in the evidence that they are more likely to be positive for high-risk HPV.

The NHS Cervical Screening Programme in the UK provides the means for cervical abnormalities to be detected in advance of the development of cervical cancer. Since there is a substantial time period between exposure to HPV and the onset of cervical cancer, cervical screening should circumvent the development of cervical cancer in women who have a greater exposure to the risk factors, so long as they attend regularly. However, when uptake of cervical screening in England is considered there are clear indications that women of lower SES are less likely to attend cervical screening. Even where women attend cervical screening, there is some evidence that colposcopy attendance may be lower. This is particularly important because women who are referred to colposcopy following a cervical screening test are considered to have had an abnormal screening result, and are therefore in need of further investigation. Women who do not attend colposcopy following an abnormal screening test result may miss out on the key benefit of the cervical screening programme, diagnosis of cervical abnormalities that, if treated, prevent cervical cancer from developing. It is unclear if colposcopy attendance is indeed poorer in lower SES women. The thesis aims to further understand socioeconomic inequalities in cervical screening. In doing so, it is anticipated that this will inform current evidence and future strategies to address socioeconomic inequalities in cervical cancer.

The aims of the thesis are to address the following questions:

1. Are socioeconomic inequalities in cervical screening coverage in England improving? (Study 1 and Study 2)

2. Which factors support or hinder cervical screening coverage in PCTs in England (Studies 3 and 4)

3. Do perceived benefits of cervical screening mediate the association between socioeconomic status and cervical screening coverage? (Study 5)

4. Are there socioeconomic inequalities in attendance at referral to colposcopy following an abnormal cervical screening test contribute to inequalities in cervical cancer? (Study 6)

Chapters 4 to 9 of the thesis address each of these questions in turn, using the theoretical and methodological approaches outlined earlier.

3.1.1 Study 1

Many of the studies of socioeconomic inequalities in cervical screening coverage in the background literature are either from some time in the past or do not cover all areas of the country. In light of this, my first study, a cross-sectional observational study, estimated the relationship between cervical screening coverage over the years 2007–12 and deprivation quintiles using linear regression models. Primary Care Trust level (n = 151) cervical screening coverage data were sourced from the Health & Social Care Information Centre (Health and Social Care Information Centre, 2012b). The income domain of the IMD (2010) was used as the measure of deprivation. The ‘coverage gap’, was calculated as the difference in mean coverage between the least and most deprived quintiles. A mixed ANOVA model was used to estimate if socioeconomic inequalities in cervical screening coverage changed over time, differed between London and the rest of England or differed in the younger and older age groups of women.

3.1.2 Study 2

In contrast to the results found in Study 1, this cross-sectional observational study estimated the relationship between breast screening coverage and deprivation quintiles using linear regression models. Primary Care Trust level (n = 151) breast screening coverage data were sourced from the Health & Social Care Information Centre (Health and

Social Care Information Centre, 2013). The income domain of the IMD (2010) was used as the measure of deprivation. As before, the 'coverage gap', was calculated as the difference in mean coverage between the least and most deprived quintiles. A mixed ANOVA model was used to estimate if socioeconomic inequalities in breast screening coverage changed over time, differed between London and the rest of England or differed between the NHS Breast Screening Programme and the older women eligible for the NHS Cervical Screening Programme. This latter point is the key focus of this study, that is, to contrast the patterns of association between deprivation and cervical screening coverage in older women with the patterns of association between deprivation and breast screening coverage, where there is great overlap in the women simultaneously invited to both. This was anticipated to detect if socioeconomic inequalities in cervical screening coverage may, at least in part, be driven by programme-specific factors, or, alternatively, if they are specific to the characteristics of the women eligible for screening.

3.1.3 Study 3

Factors known to affect screening coverage can be further broken down into area-, population- and programme-delivery factors (Crossley, 2011). The background literature highlighted a variation in cervical screening coverage in PCTs (and other areas) across England, as well as a number of area-level factors (deprivation, levels of education, etc.). Study 3, a cross-sectional observational study, aimed to identify PCTs that have performed particularly well (or poorly) in relation to cervical screening coverage with a view to providing a characterisation of high- and low-performing PCTs. Coverage corresponds to the percentage of women actually screened among the eligible population. This study sourced the number of women screened and the number of eligible women in 2011–12 from the Health & Social Care Information Centre (HSCIC). The income domain of the IMD (2010) was used as the measure of deprivation. Area-level education and ethnicity data were sourced from the Office of National Statistics (ONS) via Nomis, the official labour market statistics web resource (ONS, 2014a). Urban-rural classification of PCTs were sourced from the Association of Public Health Observatories website (APHO, 2008). The percentage of women aged 25-29 years registered with a general practice and the programme-delivery factors (average practice list size, single-handed general practices, practitioner headcount, practice staff and practitioners qualified outside the UK) were sourced from the Health and Social Care Information Centre (Health & Social Care Information Centre, 2010). Univariate regression models were fitted to consider which factors could be included in the full regression model, with Wald tests used as a criterion for inclusion. Three regression models were then fitted to estimate the association between cervical screening coverage in younger and older women and i) population factors, ii) programme-delivery factors and iii) both population and programme-delivery factors.

3.1.4 Study 4

Ecological studies (like Study 1, 2 and 3) offer good opportunities to explore health inequalities at a national level; however, insight from professionals who work in the NHS Cervical Screening Programme may help further explain some of the findings from Studies 1, 2 and 3. It may also offer the opportunity to learn about issues that are perhaps evident to those who work in the programme but are less obvious to others. The study also explored potential reasons for non-attendance at colposcopy following an abnormal screening test result because this had been identified as an area where there was little recent evident and for which data are not easily accessible. For these reasons, Study 4, a qualitative study, explored the views of health professionals on local factors associated with cervical screening coverage and colposcopy attendance. Semi-structured telephone interviews were conducted, with the guidance of a topic guide. The data were analysed thematically and this was conducted using NVivo software.

3.1.5 Study 5

Study 5, a cross-sectional, observational study, took a slightly different approach to investigating socioeconomic inequalities in cervical cancer and sought to explore how perceived benefits of the NHS Cervical Screening Programme mediate the association between SES and cervical screening coverage. Data were sourced from a TNS-BMRB omnibus survey, where women self-completed the Cervical Cancer Awareness Measure (Cervical CAM), (Simon et al., 2011) and items relating to screening participation and attitudes to screening. This study used mediation analyses, according to the Baron & Kenny approach (Baron and Kenny, 1986). The methods comprised of chi-square tests to assess the associations between i) screening status and SES group, ii) perceived benefits of cervical screening and screening status, and iii) perceived benefits and SES group. Four logistic regression models were fitted. Model 1 was a univariate logistic regression model of SES and demographic variables and screening status, Models 2 and 3 fitted the independent effects of each belief variable, and Model 4 included both belief variables.

3.1.6 Study 6

Finally, Study 6 explored socioeconomic inequalities in patient-level colposcopy attendance. The background literature in the previous chapter found some evidence that women of lower SES have lower attendance at colposcopy appointments. This may highlight an additional mechanism by which socioeconomic inequalities in cervical cancer outcomes operate. Yet, the evidence to date is limited. Study 6, a cross-sectional, observational study, explored possible associations between SES and attendance at first referral to colposcopy following an abnormal screening result. Anonymised colposcopy attendance data, age and cervical screening indicators were sourced from the East of England Cyres Colposcopy database for all women referred to colposcopy between 2006 and 2013. The income domain of the IMD (2010) was used as the measure of deprivation. Area-level ethnicity were sourced from the Office of National Statistics (ONS) via Nomis, the official labour market statistics web resource (ONS, 2014a). Chi-square tests were used to assess differences in colposcopy attendance by area-level quintiles of deprivation, age, ethnicity and cervical screening test indicator. Univariate and multivariate logistic regression was used to regress colposcopy attendance status against the aforementioned independent variables. Deprivation and age were also tested for potential interaction effects.

Chapter 4: Socioeconomic Inequalities in Cervical Screening Coverage (Study 1) [2]

4.1 Introduction

This study sought to discover whether socioeconomic inequalities in cervical screening coverage in England are improving. The evidence set out in Chapter 1 indicated that lower attendance at cervical screening by women of lower SES is likely to be a key contributory factor to socioeconomic inequalities in cervical cancer. There are reasons to believe that socioeconomic inequalities in cervical screening coverage could be improving. The gap in screening coverage between less and more deprived health authorities narrowed during the 1990s (Baker and Middleton, 2003). Since then, successive UK governments have made policy commitments to tackling inequalities in cancer screening participation (Department of Health, 2000), (Dept of Health, 2011) and a range of interventions have been introduced to tackle socioeconomic inequalities in cervical screening. In this chapter, I will begin by providing further details of the Baker and Middleton study to outline the status of the gap in cervical screening coverage in the 1990s. I will provide a brief recap of the cancer policies in place since that time and then present some of the interventions that have been introduced to reduce socioeconomic inequalities in cervical cancer screening. And then finally, I will outline the current cervical screening coverage levels in England before introducing Study 1, a study of socioeconomic inequalities in cervical screening coverage in the 2000s.

4.1.1 Cervical Screening Coverage Gap in the 1990s

Baker and Middleton undertook a retrospective time trends analysis of cervical screening coverage in England in the 1990s (Baker and Middleton, 2003). They compared health authority level cervical screening coverage (defined as the percentage of GPs for whom at least 80% of their eligible registered patients have attended cervical screening in the previous five years) at three time points: 1991, 1995 and 1999. The health authorities were placed into three categories of deprivation from most to least deprived, using the

[2] A version of this chapter has been published in the Journal of Medical Screening and is available in Appendix 1

Townsend Index. The difference in mean coverage between the health authorities in the most and least deprived categories was defined and the cervical screening inequity, or could be termed as a cervical screening coverage gap. The study found that the coverage gap reduced over the time period of the study, predominantly due to increased coverage in the more deprived health authorities. There was some improvement in the less deprived health authorities but the rate of improvement was much slower. The authors suggest that this may be due to the greater capacity for improvement in the more deprived areas. As far as I am aware, there have not been any further studies to ascertain if the cervical screening coverage gap has continued to narrow since the late 1990s.

4.1.2 Cancer Policy in the UK

As discussed in Chapter 1, cancer policy in the UK has a longstanding commitment to reducing health inequalities. In 2000 the UK government introduced ‘The Cancer Plan: a plan for investment, a plan for reform’ (Department of Health, 2000). Among its aims were the reduction of death rates and the promotion of early detection and effective screening practice, with a particular emphasis on addressing health inequalities. In 2007, the ‘Cancer Reform Strategy’ further endorsed the government’s commitment to reduce inequalities as part of its programme of action to improve cancer outcomes over the ensuing five years. In 2011, the coalition government published ‘Improving Outcomes: a strategy for cancer’ outlining its commitment to reducing avoidable cancer deaths and reducing cancer inequalities (Dept of Health, 2011).

4.1.3 Interventions to Increase Cervical Screening Coverage

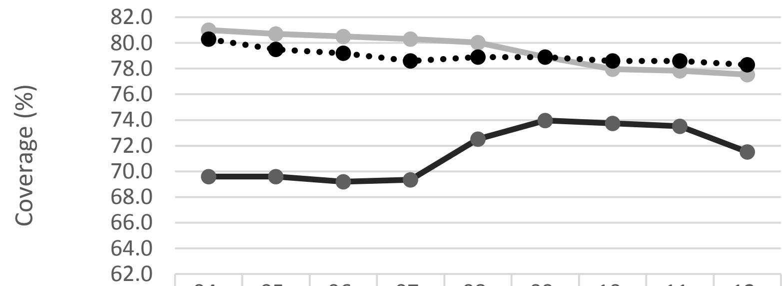
A Cochrane database systematic review of randomised control trials of interventions to increase coverage of cervical screening published before 2009 was undertaken to assess the efficacy of such interventions (Everett et al., 2011). The types of interventions included were reminder interventions (the use of letters, telephone, recommendations, prompts and follow-ups to remind women who are overdue for screening); invitation interventions (the use of letters, telephone, recommendations, prompts and follow-ups to invite a women due for screening); educational interventions to increase knowledge and awareness of the cervical screening programme or of cervical cancer; message framing interventions; the use of counselling to overcome barriers to screening; risk factor interventions to assess a women's risk of cervical cancer; procedural interventions (the use of different screening tests, length of test); and economic interventions (free screening or the use of financial incentives). Thirty-eight trials met their inclusion criteria. Invitation and education interventions were found to be the most effective means of increasing cervical screening coverage overall. Overall, educational interventions were found to be more effective than no education or usual care. The review was unable to determine if the content of any particular intervention was more effective than another. Invitation letters that were endorsed by a general practitioner or health authority were found to be among the most effective means of increasing cervical screening attendance, particularly where this is supported by an organised administrative system. The use of an endorsed letter invitation is encouraging because the NHS Cervical Screening Programme operates such a process in its Call and Recall system to invite women for cervical screening (Health and Social Care Information Centre, 2014). These findings have been further supported by a more recent systematic review which also found GP endorsed invitation letters and telephone reminders to be effective interventions to support cervical screening coverage (Camilloni et al., 2013).

Other strategies to improve screening coverage include interventions that target populations with lower screening uptake (Weller and Campbell, 2009). Over the years, research has been undertaken to inform targeted strategies for intervention including socially deprived women (Logan and McIlfatrick, 2011; Spadea et al., 2010a), ethnic minority women (Lu et al., 2012; Robb et al., 2010) and younger women (Waller et al., 2011). Other research has focused on improving coverage by maximising the role of general practitioners (Shroff et al., 1988) or mass media campaigns of real, or fictitious, celebrity diagnoses of cervical cancer (Jones et al., 2013; Lancucki et al., 2012). Cancer charities such as Cancer Research UK (Cancer Research UK, 2015a) and Jo's Cervical Cancer Trust (Jo's Cervical Cancer Trust, 2013) also work hard to improve awareness of cervical cancer and cervical screening. This is not intended to be a review of cervical screening interventions to improve cervical screening coverage, but to demonstrate that much work has been undertaken over the years to improve cervical screening coverage and, therefore, it may be reasonable to expect that this may have, over a period of time, led to improved coverage and potentially a narrowing of the cervical screening coverage gap.

4.1.4 Cervical Screening Coverage

The national target for cervical screening coverage (within last 5 years) in women aged 25–64 years is 80%, but this has not been achieved since 2004-05 when it reached 80.3% (see Figure 4). Distinct patterns of screening coverage are evident for the younger and older age women invited to screening (Health and Social Care Information Centre, 2012b). Cervical screening coverage in younger women (25–49 years, coverage within last 3.5 years) is noticeably lower than coverage for older women or the full screening programme (see Figure 4). The increased coverage seen around 2008 was attributed to the 'Jade Goody effect' (Lancucki et al., 2012), but this now appears to be in decline. In women aged 50–-64 years, cervical screening coverage (within last five years) is largely comparable to the full screening programme coverage (25–64 years) but has also been in gradual decline, falling from 81.0% in 2005 to 77.5% in 2012–13.

Figure 4. National Cervical Screening in England 2007–2012



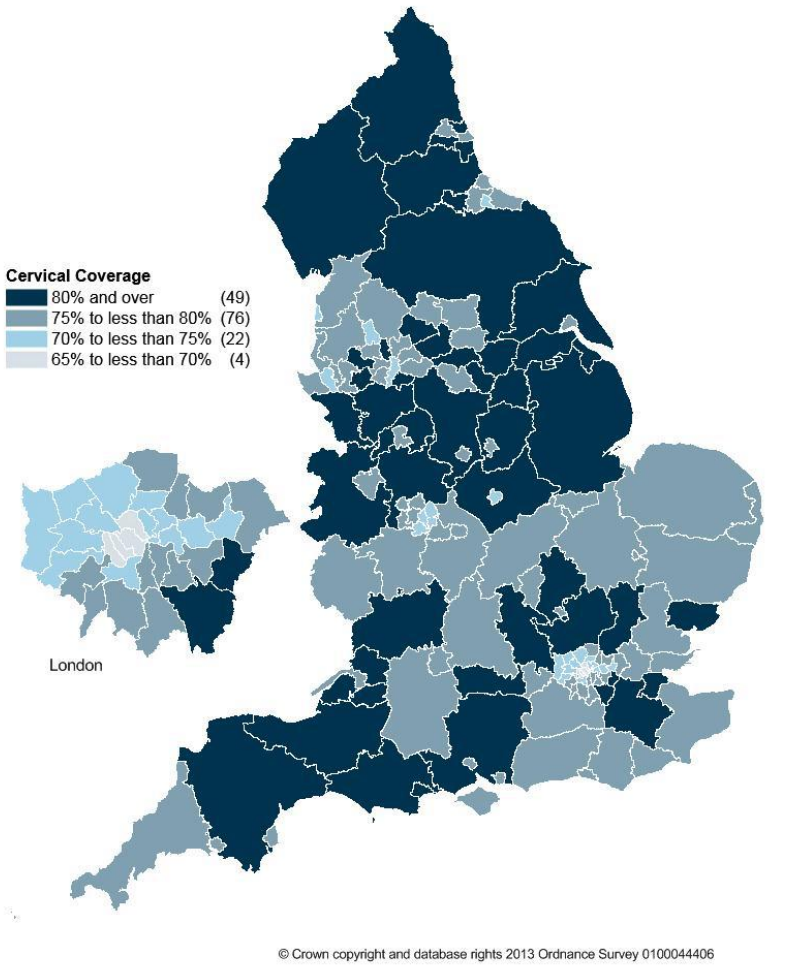
	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13
25-49 years (Coverage < 3.5 yrs)	69.6	69.6	69.2	69.3	72.5	74.0	73.7	73.5	71.5
50-64 years (Coverage < 5 yrs)	81.0	80.7	80.5	80.3	80.0	78.9	78.0	77.8	77.5
25-64 years (Coverage < 5 yrs)	80.3	79.5	79.2	78.6	78.9	78.9	78.6	78.6	78.3

Source: Health Care and Information Centre (2013).

Until 31st March 2013, Primary Care Trusts (PCTs) were responsible for cervical screening coverage for the population of women who were registered at GPs within their boundaries, or if not GP-registered, for women who were residents of the PCT (Health and Social Care Information Centre, 2013). In 2012–13 approximately two-thirds of PCTs (102/151) in England did not achieve the 80% national cervical screening coverage target. The variation in PCT-level cervical screening coverage across England is represented in

Figure 5. London had particularly low PCT coverage: all PCTs with less than 70% coverage and 18 of the 27 PCTs with less than 75% coverage are also in London (Health and Social Care Information Centre, 2013). The lower levels of coverage found in London are considered to be due to high levels of socioeconomic deprivation, population mobility and population diversity (Millett, 2009). However, as Figure 5 demonstrates, there are other areas of low coverage across the country in both urban and rural locations.

Figure 5. PCT-level cervical screening five year coverage (25–64 years) in 2012–13



Source: Graph reproduced from Health and Social Care Information Centre (2013)

4.1.5 Aims of the Study

The present study used PCT level coverage data from the NHS Cervical Screening Programmes (2007–08 to 2012–13) to examine the relationship between cervical screening coverage and deprivation across PCTs in England. Coverage data are gathered as part of the quality assurance process of the NHS Cervical Screening Programme and therefore provides an accurate measure of the number of women actually screened across the whole country. Using PCT-level data is a meaningful area-level aggregate because PCTs were responsible for cervical screening coverage in their areas at the time the coverage figures were accrued. The study addressed the coverage gap, the difference in mean coverage between the least and most deprived PCTs. This was analysed for each year between 2007 and 2002 and the differences in the coverage gap were analysed to provide a measure of what changes, if any, occurred over the time period. A reduction in the cervical screening coverage gap, may indicate that the longstanding political commitment to reduce screening inequalities was having an effect.

4.2 Methods

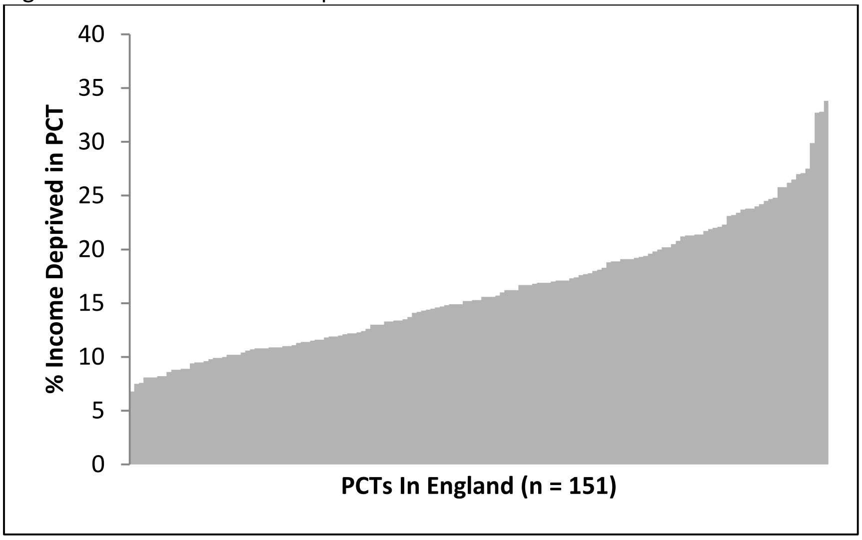
4.2.1 Measures

This study used cervical coverage data downloaded from the Health & Social Care Information Centre (Health and Social Care Information Centre, 2012b) for the years commencing 2007–12, where the calendar year of the reported data annually runs from 1st April through to 31st March. PCT-level cervical screening coverage data were available for all eligible women (25–64 years) using five year coverage figures, younger women (25–49 years) using three and a half year coverage figures and older women (50–64 years) using five year coverage figures. PCT-level data were grouped to provide a national perspective of all PCTs in England (n = 151); and also those excluding London (n = 120); and London only (n = 31) because of established differences.

The income domain score from the Index of Multiple Deprivation (IMD) 2010 was used as the measure of deprivation. The income domain score uses a population-weighted average of Lower Super Output Area (LSOA) income deprivation score, which is then aggregated to PCT level (NCIN, 2013). Figure 6 shows the variation in deprivation (percentage of households that were income deprived) across all 151 PCTs in England. The percentage of households that were income deprived at PCT level ranged from 6.8% (least deprived) to 33.8% (most deprived) with a mean deprivation of 16.2%, SD=5.78.

The IMD (2010) was chosen because it is based on data sourced during the time period of this study. The income domain score of the IMD was chosen because, as discussed in Chapter 2, the full IMD score contains health domain data that can lead to a mathematical duplication of data when associated with other health related data. However, it is acknowledged that limiting the measurement of deprivation to income alone may be considered as a weakness of this study. Therefore, sensitivity analyses using the full Index of Multiple Deprivation score was conducted and is reported in Appendix 1.

Figure 6. PCT level income deprivation



4.2.2 Statistical analysis

Data were analysed using SPSS statistical software, version 18.0 (*PASW Statistics for Windows*, 2009). Descriptive statistics were generated for PCT level cervical screening coverage for three age groups: 25–64 years (all eligible women); 25–49 years (younger women) and 50–64 years (older women). Analysis of the data for all eligible women was necessary to describe the results for the full cervical screening programme. Coverage data for the younger and older groups was useful to discern any age-specific effects. Data were then further grouped by geographical area: all PCTs in England (n = 151); PCTs in England excluding London (n = 120); and London PCTs only (n = 31).

To describe the relationship between cervical screening coverage and deprivation the following models were fitted and are described below. The outcome measure was cervical screening coverage (%).

1) A linear regression model was used to calculate what is termed as the 'coverage gap', deprivation was divided into quintiles of IMD score for each year. The 'coverage gap' is the absolute difference in mean coverage between the least and most deprived quintiles.

2) A mixed ANOVA was used to estimate if socioeconomic inequalities in cervical screening changed over time. This analysis was stratified by region (London versus the Rest of England) and age (younger versus older women). The analysis was then descriptively compared across the strata.

4.3 Results

Table 1 provides cervical screening coverage at PCT-level (Min, Max, Mean and SD) for all eligible women, younger (25–49 years) and older (50–64 years). This information is also grouped by PCT: all English PCTs (n = 151); PCTs excluding London (n = 120); and London only (n = 31). A visual representation of mean coverage for these groups is also presented in Figure 7. Across all age groups the results for all English PCTs and PCTs excluding London are broadly comparable, whereas they are visually lower for London PCTs.

4.3.1 Descriptive Statistics for PCT-Level Cervical Screening Coverage

<u>All Eligible Women</u>

Over the time period, mean cervical screening coverage across England for all eligible women was around 78%, just below the 80% programme target see Table 1. Mean coverage was slightly higher (79%) when London PCTs were excluded. Mean coverage was lower, at around 74% for London PCTs only, indicating a coverage deficit of around 5.4% when compared with PCTs excluding London over the time period.

<u>Younger and Older Women</u>

As expected, coverage was lower for younger women than older women (see Figure 7). In 2007–08, coverage was notably lower for the younger age group in all PCTs. A transient upward trend in cervical screening coverage for younger women peaked in 2009–10.

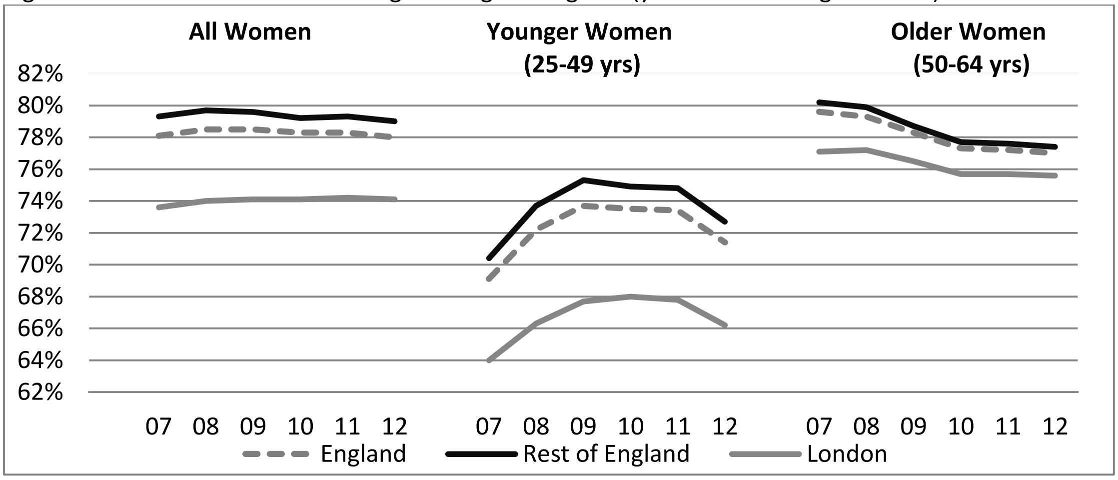
While mean coverage was higher for older women there has been a gradual decline over the time period.

Across the time period, mean coverage for both age groups was lower in London PCTs, but this was more pronounced for younger than older women. For younger women the coverage deficit between London only PCTs was around 7.1% when compared with PCTs excluding London. For older women, the coverage deficit was around 2.3%.

Table 1. Descriptive statistics for PCT Level cervical screening coverage (Year Commencing 2007–12)

	All eligible women (25–64 years)			**Younger women (25–49 years)**			**Older women (50–64 years)**		
Year	Min–Max	Mean	SD	Min–Max	Mean	SD	Min–Max	Mean	SD
All England PCTs (n = 151)									
2007	66.7–85.7	78.1	3.7	57.7–80.1	69.1	5.0	68.6–85.6	79.6	2.8
2008	65.8–85.8	78.5	3.8	57.9–81.2	72.2	4.7	67.8-85.0	79.3	3.1
2009	66.4–85.4	78.5	3.6	58.8–81.6	73.7	4.7	68.5–84.4	78.3	2.8
2010	67.2–84.3	78.3	3.4	60.1–80.5	73.5	4.4	70.0–82.4	77.3	2.6
2011	65.9–83.8	78.3	3.4	58.7–80.4	73.4	4.4	69.1–82.0	77.2	2.5
2012	65.5–83.5	78.0	3.4	56.5–78.5	71.4	4.4	69.1–82.0	77.0	2.4
Excluding London PCTs (n = 120)									
2007	71.6–85.7	79.3	2.7	60.6–80.1	70.4	4.4	73.4–85.6	80.2	2.4
2008	71.9–85.8	79.7	2.7	64.9–81.2	73.7	3.3	69.7–85.2	79.9	2.7
2009	72.8–85.4	79.6	2.5	67.0–81.6	75.3	3.1	72.1–84.4	78.7	2.4
2010	72.9–84.3	79.2	2.4	67.7–80.5	74.9	3.0	70.3–82.4	77.7	2.4
2011	73.4–83.8	79.3	2.3	67.4–80.4	74.8	3.0	70.1–82.0	77.6	2.3
2012	72.7–83.5	79.0	2.4	63.7–78.5	72.7	3.0	70.6–82.0	77.4	2.1
London PCTs (n = 31)									
2007	66.7–81.6	73.6	3.5	57.7–75.4	64.0	4.1	68.6–82.0	77.1	3.2
2008	65.8–82.1	74.0	4.0	57.9–76.7	66.3	4.5	67.8–83.1	77.2	3.6
2009	66.4–81.9	74.1	4.0	58.8–77.8	67.7	4.9	68.5–82.6	76.5	3.3
2010	67.2–81.2	74.1	3.6	60.1–77.6	68.0	4.5	70.0–81.3	75.7	2.6
2011	65.9–81.2	74.2	3.7	58.7–77.7	67.8	4.6	69.1–80.9	75.7	2.8
2012	65.5–81.5	74.1	3.9	56.5–77.3	66.2	4.8	69.1–80.4	75.6	2.7

Figure 7. PCT-level cervical screening coverage in England (year commencing 2007–12)



Prior to applying further statistical tests the data were tested for assumptions of normality. There were no outliers in the data, however, the data were negatively skewed. Figures and visual illustrations refer to the cervical screening coverage for all women in 2007. This pattern was consistent across coverage by year (2007 – 2012) and age (all women, younger women and older women). In 2007, for cervical screening coverage for all women kurtosis was 0.095 (standard error = 0.392). However, the data were negatively skewed with a skewness of -0.724 (standard error = 0.197). This is visually illustrated in the histograms and Q-Q Plot in Figures 8 and 9. The data were transformed using the Square Root function (SQRT) in SPSS as follows: SQRT((Max Screening coverage + 1) – ScreeningCoverage)). A sensitivity analysis was then conducted by comparing the results of the linear regression and mixed ANOVA analyses using the original screening data and the transformed screening data. There were no significant differences in the results (not shown) therefore the analysis was conducted using the original (untransformed) coverage data.

Figure 8. Cervical Screening Coverage in 2007 - England (all women)

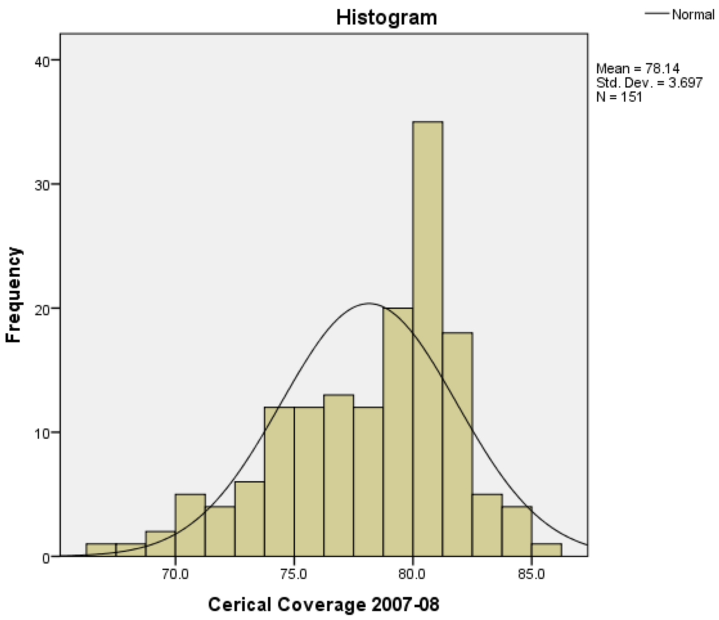
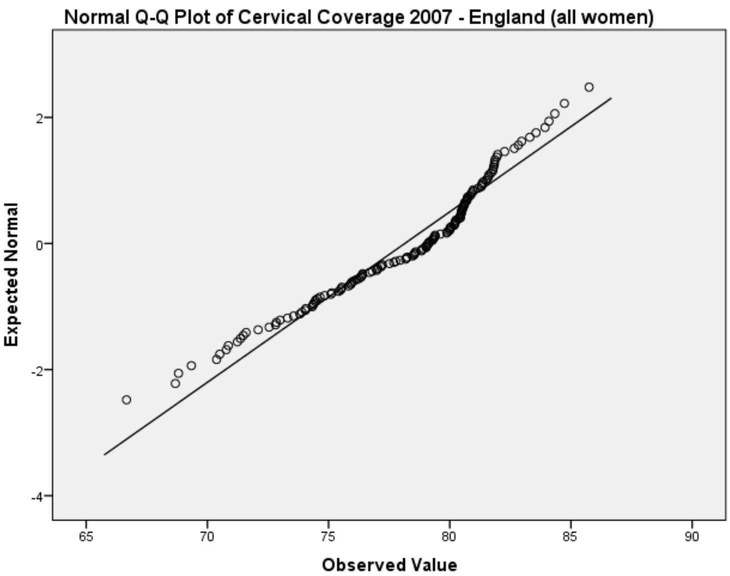


Figure 9. Q-Q Plot of Cervical Screening Coverage in 2007 - England (all women)



4.3.2 Deprivation Quintiles and Screening Coverage

Linear regression analysis using IMD quintiles of deprivation were used to ascertain the size of the cervical screening 'coverage gap', that is, the absolute difference in the mean coverage between the least and most deprived quintiles. The results for all English PCTs (n = 151) and those excluding London (n = 120) were broadly comparable. The results for all PCTs in England will be reported in Appendix 1 and this chapter will show the absolute difference in mean coverage by deprivation quintile for English PCTs excluding London and London PCTs in Tables 5, 6 and 7. The F-statistic and p-value for the linear regression model for each year are presented in the text, where applicable.

<u>All Eligible Women</u>

For PCTs in England excluding London, cervical screening coverage was lower in more deprived quintiles for all eligible women (see Table 2). The coverage gap was 4.3% ($F(4, 119) = 12.956$, $p < 0.001$) in 2007 and 4.7% ($F(4, 119) = 21.555$, $p < 0.001$) in 2012.

For London PCTs, the trend for lower cervical screening coverage in more deprived quintiles persisted but it was rarely statistically significant, see Table 2. In 2007, the cervical screening coverage gap was 3.6% ($F(4, 26) = 3.002$, $p=0.037$), and in 2012 the coverage gap was 2.0% ($F(4, 26) = 2.528$, $p=0.065$).

Table 2. England (excluding London) and London PCTs: Cervical screening coverage – all eligible women by deprivation quintile (Q1 – Low, Q5 – High)

Yr	Dep. Qs	All eligible women England (excluding London)					All eligible women London				
		B	95% CIs Lower	Upper	SE	p	B	95% CIs Lower	Upper	SE	p
07	Q1	80.66	79.82	81.51	0.43		76.59	72.02	81.17	2.23	
	Q2	-0.02	-1.25	1.21	0.62	-0.01	0.67	-0.75	6.08	2.63	0.803
	Q3	-1.50	-2.73	-0.27	0.62	-0.23*	-3.98	-9.27	1.30	2.57	0.134
	Q4	-1.76	-3.01	-0.50	0.64	-0.26*	-4.84	-10.03	0.35	2.52	0.066
	Q5	-4.29	-5.62	-2.96	0.67	-0.59**	-3.64	-8.62	1.34	2.42	0.145
08	Q1	81.23	80.42	82.03	0.41		76.89	71.52	82.26	2.61	
	Q2	-0.24	-1.41	0.93	0.59	-0.04	0.76	-5.59	7.12	3.09	0.807
	Q3	-1.70	-2.87	-0.53	0.59	-0.26*	-4.22	-10.42	1.98	3.02	0.173
	Q4	-1.97	-3.17	-0.77	0.60	-0.29*	-4.75	-10.84	1.34	2.96	0.121
	Q5	-4.74	-6.01	-3.48	0.64	-0.66**	-3.21	-9.05	2.63	2.84	0.268
09	Q1	81.18	80.47	81.90	0.36		77.21	71.67	82.75	2.70	
	Q2	-0.32	-1.37	0.73	0.53	-0.05	0.24	-6.31	6.80	3.19	0.940
	Q3	-1.78	-2.83	-0.73	0.53	-0.29*	-4.33	-10.73	2.07	3.11	0.176
	Q4	-2.06	-3.13	-0.99	0.54	-0.33**	-4.97	-11.25	1.32	3.06	0.116
	Q5	-4.75	-5.88	-3.62	0.57	-0.70**	-3.44	-9.46	2.59	2.93	0.252
10	Q1	80.93	80.27	81.60	0.33		77.41	73.01	81.82	2.14	
	Q2	-0.54	-1.51	0.42	0.49	-0.09	0.59	-4.63	5.80	2.54	0.819
	Q3	-1.75	-2.71	-0.78	0.49	-0.30**	-4.02	-9.11	1.06	2.47	0.116
	Q4	-2.23	-3.21	-1.24	0.50	-0.37**	-5.76	-10.75	-0.77	2.43	0.025
	Q5	-4.98	-6.02	-3.93	0.53	-0.76**	-3.68	-8.47	1.11	2.33	0.126
11	Q1	80.90	80.25	81.55	0.33		77.44	72.70	82.19	2.31	
	Q2	-0.55	-1.49	0.39	0.48	-0.10	0.24	-5.38	5.85	2.73	0.932
	Q3	-1.54	-2.48	-0.60	0.48	-0.27*	-4.05	-9.52	1.43	2.67	0.141
	Q4	-2.05	-3.01	-1.08	0.49	-0.35**	-6.06	-11.44	-0.68	2.62	0.029*
	Q5	-4.80	-5.82	-3.78	0.51	-0.76**	-3.21	-8.37	1.95	2.51	0.212
12	Q1	80.47	79.79	81.15	0.34		76.51	71.35	81.68	2.51	
	Q2	-0.53	-1.52	0.46	0.50	-0.09	1.02	-5.10	7.13	2.98	0.735
	Q3	-1.31	-2.29	-0.32	0.50	-0.23*	-4.05	-10.02	1.92	2.90	0.175
	Q4	-1.81	-2.82	-0.80	0.51	-0.30*	-4.79	-10.65	1.07	2.85	0.105
	Q5	-4.69	-5.76	-3.63	0.54	-0.73**	-2.02	-7.64	3.60	2.73	0.467

* p < 0.01, ** p < 0.001

Younger and Older Women

For PCTs in England excluding London, a statistically significant cervical screening coverage gap was found for all age groups, but was stronger for younger women (see Table 3). The cervical coverage gap in younger women was 4.2% ($F(4, 119) = 5.084$, $p=0.001$) in 2007 and 5.9% ($F(4, 119) = 19.490$, $p < 0.001$ in 2012). For older women, the screening coverage gap remained at around 4.1% for the duration of the study period.

For London PCTs (see Table 4), the cervical screening coverage gap was still evident but was no longer statistically significant, with the exception of younger women in 2007. In younger women, the coverage gap was 5.8% ($F(4,26)=3.478$, $p=0.021$) in 2007 and 2.5% ($F(4,26)=3.14$, $p=0.031$) in 2012. The coverage gap was notably weaker in older women. For older women, the cervical screening coverage gap was 2.8% ($F(4,26)=0.683$, $p=0.610$) in 2007 and 0.03% ($F(4,26)=0.687$, $p=0.607$) in 2012.

Table 3. England excluding London: cervical screening coverage in younger and older women

Yr	Dep Qs	Cervical screening (25–49 years)					Cervical screening (50–64 years)				
		B	95% CIs Lower	Upper	SE	P	B	95% CIs Lower	Upper	SE	P
07	Q1	71.46	69.92	73.01	0.78		81.83	81.10	82.55	0.37	
	Q2	1.08	-1.17	3.32	1.13	0.10	-0.58	-1.64	0.48	0.54	-0.10
	Q3	-1.21	-3.45	1.03	1.13	-0.11	-2.26	-3.32	-1.20	0.54	-0.39**
	Q4	-1.76	-4.06	0.53	1.16	-0.16	-1.86	-3.32	-1.20	0.54	-0.31*
	Q5	-4.20	-6.62	-1.11	1.22	-0.35*	-4.05	-5.19	-2.90	0.58	-0.63**
08	Q1	75.74	74.78	76.70	0.48		81.77	80.93	82.61	0.43	
	Q2	-0.09	-1.49	1.31	0.71	-0.01	-0.99	-2.22	0.23	0.62	-0.15
	Q3	-2.11	-3.50	-0.71	0.72	-0.26*	-2.33	-3.56	-1.10	0.62	-0.35**
	Q4	-3.05	-4.48	-1.62	0.72	-0.37**	-2.25	-3.50	-0.99	0.63	-0.33*
	Q5	-5.92	-7.42	-4.41	0.76	-0.66**	-4.82	-6.15	-3.49	0.67	-0.65**
09	Q1	77.17	76.30	78.05	0.44		80.43	79.67	81.19	0.38	
	Q2	-0.32	-1.59	0.95	0.64	-0.04	-0.94	-2.05	0.16	0.56	-0.16
	Q3	-1.79	-3.06	-0.52	0.54	-0.24*	-2.25	-3.35	-1.14	0.56	-0.38**
	Q4	-2.59	-3.90	-1.29	0.66	-0.33**	-2.01	-3.14	-0.88	0.57	0.33*
	Q5	-6.04	-7.42	-4.67	0.69	-0.72**	-4.26	-5.45	-3.06	0.60	-0.64**
10	Q1	76.93	76.11	77.76	0.42		79.56	78.83	80.30	0.37	
	Q2	-0.60	-1.80	0.61	0.61	-0.08	-1.13	-2.20	-0.05	0.54	-0.19*
	Q3	-1.82	-3.02	-0.61	0.61	-0.25*	-2.24	-3.32	-1.17	0.54	-0.38**
	Q4	-2.67	-3.90	-1.44	0.62	-0.35**	-2.29	-3.38	-1.19	0.55	-0.38**
	Q5	-6.23	-7.52	-4.93	0.66	-0.76**	-4.45	-5.60	-3.29	0.58	-0.68**
11	Q1	76.49	75.64	77.35	0.43		79.34	78.65	80.04	0.35	
	Q2	-0.53	-1.78	0.71	0.63	-0.07	-1.09	-2.11	-0.07	0.51	-0.19*
	Q3	-1.22	-2.47	0.02	0.63	-0.17	-2.08	-3.10	-1.06	0.51	-0.37**
	Q4	-2.24	-3.51	-0.97	0.64	-0.30*	-2.04	-3.08	-0.99	0.52	-0.35**
	Q5	-5.76	-7.10	-4.42	0.68	-0.72**	-4.25	-5.35	-3.15	0.56	-0.68**
12	Q1	74.45	73.55	75.36	0.46		78.98	78.34	79.62	0.32	
	Q2	-0.60	-1.92	0.71	0.66	-0.08	-0.97	-1.90	-0.04	0.47	-0.19*
	Q3	-1.11	-1.92	0.71	0.66	-0.15	-1.91	-2.85	-0.98	0.47	-0.37**
	Q4	-2.18	-3.52	-0.84	0.68	-0.28*	-1.70	-2.66	-0.75	0.48	-0.48*
	Q5	-5.86	-7.28	-4.44	0.72	-0.70**	-4.11	-5.12	-3.10	0.51	-0.71**

* $p < 0.01$, ** $p < 0.001$

Table 4. London only: Deprivation (quintiles) and cervical screening coverage in younger and older women

Year	Dep. Quintiles Q1 Least Q5 Most	Cervical screening (25–49 years)					Cervical screening (50–64 years)				
		B	95% CIs Lower	95% CIs Upper	SE	P	B	95% CIs Lower	95% CIs Upper	SE	P
07	Q1	68.81	63.65	73.97	2.51		79.58	74.80	84.35	2.32	
	Q2	-0.58	-6.68	5.52	2.97	0.846	-1.05	-6.70	4.60	2.75	0.705
	Q3	-6.16	-12.11	-0.21	2.90	0.043*	-2.87	-8.38	2.65	2.68	0.295
	Q4	-6.41	-12.25	-0.56	2.84	0.033*	-3.35	-8.76	2.07	2.63	0.215
	Q5	-5.80	-11.40	-0.19	2.73	0.043*	-2.76	-7.95	2.43	2.53	0.284
08	Q1	70.38	64.43	76.33	2.90		79.16	73.79	84.52	2.61	
	Q2	0.15	-6.89	7.19	3.43	0.965	-0.61	-6.95	5.74	3.09	0.846
	Q3	-5.77	-12.65	1.10	3.34	0.096	-2.94	-9.13	3.25	3.01	0.338
	Q4	-6.30	-13.05	0.45	3.28	0.066	-2.84	-8.92	3.25	2.96	0.347
	Q5	-4.45	-10.93	2.02	3.15	0.169	-1.84	-7.68	3.99	2.84	0.521
09	Q1	71.90	65.30	78.50	3.21		78.37	73.36	83.37	2.44	
	Q2	0.29	-7.52	8.11	3.80	0.939	-1.25	-7.18	4.67	2.88	0.667
	Q3	-5.65	-13.28	1.97	3.71	0.140	-2.77	-8.55	3.01	2.81	0.333
	Q4	-6.64	-14.13	0.85	3.64	0.080	-2.32	-7.99	3.36	2.76	0.409
	Q5	-4.50	-11.68	2.68	3.49	0.209	-1.71	-7.15	3.73	2.65	0.523
10	Q1	72.58	67.20	77.96	2.62		77.03	73.11	80.96	1.91	
	Q2	0.55	-5.82	6.92	3.10	0.860	-0.34	-4.98	4.31	2.26	0.883
	Q3	-5.64	-11.85	0.58	3.02	0.074	-1.86	-6.39	2.67	2.21	0.407
	Q4	-7.90	-14.00	-1.80	3.97	0.013*	-1.87	-6.32	2.58	2.17	0.395
	Q5	-5.13	-10.98	0.73	2.85	0.083	-1.27	-5.53	3.00	2.08	0.548
11	Q1	72.04	66.46	77.62	2.72		77.11	72.96	81.25	2.02	
	Q2	0.57	-6.03	7.18	3.21	0.859	-0.91	-5.81	3.99	2.38	0.705
	Q3	-5.45	-11.90	0.99	3.14	0.094	-2.27	-7.05	2.51	2.33	0.338
	Q4	-7.58	-13.90	-1.25	3.08	0.021*	-2.34	-7.04	2.35	2.28	0.314
	Q5	-4.30	-10.37	1.77	2.95	0.157	-0.90	-5.4	3.60	2.19	0.685
12	Q1	69.21	63.10	75.31	2.97		76.30	72.25	80.35	1.97	
	Q2	1.62	-5.61	8.851	3.52	0.648	0.06	-4.73	4.85	2.33	0.980
	Q3	-5.39	-12.44	1.66	3.43	0.128	-2.03	-6.71	2.65	2.28	0.380
	Q4	-5.93	-12.86	1.00	3.37	0.090	-1.23	-5.82	3.37	2.24	0.588
	Q5	-2.49	-9.13	4.15	3.23	0.448	-0.03	-4.43	4.37	2.14	0.989

* $p < 0.01$

4.3.3 Socioeconomic Inequalities in Screening Coverage over Time

Comparison of Cervical Screening Coverage in Rest of England and London

Rest of England

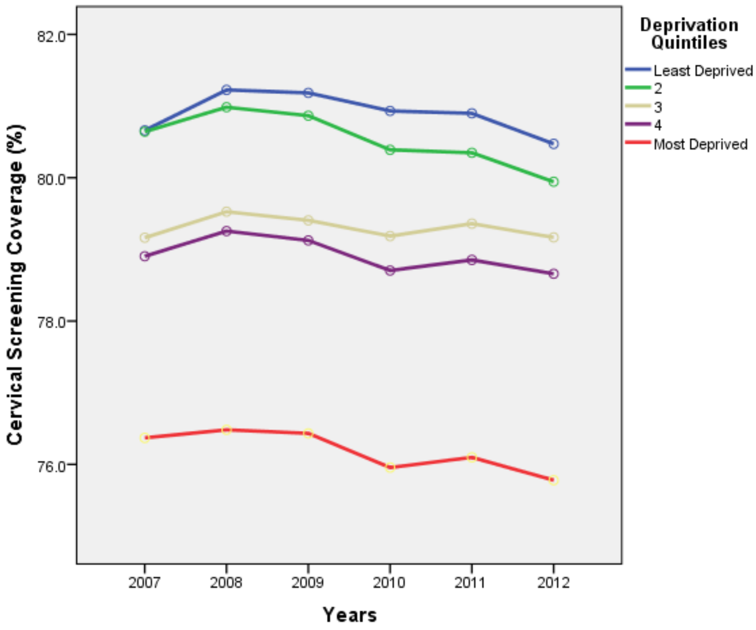
A mixed ANOVA was conducted to determine whether there were statistically significant differences in cervical screening coverage from 2007 to 2012 and to test if there was an interaction between deprivation and time on cervical screening coverage in women aged 25-64 years. The assumption of sphericity was violated, as assessed by Mauchley's test of sphericity, χ^2 (14) = 629.17, $p < 0.001$, therefore a Greenhouse-Geisser correction was applied.

The main effect of deprivation showed there was a statistically significant difference in cervical screening coverage between deprivation quintiles F (4, 115) = 21.54, $p < 0.001$, partial $\eta^2 = 0.428$. Cervical screening coverage in the most deprived quintile (Q5) was notably lower than cervical screening coverage the other quintiles, as illustrated in Figure 10.

The main effect of time showed a statistically significant difference in cervical screening coverage across the years, F (1.49, 259.21) = 17.204, $p < 0.001$, $\eta^2 = 0.130$. This is likely to be due to the increase in coverage in 2008, notable in all quintiles with the exception of the least deprived (Q5), and then subsequent fall in coverage in 2010.

However, there was no significant interaction between deprivation and time on cervical screening coverage for all women aged 25-64 years, F (1.77, 259.21) = 1.066, $p = 0.385$, partial $\eta^2 = 0.036$.

Figure 10. Cervical Screening Coverage by Deprivation Quintile - Rest of England



London

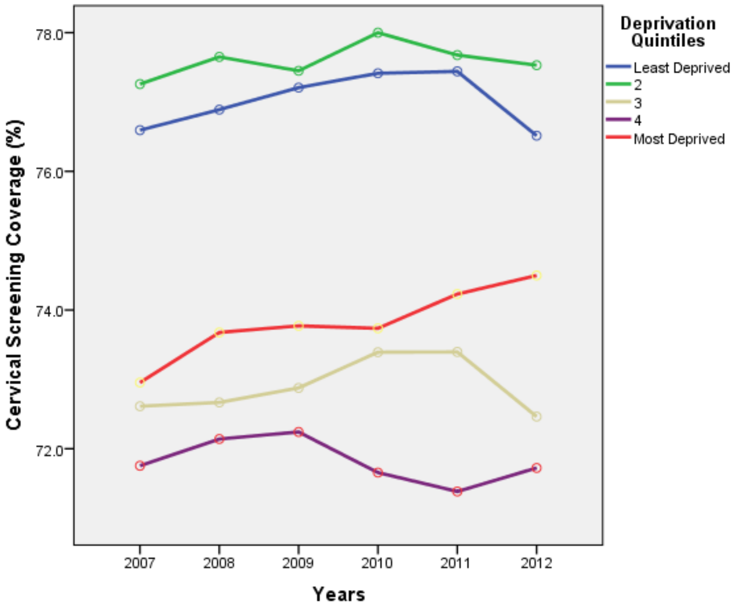
A mixed ANOVA was conducted to determine whether there were statistically significant differences in cervical screening coverage from 2007 to 2012 and to test if there was an interaction between deprivation and time on cervical screening coverage. The assumption of sphericity was violated, as assessed by Mauchley's test of sphericity, χ^2 (14) = 84.85, p < 0.001, therefore a Greenhouse-Geisser correction was applied.

The main effect of deprivation showed there was a statistically significant difference in cervical screening coverage between deprivation quintiles F (4, 26) = 2.93, p = 0.040, partial η^2 = 0.311. Cervical screening coverage was notable lower in the more deprived quintiles (Q3-Q5), as illustrated in Figure 11. Interestingly, the mean cervical screening coverage in the most deprived quintile (Q5) was higher than the mean cervical coverage for Q3 and Q4.

The main effect of time showed there was no statistically significant difference in cervical screening coverage across the years, F (2.06, 53.61) = 0.789, p = 0.463, η^2 = 0.029.

There was no significant interaction between deprivation and time on cervical screening coverage for all women aged 25-64 years, F (8.25, 53.61) = 0.645, p = 0.741, partial η^2 = 0.090.

Figure 11. Cervical Screening Coverage by Deprivation Quintile - London



Comparison of Cervical Screening Coverage in Rest of England and London

There was significant variation in cervical screening coverage across quintiles of deprivation in PCTs in England (excluding London) and in London itself, but there was no interaction between deprivation and time on cervical screening coverage over the period. However, there were differences in the patterns of cervical screening coverage over the period in the two areas. PCTs in England (excluding London) displayed a similar peak in screening coverage around 2008 and 2009, and then coverage fell into steady decline. This is similar to the 'Jade Goody effect'. However, in London there appeared to be different trends in coverage across the quintiles (see Figure 11) and no sign of a 'Jade Goody effect'.

The results for all England are reported in Appendix 3.

Comparison of Cervical Screening Coverage in Younger and Older Women

Younger Women

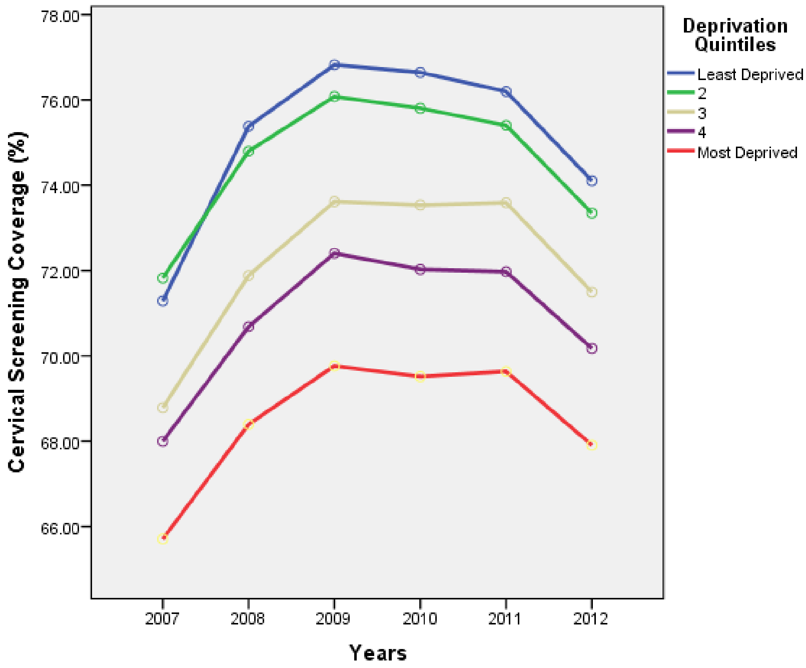
The analyses were repeated for younger and older women. The assumption of sphericity was violated, as assessed by Mauchley's test of sphericity, χ^2 (14) = 853.91, $p < 0.001$, therefore a Greenhouse-Geisser correction was applied.

The main effect of deprivation showed there was a statistically significant difference in cervical screening coverage between deprivation quintiles F (4, 146) = 16.31, $p < 0.001$, partial η^2 = 0.309. Cervical screening coverage in the most deprived quintile (Q5) was visibly lower than other quintiles, particularly the least deprived quintiles (Q1 and Q2), as illustrated in Figure 12.

The main effect of time showed a statistically significant difference in cervical screening coverage across the years, F (1.51, 220.82) = 190.46, $p < 0.001$, η^2 = 0.566. There was a distinct peak in cervical screening coverage in 2009 and 2010, followed by a distinct fall in coverage particularly in 2012.

There was no significant interaction between deprivation and time on cervical screening coverage for all women aged 25-49 years, F (6.05, 220.82) = 1.126, p = 0.348, partial η^2 = 0.030.

Figure 12. Cervical Screening Coverage by Deprivation Quintile - Younger Women



Older Women

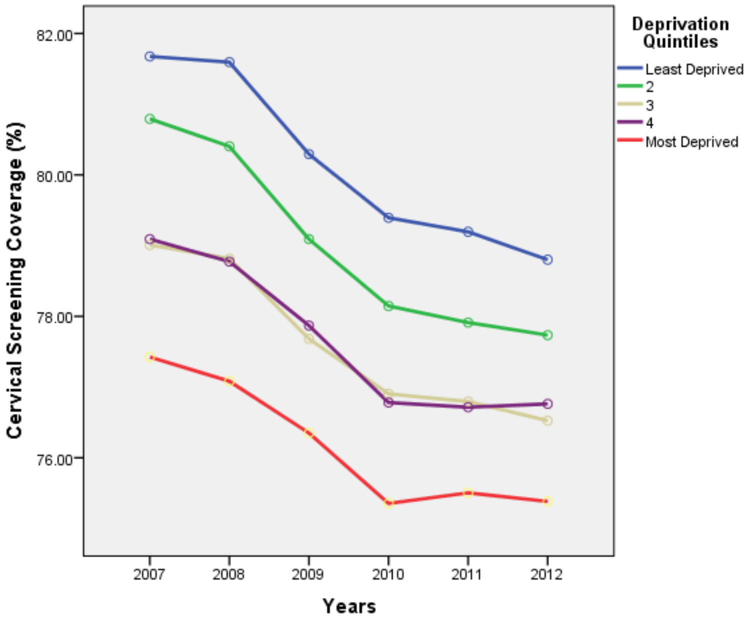
As in previous analyses, the assumption of sphericity was violated, as assessed by Mauchley's test of sphericity, χ^2 (14) = 407.13, $p < 0.001$, therefore a Greenhouse-Geisser correction was applied.

The main effect of deprivation showed there was a statistically significant difference in cervical screening coverage between deprivation quintiles F (4, 146) = 13.85, $p < 0.001$, partial η^2 = 0.275. Figure 13 illustrates that while the pattern of screening coverage is similar across all quintiles over the period, there are distinct differences in the levels of coverage between quintiles.

The main effect of time showed a statistically significant difference in cervical screening coverage across the years, F (2.68, 543.73) = 255.09, $p < 0.001$, η^2 = 0.636. Figure 13 reveals a relatively similar reduction in cervical screening coverage over the period across all quintiles.

There was no significant interaction between deprivation and time on cervical screening coverage for all women aged 50-64 years, F (10.74, 543.73) = 1.432, p = 0.158, partial η^2 = 0.038.

Figure 13. Cervical Screening Coverage by Deprivation Quintile - Older Women



Comparison of Cervical Screening Coverage in Younger and Older Women

There were significant differences in screening coverage across quintiles of deprivation in both younger and older women but there was no interaction between deprivation and time on cervical screening coverage over the period. However, the patterns of association between deprivation and coverage were markedly different. For younger women, cervical screening coverage showed evidence of the ‘Jade Goody effect’ with a peak in coverage in 2009, followed by a steady decline. For older women, cervical screening coverage has been in steady decline over the period.

4.4 Discussion

PCT-level income deprivation was found to be negatively associated with cervical screening coverage: all eligible women (25–64 years), younger women (25–49 years) and older women (50–64 years). However, different patterns and strength of association were evident in younger women in PCTs in England (excluding London) and London only PCTs. London only PCTs were also found to have different patterns and strength of association between deprivation and cervical screening coverage regardless of the age group of analysis (all eligible women, younger and older women).

The association between deprivation and cervical screening coverage was consistent across PCTs in England excluding London and in London only (and in England as a whole). There were significant changes to cervical screening coverage over the time period in England (excluding London) in a pattern that followed the 'Jade Goody' effect (Lancucki et al., 2012). Unfortunately, the significant increase in cervical screening coverage in 2008 and 2009 was followed by a subsequent downturn in cervical screening, such that there was no significant difference in cervical screening coverage at the end of the period when compared with coverage at the beginning of the period. Similar patterns were found across all quintiles of deprivation, consistent with the finding that there was no interaction between deprivation and time.

The association between cervical screening coverage and PCT-level income deprivation was different in London PCTs, where it was generally weaker and non-significant, regardless of age group under investigation. Overall, London PCTs appeared to be immune to the 'Jade Goody effect' with no significant changes in cervical screening coverage found at any point over the time period. Like PCTs in the rest of England, there were significant and consistent differences in screening coverage by quintiles of deprivation over the time period. However, the pattern of association between coverage and deprivation was quite different. In the rest of England the most deprived quintile of deprivation was shown to have visibly lower coverage than all other quintiles, while in London, quintiles 3, 4 and 5 were notably lower than the higher quintiles (Q1 and Q2). It may be that an area-level measure of deprivation is rendered insensitive in London because the affluent and the non-affluent often live close together. For example, affordable housing in new build homes and wealthy people buying council flats from tenants.

The cervical screening coverage gap was wider for younger women than older woman. In younger women it widened over the study period in PCTs in England (excluding London) whereas the coverage gap narrowed slightly in these areas for older women. The association between cervical screening coverage and deprivation was stronger in younger women than older women and displayed different patterns of association. In younger women, cervical screening coverage peaked around 2009-10 across all quintiles. While coverage was significantly higher in 2012-13 than at the start of the period (2007-08) the coverage gap between the least and most deprived had widened. For older women, there was a significant reduction in cervical screening coverage over the period in a pattern that is mirrored across quintiles of deprivation with no discernible difference in the cervical coverage gap. The pattern of change observed in younger women in this study was similar to that described as the 'Jade Goody effect' (Lancucki et al., 2012). Younger women and those from more deprived areas are considered to have been more influenced to attend cervical screening by the Jade Goody story and this may explain the different pattern of association between screening coverage and deprivation in younger versus older women (Marlow et al., 2012). These results support previous evidence discussed in Chapter 2 of the negative association between cervical screening coverage and income deprivation at area level (Baker and Middleton, 2003; Bang et al., 2012; O'Neill et al., 2009). They also add to these findings by indicating that, for young women at least, the trend in the cervical screening coverage gap is widening and that this should be highlighted as a cause for concern.

Government policy to reduce inequalities in cancer outcomes was in place throughout this period: The Cancer Plan from 2000 to 2011 (Department of Health, 2000) and since 2011 Improving Outcomes: Saving Lives (Dept of Health, 2011). However, the results in this study indicate that there has been no substantive change in the association between cervical screening coverage and deprivation from 2007 to 2012. However, the trend for the cervical screening coverage gap for younger women is widening albeit, not as yet to a statistically significant extent. Younger women, as has been shown earlier in this chapter, also have the lowest rates of coverage in the cervical screening programme. For London PCTs, there is a weaker association between cervical screening coverage and deprivation. London PCTs also have the lowest mean cervical screening coverage when compared with other areas, and this mean coverage is lowest of all for younger women living in London PCTs.

4.4.1 Strengths and Limitations

This study used area-level measures of socioeconomic status and this inherently limits the representation of individual-level SES. This may have been particularly problematic with respect to London PCTs, where heterogeneity in income may be evident within very small geographic areas. However, the income domain measure of PCT-level deprivation is aggregated from Lower Super Output Areas (LSOAs) and these may afford a better representation of individual-level deprivation in other parts of the country. The income domain of the IMD was chosen as the measure of deprivation, rather than the full IMD score that encompasses all seven domains of the IMD. It is acknowledged that the use of the income domain only is a weakness of the study as this fails to capture the other complex dimensions of socioeconomic deprivation. However, income is considered to be a central component to any consideration of deprivation because it is a key indicator of material deprivation (Noble et al., 2006). This is further explained in the words of Peter Townsend as follows:

> "*while people experiencing some forms of deprivation may not all have low income, people experiencing multiple or single but very severe forms of deprivation are in almost every instance likely to have very little income and little or no other resources*" (Townsend, 1987, p. 131)

As mentioned in Chapter 2, the inclusion of the health domain in the full IMD as a predictor of a health related outcome may be considered as a mathematical coupling of health related data (Adams and White, 2006) and the use of the income domain may offer policymakers a more direct measure upon which to focus policy change. That being said, sensitivity analyses using the full IMD were conducted to assess for potential differences when multiple domains of deprivation are considered. The results were similar to those using the income domain of IMD only and are reported in Appendix 2.

The use of area-level cervical screening coverage may also be a limitation because it cannot represent individual-level attendance. However, since these data are gathered through the quality assurance processes of the NHS Cervical Screening Programme they do represent an accurate measure of coverage across the country, albeit clustered into areas. Other methods of gathering individual level cervical screening attendance such as population-based surveys, have lower response rates, rely upon self-reported attendance, which may be subject to recall bias and may not provide insight into the geographical variation in cervical screening coverage.

This study has estimated the relationship between income deprivation and cervical screening coverage using a linear regression coefficient model. In that respect, the obtained coefficient values represent the absolute difference in screening coverage by deprivation group. The screening coverage gap has been calculated as the actual percentage difference in screening coverage in women living in the least and most deprived areas. Quintiles of the income domain were used in the study of socioeconomic variation in cervical screening coverage to specifically ascertain the aforementioned 'coverage gap'. This was inspired by, and hoped to have some synergy with, other studies that calculated a 'deprivation gap' in cervical cancer (Rachet et al., 2010; Shack, Jordan, Thomson, Mak, & Moller, 2008). Quintiles of deprivation (using individual domains of the IMD or the full IMD) are common in cancer screening literature, including socioeconomic variation in cervical screening (Sutton & Rutherford, 2005) and colorectal cancer screening (von Wagner et al., 2011).

This study focused on the simple association between cervical screening coverage and income deprivation and as such was unable to determine whether factors specific to the cervical screening programme may be hampering progress in reducing cervical screening inequalities. Further investigation of some of these factors was undertaken in Study 3.

This study's strengths were that it is the first study in many years to address the cervical screening coverage gap over a period of time. This has provided insight into the potential trends for socioeconomic inequalities in cervical screening coverage and indicates that further action needs to be taken to address this issue.

4.5 Conclusion

Socioeconomic inequalities in cervical screening coverage remain evident in the NHS Cervical Screening Programme in England, and show no signs of improvement. Longstanding availability of this screening programme and ongoing government commitment to improve cancer screening coverage in lower SES groups does not appear to have had any effect on inequalities in cervical screening coverage regardless of age or location.

Chapter 5: Socioeconomic Inequalities in Breast Screening Coverage (Study 2)[3]

5.1 Introduction

The preceding chapter provided evidence of the continued association between PCT-level socioeconomic deprivation and cervical screening coverage at PCT level in England. There was a significant increase in cervical screening coverage for younger women and a significant decrease in older women. However, there was no significant reduction in the association between cervical screening coverage and income deprivation for the cervical screening programme overall. The coverage gap did not narrow in any geographical area, or for younger or older women. The study was limited in its ability to infer if the continued inequalities in cervical screening coverage may be attributable to characteristics of the screening programme itself. One way of examining which factors may affect the association between screening coverage and deprivation at PCT level is to contrast these results with a similar study of breast screening coverage.

The NHS Breast Screening Programme (NHSBSP) has a number of similarities that make it a useful comparative screening programme. It was set up in the UK at the same time as the NHS Cervical Screening Programme which has enabled them to become culturally normative to a comparable extent. Women aged 47–73 years (recently extended from 50–70 years) are eligible for breast screening; an age-group that is broadly comparable with women eligible for 5-yearly cervical screening (50-64 years). A comparison of the association between deprivation and coverage in the NHSCSP and the NHSBSP has the potential to determine if programme characteristics may be associated with ongoing cervical screening coverage inequalities. This rationale is based upon the premise that if there is an association between screening coverage and PCT-level income deprivation and it is different across screening programmes, then we may be able to infer that this is due to the different characteristics of the respective screening programme. Following on from there, we may also infer that if the association between coverage and socioeconomic

[3] A version of this chapter has been published in the Journal of Medical Screening and is available in Appendix 1

deprivation is similar across screening programmes, then this may be due to an association with area- or population-level characteristics.

Similar to cervical screening, breast screening coverage is lower in general practices serving more deprived populations (Bang et al., 2012; O'Neill et al., 2009) and in women living in areas with higher levels of socioeconomic deprivation (Maheswaran et al., 2006). Individual level markers of socioeconomic status, such as car- and home-ownership, owner-occupied households and households with cars are significantly more likely to attend breast screening (Moser et al., 2009).

There are, however, some differences in the way in which the breast and screening programmes are organised. Women are routinely invited to breast cancer screening according to the general practice where they are registered and could be first invited to screening any time within three years of turning 50. Unlike cervical screening, breast cancer screening takes place in a breast screening unit located in a hospital clinic or mobile unit. Therefore, women do not attend their GP for breast screening. An invitation to breast screening will specify a date, time and location for the women to attend breast screening. Unlike cervical screening, this avoids placing the onus on the woman to schedule her own screening appointment. Albeit that a pre-defined breast screening appointment may not be suitable for a women and therefore does place some onus on her to reschedule to a more convenient time, or failing that, risk missed appointments.

The similarities across cervical and breast screening programmes make a comparison across programmes a useful means of exploring potential divergences in the association between coverage and income deprivation. The present study therefore examined associations between area-level deprivation and breast and cervical screening coverage in England from 2007 to 2012.

If the association between PCT-level deprivation and breast screening coverage in England differs from the cervical findings in Chapter 4, then we may infer that this could be due to differences in the characteristics or delivery of the screening programme. Conversely, if the association between PCT-level deprivation and breast screening coverage is similar to the findings for cervical screening coverage then we may infer that population characteristics, such as a being more engaged with health issues generally, probably explain the similarities across programmes.

Using breast screening coverage data, this study followed the same methods as described in the previous chapter, and compared results for cervical screening coverage in older women as they were eligible for both screening programmes.

5.2 Methods

5.2.1 Measures

PCT data on breast coverage for the period 2007–12, were downloaded from the Health and Social Care Information Centre (Health and Social Care Information Centre, 2013; Health & Social Care Information Centre, 2014b). Breast screening coverage data were for women aged 53–70 years. Breast screening coverage is defined as the percentage of eligible women who have had a test with a recorded result in the last three years (Health & Social Care Information Centre, 2014b).

5.2.2 Statistical Analysis

Data were analysed using SPSS statistical software, version 18.0 (*PASW Statistics for Windows*, 2009). Descriptive statistics were generated for PCT-level breast screening coverage for all eligible women. Analysis of the data for all eligible women in all PCTs in England was necessary to compare the results for the full cervical screening programme. Data were further grouped by geographical area: all PCTs in England (n = 151); PCTs in England excluding London (n = 120); and London PCTs only (n = 31).

To describe the relationship between breast and cervical screening coverage and deprivation the following models were fitted and are described below. The outcome measure was breast screening coverage (%).

1) A linear regression model was used to calculate what is termed as the 'coverage gap', deprivation was divided into quintiles of IMD score for each year. The 'coverage gap'

is the absolute difference in mean coverage between the least and most deprived quintiles.

2) A mixed ANOVA was used to determine if socioeconomic inequalities in breast screening coverage changed over time. This analysis was stratified by region (London versus the Rest of England) and age (younger versus older women). The analysis was then descriptively compared across the strata.

5.3 Results

5.3.1 Descriptive Statistics

Annual coverage figures for the two programmes from 2007 to 2012 are shown in Table 8. Across all PCTs in England, breast screening coverage was fairly stable at 74–75%, although the range shows that there was an improvement in the worst-performing PCTs, with the minimum coverage increasing from 42.3% in 2007/8 to 58.3% in 2012/13.

In PCTs excluding London, breast screening coverage was slightly higher than the national mean and fairly stable at 76–77%. Similarly the range indicates an improvement in the worst-performing PCTs, where the minimum coverage increased from 56.6% in 2007/8 to 64.5% in 2012/13.

In London PCTs, breast screening coverage was lower than in other areas and the mean varied from around 64% to 69%. The range highlighted an improvement in the worst-performing PCTs, where the minimum coverage increased from 42.3% in 2007/8 to 58.3% in 2012/13.

Table 5. Descriptive statistics for screening coverage in the breast and cervical screening programmes

	Breast screening programme (53–70 years)			Cervical screening programme (50–64 years)		
Year Commencing	Min–Max	Mean	SD	Min-Max	Mean	SD
England PCTs (n = 151)						
2007–08	42.3–83.5	73.8	8.2	68.6–85.6	79.6	2.8
2008–09	50.2–84.3	74.5	7.6	67.8–85.0	79.3	3.1
2009–10	56.9–84.7	75.2	6.3	68.5–84.4	78.3	2.8
2010–11	59.4–84.9	75.6	5.4	70.0–82.4	77.3	2.6
2011–12	59.1–84.4	75.5	5.2	69.1–82.0	77.2	2.5
2012–13	58.3–83.3	74.8	5.3	69.1–82.0	77.0	2.4
England, excluding London PCTs (n = 120)						
2007–08	56.6–83.5	76.6	4.9	73.4–85.6	80.2	2.4
2008–09	57.7–84.3	77.3	4.4	69.7–85.2	79.9	2.7
2009–10	62.9–84.7	77.5	3.9	72.1–84.4	78.7	2.4
2010–11	65.8–84.9	77.5	3.5	70.3–82.4	77.7	2.4
2011–12	64.3–84.4	77.3	3.6	70.1–82.0	77.6	2.3
2012–13	64.5–83.3	76.6	3.6	70.6–82.0	77.4	2.1
London PCTs (n = 31)						
2007–08	42.3–78.8	63.0	9.1	68.6–82.0	77.1	3.2
2008–09	50.2–78.9	64.0	8.2	67.8–83.1	77.2	3.6
2009–10	56.9–77.9	66.4	5.8	68.5–82.6	76.5	3.3
2010–11	59.4–78.5	68.2	4.9	70.0–81.3	75.7	2.6
2011–12	59.1–78.9	68.6	4.9	69.1–80.9	75.7	2.8
2012–13	58.3–77.9	68.0	5.2	69.1–80.4	75.6	2.7

Prior to applying further statistical tests the breast screening coverage data were tested for assumptions of normality. There were was one outlier in the data for 2007 but for no other year over the period. In 2012, for breast screening coverage in all women the z-score for kurtosis was 5.589 (standard error = 0.392) and the z-score for skewness of -7.598 (standard error = 0.197) indicating that the data were not normally distributed. For subsequent years, this was less pronounced, such that in 2009 the z-score for kurtosis was 0.961 (and therefore within the +- 2.58 range for normality). Similar patterns were evident for kurtosis in all subsequent years. In 2009, the z-score for skewness was -5.350, with similar results for subsequent years, which indicated that the data remained negatively skewed across the period. This is visually illustrated for breast screening coverage in the histogram and Q-Q Plots for 2009 (see Figure 14 and 15).

The data were initially transformed using the LG10 logarithmic function in SPSS as follows: LG10 ((Max Screening Coverage + 1) – Screening Coverage). A sensitivity analyses was then conducted by comparing the results of the analyses using the original breast screening data and the transformed screening data. There were no significant differences in the results therefore the analysis was conducted, and will be reported, using the original (untransformed) breast screening coverage data.

Figure 14. Histogram of Breast Screening Coverage in 2009 - England

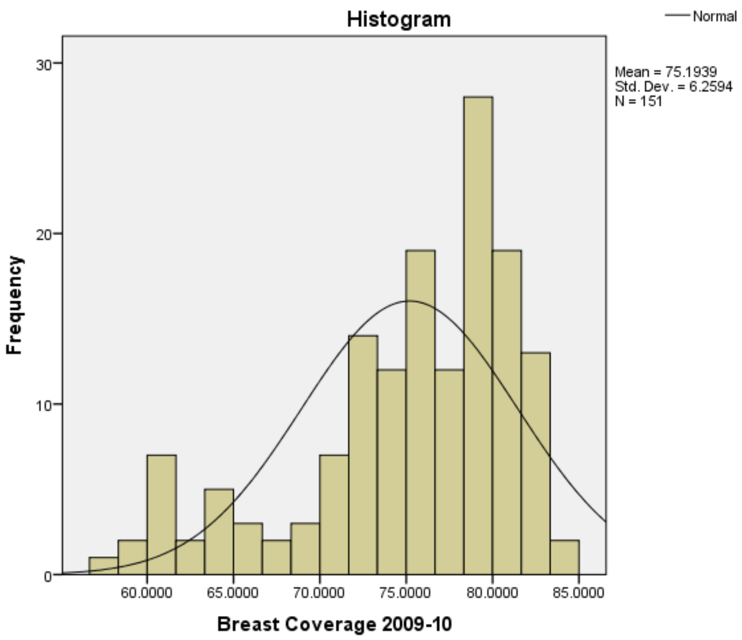
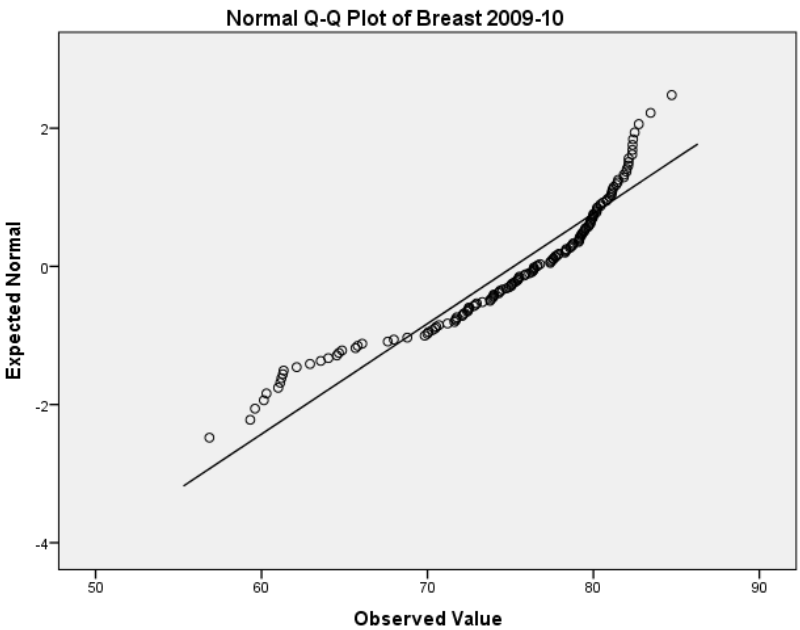


Figure 15. Q-Q Plot of Breast Screening Coverage in 2009 - England



5.3.2 Deprivation Quintiles and Breast Cancer Screening Coverage

In all England PCTs, the breast cancer screening coverage was lower in more deprived quintiles (see Table 6). In 2007, the breast screening coverage gap was 12.3% ($F(4, 146) = 13.987$, $p < 0.001$), and in subsequent years this narrowed, such that the coverage gap was 8.3% ($F(4, 146) = 16.933$, $p < 0.001$) in 2012.

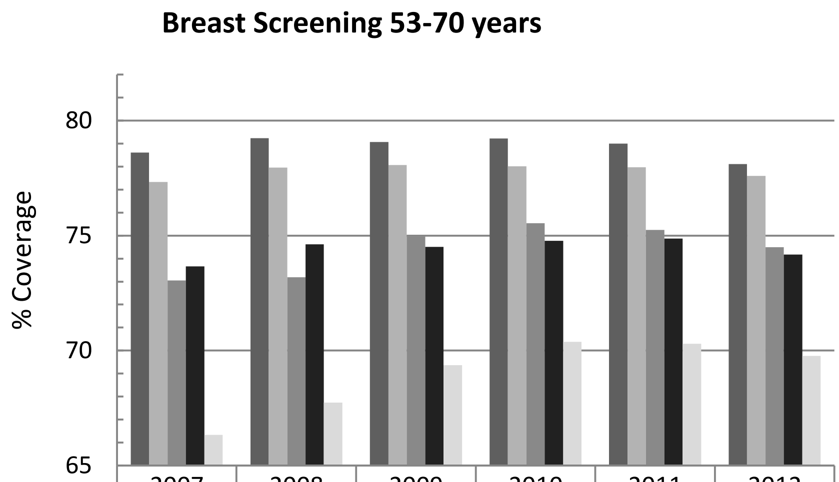
Table 6. All England: Breast and cervical screening coverage (Dep. Qs: Q1 – Low, Q5 – High)

Yr	Dep Qs	Breast screening coverage (53–70 years)					Cervical screening coverage (50–64 years)				
		B	95% CIs		SE	p	B	95% CIs		SE	p
			Lower	Upper				Lower	Upper		
07	Q1	78.61	76.07	81.14	1.28	-	81.68	80.79	82.56	0.49	-
	Q2	-1.27	-4.86	2.31	1.81	0.484	-0.88	-2.13	0.37	0.63	0.165
	Q3	-5.56	-9.12	-2.01	1.80	0.002*	-2.67	-3.91	-1.42	0.63	<0.001†
	Q4	-4.94	-8.53	-1.36	1.81	0.007*	-2.58	-3.83	-1.33	0.63	<0.001†
	Q5	-12.28	-15.86	-8.69	1.81	<0.001†	-4.25	-5.50	-3.00	0.63	<0.001†
08	Q1	79.24	76.89	81.60	1.19	-	81.59	80.61	82.58	0.50	-
	Q2	-1.28	-4.61	2.05	1.69	0.449	-1.19	-2.58	0.20	0.70	0.092
	Q3	-6.05	-9.36	-2.75	1.67	<0.001†	-2.78	-4.15	-1.40	0.70	<0.001†
	Q4	-4.62	-7.95	-1.26	1.68	0.007*	-2.82	-4.21	-1.43	0.70	<0.001†
	Q5	-11.51	-14.84	-8.18	1.69	<0.001†	-4.51	-5.90	-3.13	0.70	<0.001†
09	Q1	79.06	77.14	80.99	0.97	-	80.29	79.41	81.18	0.45	-
	Q2	-0.99	-3.71	1.73	1.38	0.472	-1.20	-2.45	0.05	0.63	0.059
	Q3	-4.10	-6.79	-1.40	1.37	0.003*	-2.61	-3.85	-1.37	0.63	<0.001†
	Q4	-4.55	-7.27	-1.83	1.38	0.001*	-2.42	-3.68	-1.17	0.63	<0.001†
	Q5	-9.70	-12.42	-6.98	1.38	<0.001†	-3.94	-5.20	-2.69	0.63	<0.001†
10	Q1	79.22	77.61	80.83	0.82	-	79.39	78.60	80.19	0.40	-
	Q2	-1.21	-3.49	1.07	1.15	0.296	-1.25	-2.37	-0.12	0.57	0.030*
	Q3	-3.68	-5.94	-1.42	1.14	0.002*	-2.49	-3.61	-1.38	0.56	<0.001†
	Q4	-4.45	-6.73	-2.17	1.15	<0.001†	-2.61	-3.74	-1.38	0.57	<0.001†
	Q5	-8.84	-11.12	-6.56	1.15	<0.001†	-4.04	-5.16	-2.92	0.57	<0.001†
11	Q1	78.99	77.45	80.54	0.78	-	79.20	78.40	79.99	0.40	-
	Q2	-1.03	-3.22	1.16	1.11	0.355	-1.28	-2.41	-0.16	0.57	0.026*
	Q3	-3.75	-5.93	-1.58	1.10	0.001*	-2.40	-3.52	-1.28	0.57	<0.001†
	Q4	-4.12	-6.31	-1.93	1.11	<0.001†	-2.48	-3.61	-1.35	0.57	<0.001†
	Q5	-8.70	-10.89	-6.51	1.11	<0.001†	-3.69	-4.82	-2.56	0.57	<0.001†
12	Q1	78.11	76.51	79.71	0.81	-	78.80	78.05	79.56	0.38	-
	Q2	-0.51	-2.78	1.75	1.15	0.655	-1.07	-2.14	0.01	0.54	0.051
	Q3	-3.62	-5.87	-1.38	1.14	0.002*	-2.28	-3.34	-1.22	0.54	<0.001†
	Q4	-3.93	-6.20	-1.67	1.15	0.001*	-2.04	-3.11	-0.97	0.54	<0.001†
	Q5	-8.34	-10.60	-6.07	1.15	<0.001†	-3.42	-4.49	-2.35	0.54	<0.001†

* $p < 0.01$, † $p < 0.001$

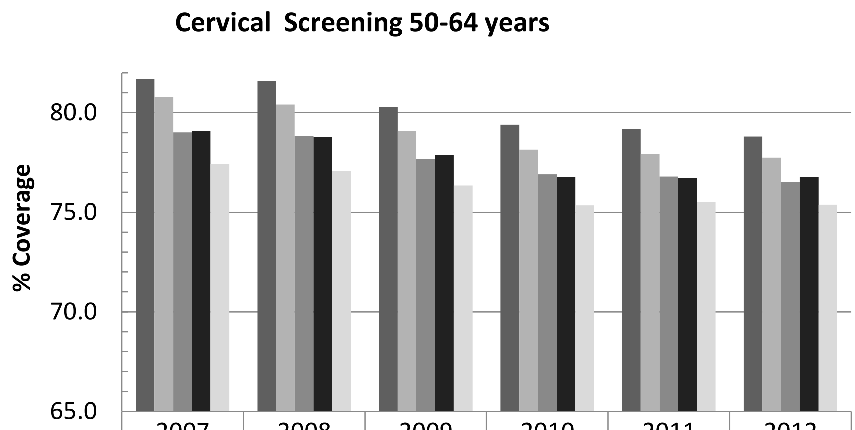
Figure 16 shows breast screening coverage by quintile of deprivation across the time period for all of England, and clearly illustrates the narrowing of the coverage gap between the most and least deprived quintiles. In contrast, there is little difference in the coverage gap for older women in cervical screening (see Figure 17) in the midst of a general reduction in cervical screening coverage across all quintiles.

Figure 16. Breast screening coverage by quintile of PCT-level deprivation 2007–12, mean coverage in table



	2007	2008	2009	2010	2011	2012
1 - Least Deprived	78.6	79.2	79.1	79.2	79.0	78.1
2	77.3	78.0	78.1	78.0	78.0	77.6
3	73.0	73.2	75.0	75.5	75.2	74.5
4	73.7	74.6	74.5	74.8	74.9	74.2
5 - Most Deprived	66.3	67.7	69.4	70.4	70.3	69.8

Figure 17. Cervical screening coverage by quintile of PCT-level deprivation, 2007–12



	2007	2008	2009	2010	2011	2012
1 - Least Deprived	81.7	81.6	80.3	79.4	79.2	78.8
2	80.8	80.4	79.1	78.1	77.9	77.7
3	79.0	78.8	77.7	76.9	76.8	76.5
4	79.1	78.8	77.9	76.8	76.7	76.8
5 - Most Deprived	77.4	77.1	76.3	75.4	75.5	75.4

For PCTs in England excluding London, the absolute difference in breast screening coverage between the least deprived (Q1) and most deprived (Q5) quintile was 8.3% ($F(4, 115) = 13.246$, $p < 0.001$) in 2007 and 7.6% ($F(4, 115) = 29.889$, $p < 0.001$) in 2012, which showed that there was little difference in the coverage gap between 2007 and 2012 (data not shown). However, linear regression models for each year showed that the more deprived quintiles (Q3, Q4 and Q5) had significantly lower coverage ($p < 0.01$ or $p < 0.001$) than the least deprived quintile.

For London PCTs (see Table 7), the association between cervical screening coverage and deprivation was quite different from PCTs in England excluding London. The difference in breast screening coverage between the least deprived (Q1) and most deprived (Q5) quintile was 12.5% ($F(4, 26) = 2.757$, $p=0.049$) in 2007 and 2.6% ($F(4, 26) = 1.360$, $p=2.75$) in 2012. The breast screening coverage gap was not statistically significant in any year.

Table 7. London only: Breast and cervical screening coverage and deprivation quintiles (Dep Qs)

Yr	Dep Qs	Breast screening coverage (53–70 years)					Cervical screening coverage (50–64 years)				
		B	95% CIs Lower	Upper	SE	p	B	95% CIs Lower	Upper	SE	p
07	Q1	70.98	59.02	82.93	5.82		79.58	74.80	84.35	2.32	
	Q2	0.53	-13.62	14.68	6.88	0.939	-1.05	-6.70	4.60	2.75	0.705
	Q3	-10.37	-24.18	3.44	6.72	0.135	-2.87	-8.38	2.65	2.68	0.295
	Q4	-7.40	-20.96	6.16	6.60	0.272	-3.35	-8.76	2.07	2.63	0.215
	Q5	-12.46	-25.46	0.54	6.32	0.060	-2.76	-7.95	2.43	2.53	0.284
08	Q1	71.47	60.95	81.99	5.12		79.16	73.79	84.52	2.61	
	Q2	0.59	-11.85	13.04	6.10	0.923	-0.61	-6.95	5.74	3.09	0.846
	Q3	-10.88	-23.03	1.27	5.91	0.077	-2.94	-9.13	3.25	3.01	0.338
	Q4	-7.10	-19.03	4.83	5.80	0.232	-2.84	-8.92	3.25	2.96	0.347
	Q5	-11.00	-22.43	0.44	5.56	0.059	-1.84	-7.68	3.99	2.84	0.521
09	Q1	72.13	64.61	79.65	3.66		78.37	73.36	83.37	2.44	
	Q2	0.08	-8.83	8.96	4.33	0.986	-1.25	-7.18	4.67	2.88	0.667
	Q3	-7.16	-15.84	1.53	4.23	0.102	-2.77	-8.55	3.01	2.81	0.333
	Q4	-7.59	-16.12	0.94	4.15	0.079	-2.32	-7.99	3.36	2.76	0.409
	Q5	-7.55	-15.73	0.62	3.98	0.069	-1.71	-7.15	3.73	2.65	0.523
10	Q1	72.11	65.64	78.57	3.15		77.03	73.11	80.96	1.91	
	Q2	0.60	-7.05	8.25	3.72	0.873	-0.34	-4.98	4.31	2.26	0.883
	Q3	-3.60	-11.06	3.87	3.63	0.331	-1.86	-6.39	2.67	2.21	0.407
	Q4	-6.37	-13.70	0.96	3.57	0.086	-1.87	-6.32	2.58	2.17	0.395
	Q5	-5.26	-12.19	1.77	3.42	0.136	-1.27	-5.53	3.00	2.08	0.548
11	Q1	72.52	65.89	79.16	3.23		77.11	72.96	81.25	2.02	
	Q2	0.19	-7.66	8.04	3.82	0.960	-0.91	-5.81	3.99	2.38	0.705
	Q3	-3.69	-11.35	3.97	3.73	0.331	-2.27	-7.05	2.51	2.33	0.338
	Q4	-6.34	-13.86	1.19	3.66	0.095	-2.34	-7.04	2.35	2.28	0.314
	Q5	-5.15	-12.36	2.07	3.51	0.154	-0.90	-5.4	3.60	2.19	0.685
12	Q1	69.97	62.65	77.30	3.56		76.30	72.25	80.35	1.97	
	Q2	2.16	-6.51	10.82	4.21	0.613	0.06	-4.73	4.85	2.33	0.980
	Q3	-2.43	-10.88	6.03	4.11	0.560	-2.03	-6.71	2.65	2.28	0.380
	Q4	-4.36	-12.66	3.94	4.04	0.290	-1.23	-5.82	3.37	2.24	0.588
	Q5	-2.57	-10.53	5.39	3.87	0.512	-0.03	-4.43	4.37	2.14	0.989

5.3.3 Socioeconomic Inequalities in breast screening and cervical screening in older women

Comparison of Breast Screening and Cervical Screening Programmes

Breast screening

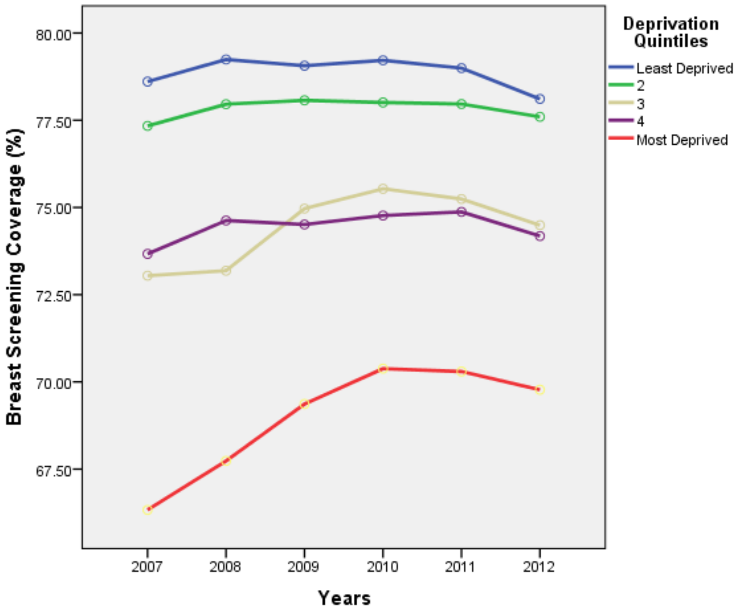
A mixed ANOVA was conducted to determine whether there were statistically significant differences in breast screening coverage from 2007 to 2012 in all PCTs in England. The assumption of sphericity was violated, as assessed by Mauchley's test of sphericity, χ^2 (14) = 603.56, $p < 0.001$, therefore a Greenhouse-Geisser correction was applied.

The main effect of deprivation showed there was a statistically significant difference in breast screening coverage between deprivation quintiles F (4, 146) = 17.77, $p < 0.001$, partial $\eta^2 = 0.327$. Breast screening coverage in the most deprived quintile (Q5) was visibly lower than all other quintiles, as illustrated in Figure 18.

The main effect of time showed a statistically significant difference in breast screening coverage across the years, F (2.17, 317.30) = 12.495, $p < 0.001$, $\eta^2 = 0.079$. Figure 18, demonstrates a sharp increase in breast screening coverage among women in the most deprived quintile. There is a similar, though less distinct, increase in coverage in quintile 3, but there was little change in breast screening coverage in all other quintiles.

There was a significant interaction between deprivation and time on breast screening coverage, F (8.69, 317.30) = 2.780, $p = 0.004$, partial $\eta^2 = 0.071$.

Figure 18. Breast Screening Coverage by Deprivation Quintile - England



Cervical screening coverage in older women

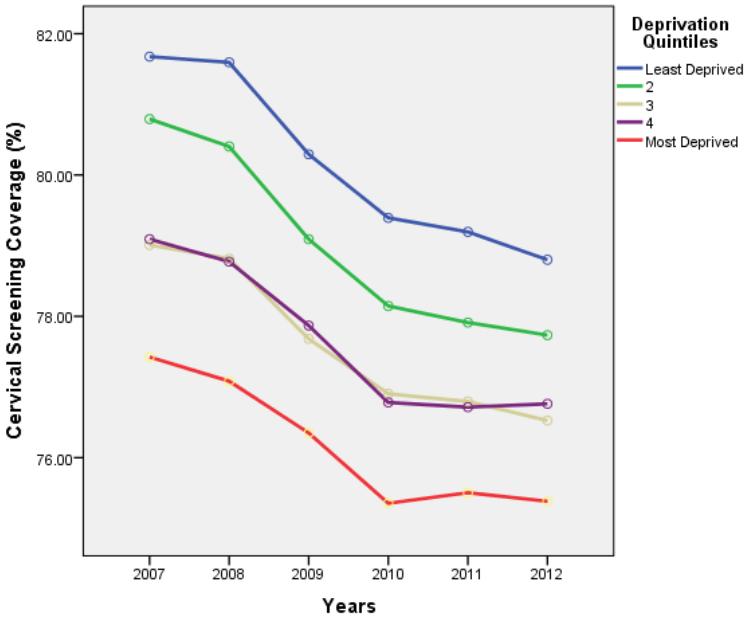
For ease of reference, the results for socioeconomic inequalities in cervical screening in older women are repeated here from the previous chapter. The assumption of sphericity was violated, as assessed by Mauchley's test of sphericity, χ^2 (14) = 407.13, $p < 0.001$, therefore a Greenhouse-Geisser correction was applied.

The main effect of deprivation showed there was a statistically significant difference in cervical screening coverage between deprivation quintiles F (4, 146) = 13.85, $p < 0.001$, partial η^2 = 0.275. Figure 19 illustrates that while the pattern of screening coverage is similar across all quintiles over the period, there are distinct differences in the levels of coverage between quintiles.

The main effect of time showed a statistically significant difference in cervical screening coverage across the years, F (2.68, 543.73) = 255.09, $p < 0.001$, η^2 = 0.636. Figure 19 reveals a relatively similar reduction in cervical screening coverage over the period across all quintiles.

There was no significant interaction between deprivation and time on cervical screening coverage for all women aged 50-64 years, $F(10.74, 543.73) = 1.432$, $p = 0.158$, partial $\eta^2 = 0.038$.

Figure 19. Cervical Screening Coverage by Deprivation Quintile - Older Women



Comparison of Breast Screening and Cervical Screening Programmes

There was significant variation in breast screening coverage across quintiles of deprivation with a significant interaction between deprivation and time driven by an increase in breast screening coverage among women in the most deprived quintile. This is in contrast to the significant reduction in cervical screening coverage across all quintiles of deprivation over the period and the lack of interaction between deprivation and time. However, cervical screening coverage remains higher than breast screening coverage overall.

Comparison of Breast Screening Coverage in Rest of England and London

Rest of England

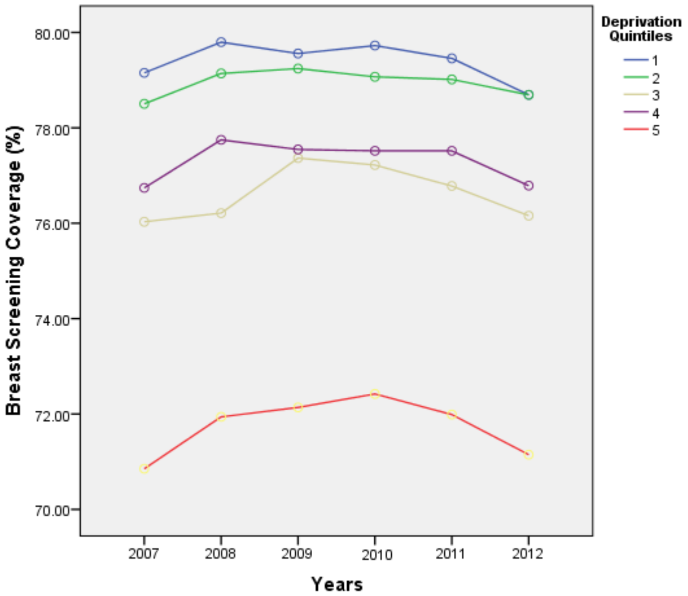
A mixed ANOVA was conducted as outlined previously for breast screening coverage in PCTs in England excluding London. The assumption of sphericity was violated, as assessed by Mauchley's test of sphericity, $\chi^2(14) = 311.24$, $p < 0.001$, therefore a Greenhouse-Geisser correction was applied.

The main effect of deprivation showed there was a statistically significant difference in breast screening coverage between deprivation quintiles $F(4, 115) = 26.36$, $p < 0.001$, partial $\eta^2 = 0.478$. Breast screening coverage in the most deprived quintile (Q5) is notably lower than in less deprived quintiles, see Figure 20.

The main effect of time showed a statistically significant difference in breast screening coverage across the years, $F(2.73, 314.08) = 7.06$, $p < 0.001$, $\eta^2 = 0.058$. This may be due to an increase in breast screening coverage in 2008 and 2009 (see Figure 20).

However, there was no significant interaction between deprivation and time on breast screening coverage, $F(10.92, 314.08) = 0.514$, $p = 0.892$, partial $\eta^2 = 0.018$.

Figure 20. Breast Screening Coverage by Deprivation Quintile - Rest of England



London

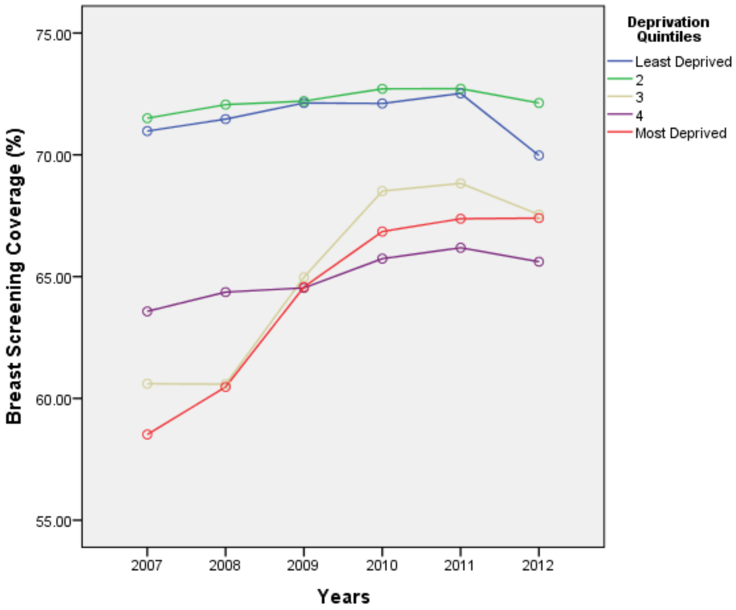
A mixed ANOVA was conducted as outlined previously for breast screening coverage in London. The assumption of sphericity was violated, as assessed by Mauchley's test of sphericity, $\chi^2(14) = 151.90$, $p < 0.001$, therefore a Greenhouse-Geisser correction was applied.

The main effect of deprivation showed there was a statistically significant difference in breast screening coverage between deprivation quintiles $F(4, 26) = 2.83$, $p < 0.045$, partial $\eta^2 = 0.303$. Breast screening coverage in the least deprived quintiles (Q1 and Q2) were relatively stable over the period (see Figure 21). The more deprived quintiles had lower coverage overall.

The main effect of time showed a statistically significant difference in breast screening coverage across the years, $F\ (1.72, 44.72) = 7.03$, $p < 0.003$, $\eta^2 = 0.213$. This may be reflected in the sharp increase in breast screening coverage in quintiles 3 and 5, in particular, over the period.

However, there was no significant interaction between deprivation and time on breast screening coverage, $F(6.88, 44.72) = 1.903$, $p = 0.093$, partial $\eta^2 = 0.226$.

Figure 21.Breast Screening Coverage by Deprivation Quintile – London



Comparison of Breast Screening Coverage in Rest of England and London

There was significant variation in breast screening coverage across quintiles of deprivation in PCTs in England (excluding London) and in London itself, but there was no interaction between deprivation and time on breast screening coverage over the period. There were differences in the patterns of breast screening coverage over the period in the two areas. Breast screening coverage increased in 2009 and 2010 in comparison with 2007 for PCTs in England (excluding London) and this pattern was broadly similar across all quintiles. However, the observed increase in breast coverage in London in 2011 appeared to be driven by improved coverage in deprivation quintiles 3 and 5, although there was no interaction between deprivation and time. Coverage in London was also strikingly lower than coverage in the rest of England.

5.4 Discussion

As expected, PCT-level income deprivation had a statistically significant negative association with coverage for breast screening. Over the period from 2007 to 2012, there was a significant reduction in the association between breast screening coverage and deprivation, as evidenced by the significant interaction between deprivation and time. The improvement in breast screening coverage in more deprived PCTs is clearly visible in Figures 16 and 18. There was a significant interaction between deprivation and time on breast screening coverage, largely driven by the improvement in breast screening coverage in the most deprived areas. The pattern of association between cervical screening coverage in women of comparable age and deprivation was quite different. For cervical screening coverage, there was a significant reduction in coverage across all socioeconomic groups over time. This trend is of concern because it indicates a steady decline in cervical screening in all older women with no indication of an improvement in the cervical screening coverage gap. Mean cervical screening coverage is, however, consistently higher overall than breast screening coverage and even with the observed improvements, the coverage gap remains greater for breast than cervical screening. For example, in 2012 the coverage gap was 8.3% for breast screening and 4.9% for cervical screening, suggesting there may have been more scope for change within the breast screening programme.

Breast coverage in London was much lower than in the rest of England, such that coverage in the least deprived quintiles of London was similar to coverage in the most deprived quintiles in the rest of England. Both areas did, however, increase coverage in the middle years of the period, although this appeared largely to have reached a plateau or to be in decline towards the end of the period, indicating that there may be no further improvements. Improvements in breast screening coverage were evident in the most deprived quintile in both London and the rest of England, hence the overall increase found for England as a whole.

We need to understand more about these screening coverage differentials, particularly since they are in women who are simultaneously eligible for both screening programmes.

The invitation process differs across programmes, such that, cervical screening requires the women to call her GP to arrange an appointment for screening in her local general practice. For breast screening, women received an invitation with a prescheduled appointment at a breast screening clinic, most likely in a local hospital or mobile breast screening unit. It may be that rescheduling an appointment for breast screening is more difficult than rearranging a cervical screening appointment at the GPs. If efforts to change prescheduled breast screening appointments were made easier in recent years then this might account for the some of the increase in breast screening coverage in lower SES women.

Mammography can be a painful experience for some women, and breast screening attendance is lower for women who experienced pain at a previous breast screening appointment (Whelehan et al., 2013). This may offer an explanation for lower coverage in breast screening, and arguably, could contribute to a socioeconomic variation in breast screening coverage in lower SES groups who are already reluctant to attend.

Women of lower SES have also been found to consider tests for breast cancer more embarrassing than higher SES women (Grunfeld et al., 2002). This would contribute to their lower attendance at breast screening overall. However, what is not clear, is whether efforts have been made by the NHS Breast Screening Programme to alleviate feelings of embarrassment regarding breast screening and that this may have contributed to the increase in breast screening coverage evidenced in recent years.

Despite these differences, an exploration of the barriers to screening attendance found that women expressed similar issues for both the cervical and breast screening programme, including not getting around to going or not liking the idea of the test (Lo et al., 2013). This suggests that there may be other reasons for the disparity across programmes. I considered that strategies to increase breast screening coverage in deprived areas of England may have been given greater emphasis in recent years or have been more successful. A multi-faceted approach to increase screening coverage, rather than a single best approach, is widely accepted (Weller and Campbell, 2009), although evaluation of these approaches is not widely undertaken.

It may be that lower SES groups have become more aware of breast cancer through the media. For example, the diagnosis and subsequent death of Jade Goody from cervical cancer has been discussed in relation to improvements in cervical screening in younger, more deprived women. Similarly, breast cancer was diagnosed in celebrities over the time period of the study. Kylie Minogue was diagnosed with breast cancer in 2005 and there was an increase in breast screening in the immediate aftermath of her diagnosis (Twine et al., 2006). Increased screening coverage has also been associated with the diagnosis of cancer in soap opera characters, including a storyline in Coronation Street (Richardson et al., 2002). A content analysis of newspaper coverage of four most common cancer types (breast, lung, prostate and bowel) in 2011-12 found that breast cancer received the highest coverage in its awareness month (Konfortion et al., 2014).

Breast cancer may also have a higher profile in the media through concerns about a family history of breast cancer and the availability of genetic testing. Online information seeking on breast cancer increased substantially in the immediate aftermath of the high profile prophylactic mastectomy by Angelina Jolie (Noar et al., 2015).

Women of lower SES are more likely to know of friends or family with a breast cancer diagnosis. For example, in 2011 there were 50,285 new cases and, in 2012, 11,716 deaths from breast cancer in the UK (Cancer Research UK, 2015b). There were 3,064 new cases and 919 deaths from cervical cancer in the UK over the same periods (Cancer Research UK, 2015c). Further, the incidence of breast cancer increases in older women and is therefore likely that women will become more aware of others with the disease as they themselves get older. Women with no family history of breast cancer have a lower perceived risk of breast cancer, and are associated with delay in help seeking for symptoms of cancer (Grunfeld et al., 2002). It may be that this personal knowledge of the impact of breast cancer in combination with the aforementioned media attention is driving an increase in breast screening coverage in lower SES women. However, it is acknowledged, that breast screening coverage is lower than cervical screening coverage overall.

Changes to the way in which the benefits and harms of screening are communicated to women in the leaflet accompanying their breast screening invitation were introduced in 2013. It is unclear how these may affect breast screening coverage (Forbes and Ramirez, 2014). However, given the time of their introduction this cannot explain the differences found over the period of this study.

The notably weaker association between both breast and cervical screening coverage and deprivation in London PCTs indicates that factors associated at this specific area-level, or city level, may be more pertinent. As discussed in the earlier chapter, there are a number of issues that may affect screening coverage in London. As suggested by Kinnear et al. organisational issues may be key to lower breast screening coverage in cities (Kinnear et al., 2011). However, this may affect cervical and breast screening coverage since being registered with a GP is essential for both programmes. For example, they may jointly be affected by the knock on effect of London's high population mobility on list inflation.

5.4.1 Strengths and Limitations

There were limitations to this study. This study focused on the simple association between breast screening coverage and income, and was therefore not able to take into account other factors that are known to affect screening coverage. These were addressed in the following study. Coverage data sourced from the NHS Health and Social Care Information Centre (NHSHSCIC) does not include any information about the demographic or socioeconomic characteristics of the women who attended, or did not attend, screening programmes. While national surveys or local area studies are able to provide individual socio-demographic and screening attendance data, these can be expensive, relate to smaller geographical areas and often rely on self-reported screening attendance. Area-based measures of deprivation are generally seen as a proxy for individual-level SES, with individual markers considered more accurate. However, in this study they were based on scores at Lower Super Output Areas (LSOA), which are relatively small, homogenised geographic units, and then weighted to PCT level, so should be fairly accurate. Nonetheless, associations might be stronger with individual-level measures.

There were limitations to the chosen analytical approach. These follow those outlined in Study 1, as both studies have used the same analytical approach.

As discussed in the previous chapter, it is acknowledged that the use of the income domain only is a weakness of the study as this fails to capture to other complex dimensions of socioeconomic deprivation. Sensitivity analyses using the full IMD was conducted to assess for potential differences when multiple domains of deprivation are considered. The results were similar to those using the income domain of IMD only and are reported in Appendix 4.

This study has estimated the relationship between income deprivation and breast screening coverage using a linear regression coefficient model to represent the absolute difference in screening coverage by deprivation group. The actual percentage difference in screening coverage in women living in the least and most deprived areas constitutes the screening coverage gap. This approach has been applied in other studies of deprivation and cancer (Rachet et al., 2010; Shack, Jordan, Thomson, Mak, & Moller, 2008) and cancer screening (Sutton and Rutherford, 2005; C von Wagner et al., 2011).

5.5 Conclusion

There was a significant reduction in the breast screening coverage gap but no improvement for the cervical screening coverage gap, although the magnitude of the inequality was consistently lower for cervical than breast screening. The differences across programmes suggest that characteristics in the delivery of the programme may be important explanatory factors.

Chapter 6: Cervical Screening Coverage: High- and Low-performing PCTs[4] (Study 3)

6.1 Introduction

Study 2 compared the coverage gap and patterns of association between deprivation and coverage over time in older women eligible for screening in the NHS Cervical Screening Programme with the same outcomes in the NHS Breast Screening Programme. Cervical screening coverage was higher than breast screening coverage overall. However, there was a significant decrease in cervical screening coverage in older women over the period. The pattern of association between cervical screening coverage and deprivation was such that, overall, there was no improvement in the cervical screening coverage gap in the NHS Cervical Screening Programme. However, there was a significant increase in breast screening coverage, particularly in women living in the most deprived areas. This led to a reduction in the coverage gap for the NHS Breast Screening Programme over the period. Why should coverage for older women, who are simultaneously eligible for both screening programmes, be different? One possibility is that programme-specific factors may contribute to the differences in coverage, and coverage gap, between the two screening programmes.

Studies 1 and 2 also revealed that the pattern of association between PCT-level deprivation and screening coverage was different for London PCTs compared with the rest of England: much weaker and often not statistically significant. There was no significant change in cervical screening coverage over the time period in London, while a 'Jade Goody effect' was apparent elsewhere. While there was some improvement in breast screening coverage in London, this was transient and there was no improvement in the coverage gap as was found for England. There may be a number of factors that account for this difference. Further exploration of the factors that may be affecting coverage within London PCTs would be beneficial.

[4] A version of this chapter has been published in BMJ Open and is available in Appendix 5.

In Study 1, there was also wide variation in cervical screening coverage across PCTs. It is evident that some PCTs perform better than others with respect to achieving the national target of 80% coverage. If we were able to identify PCTs that were exceptional in their screening performance, for example where PCTs achieve relatively high levels of coverage given their high levels of deprivation (or vice versa), then we may be able to learn more about the characteristics that support, or hinder, optimal cervical screening coverage.

This chapter (Study 3) identifies high- and low-performing PCTs which may assist with strategies to improve cervical screening coverage by highlighting which PCTs require most support and which could potentially be used as examples of best practice. This chapter further describes other characteristics of high- and low-performing PCTs. This may assist, in particular, with strategies to identify and support PCTs that are at risk of poor performance.

The factors of interest can be broadly categorised as population and programme-delivery level factors. The evidence from Study 1 found population-level factors (deprivation and age) were associated with coverage, and that the pattern of association was distinctly different for women living in London PCTs. Therefore this study sought to include measures of deprivation, age and for living in London PCTs. In the preceding chapter, inequalities in cervical screening coverage were found to be resilient to change, unlike breast screening coverage, over the same period. This indicated that programme-delivery-specific factors may require further investigation. For the NHSCSP, programme-delivery factors largely relate to general-practice characteristics since they require the necessary administrative systems and staff to support women to make appointments for screening and ultimately conduct the screening test (Crossley, 2011). In Chapter 1, additional population and programme-delivery level factors were found to be associated with cervical screening coverage. The rationale for which factors should be included in this study is presented in greater detail in the section below.

6.1.1 Factors Associated with Cervical Screening Coverage

In this section I discuss the rationale used for the inclusion of certain population and programme-delivery level factors known to be associated with cervical screening coverage.

Further details of the precise measures used and their source can be found in the Methods section.

Population-level characteristics

Deprivation

As discussed in the background literature in Chapter 1, income deprivation has been associated with lower cervical screening coverage at a variety of area-levels including health authorities (Baker and Middleton, 2003), PCTs (Bang et al., 2012) and general practice (Baker and Middleton, 2003); Bang et al., 2012). In the previous chapter we found income deprivation to be inversely associated with cervical screening coverage in PCTs across England. Therefore, there is strong evidence to support the inclusion of deprivation in the model.

Education

As discussed in the background literature in Chapter 1, level of education, including years in full-time education (Sutton and Rutherford, 2005), level of educational attainment (Moser et al., 2009), and adult learning (Sabates and Feinstein, 2006) has been associated with cervical screening attendance. In PCTs with lower population levels of education, it may be reasonable to expect that cervical screening coverage may be lower and that this should be accounted for.

Ethnicity

The National Statistics Omnibus Survey 2005-07 found attendance at cervical screening to be higher in white British women (Moser et al., 2009). The proportion of ethnic minority registered patients has also been negatively associated with cervical screening coverage at both PCT and general Practice level (Bang et al., 2012). However, it would be over-simplistic to assume that non-white populations are homogenous with respect to screening attendance, as there is distinct variation in cervical screening coverage between different ethnic populations (Webb et al., 2004). A population-based study utilising screening records from a Manchester Health Authority found non-attendance for cervical screening was greater in South Asian women and never having attended screening was significant for women who were born overseas (Webb et al., 2004). In PCTs with a higher proportion of non-white population it may be reasonable to expect that cervical screening coverage may be lower, but this may vary by ethnic group.

Urban versus Rural Areas

Cervical screening coverage has been found to vary according to the geographical area in which women live. Study 1 found lower cervical screening coverage, and a weaker association between screening coverage and deprivation, in London than other parts of England, and it may be that urbanisation could play a role in explaining these results. As previously mentioned, we found distinct patterns of association between deprivation and cervical screening coverage in London PCTs compared with the rest of England. As mentioned in Chapter 4, population mobility may play a role in the lower levels of cervical screening coverage found in London (Millett, 2009).

Access to health services have been found to differ across urban and rural areas (Jordan et al., 2004). Living in rural areas may require women to travel a relatively greater distance to attend a cervical screening appointment than in more urban areas. Distance from the place of screening has been associated with lower screening coverage (Maheswaran et al., 2006). Additionally, it may imply a prohibitive transport cost for lower SES groups. Therefore, consideration of where women live and the association of urbanisation and screening coverage may be important.

Age

In the previous study we found that cervical screening coverage has been lower in younger women since at least 2007. In fact, cervical screening coverage in England has been consistently lower among younger women, and in those aged 25-29 years in particular (Bang et al., 2012; Health and Social Care Information Centre, 2012a; Lancucki et al., 2010), for over a decade. In PCTs with a higher proportion of 25–29 year old women, it may be reasonable to expect that cervical screening coverage may be lower and that this should be accounted for.

Programme-Delivery Level Factors

General practices play a key role in the delivery of the Cervical Screening Programme (Health and Social Care Information Centre, 2013). A GP's capacity to effectively deliver the cervical screening programme may be affected by a number of different issues. Included in this analyses are factors related to the size of the Practice (number of registered patients), the general practice staffing (single-handed practices; practitioner headcount; number of full-time practice staff) and the ethnic characteristics of the general practitioner.

Practice List Size

The number of patients registered to general practices has been associated with non-attendance at cervical screening, where GPs with greater than 8000 registered patients had lower cervical screening attendance than practices with 4000 registered patients (Webb et al., 2004). Higher volumes of patients overall may affect the GP's capacity to offer cervical screening appointments and carry them out. This may also be influenced by the number of staff the general practice has available to support the screening programme. This may be particularly important in terms of supporting women to make appointments, send out reminders or proactively supporting women to attend. PCTs with a greater proportion of GPs with high practice lists may have lower cervical screening coverage.

Single-handed General Practices

Lower cervical screening attendance has been associated with single-handed general practices where GP staff numbers are lower (Webb et al., 2004), so this factor was included in the model.

Practitioner Headcount and Number of Full-time Practice Staff

A higher number of nurses per general practice has been associated with higher cervical screening coverage in deprived areas (Baker and Middleton, 2003). PCTs with more general practices with fewer practice staff may have lower cervical screening coverage.

Similarly, PCTs with a lower overall Practitioner headcount per 100,000 population may also have lower cervical screening coverage.

GPs Qualified Outside the UK

Women may be more likely to register with a GP of the same ethnic origin, for example, two-thirds of South Asian women in the West Midlands were found to be registered with a South Asian GP (Szczepura et al., 2008). South Asian women who are registered with a female South-Asian GP have higher cervical screening attendance when compared with South-Asian women registered with a non-South Asian female GP, or a male GP of either ethnic origin (Webb et al., 2004). Cervical screening attendance may be higher when patient and GP ethnicity is matched, so we may find higher levels of cervical screening coverage in these PCTs. It may then be pertinent to adjust for GP ethnicity. Unfortunately, obtaining GP ethnicity data is difficult and time-consuming (Szczepura et al., 2008). The percentage of general practitioners who obtained their qualifications outside UK (reported by ONS at PCT level) was considered as a proxy measure.

6.1.2 Aims of the Study

This aim of this study was to identify PCTs whose cervical screening coverage was better (or worse) than expected, after adjusting for their level of deprivation and other population and programme-delivery factors shown to be associated with cervical screening coverage. This may assist with strategies to improve cervical screening coverage by highlighting which PCTs require most support and which could potentially be used as examples of best practice

6.2 Methods

6.2.1 Measures

Coverage corresponds to the percentage of women actually screened among the women eligible for screening. For this study, the number of women screened and the number of eligible women in 2011–12, sourced from the Health & Social Care Information Centre (HSCIC).

Population Level Factors

Deprivation

Like Study 1, the income domain score from the Index of Multiple Deprivation (IMD) 2010 – a measure of the percentage of households on low income, benefits or other support was used as the measure of deprivation.

Education

Education data were sourced from the 2011 Census and downloaded from Nomis, the ONS web service (ONS, 2014a). The explanatory variable used was the percentage of the population without any higher education.

Ethnicity

Ethnicity data were sourced from the 2011 Census and downloaded from Nomis, the ONS web service (ONS, 2014b). Two explanatory variables were used: the percentage of Asian, Black, or Mixed ethnic minority groups, and the percentage of 'other ethnic' minority groups, which includes Asian and African Arabs and any 'other ethnic' minority groups (e.g. Polynesians, Melanesians and Micronesians).

Urbanisation versus Rural Areas

Two measures were used to assess patterns of urbanisation: the Urban-Rural Classification assessed PCT-level urbanisation across all PCTs and the London Strategic Health Authority (SHA) code was used to distinguish London PCTs. The Urban-Rural Classification of PCTs (post October 2006 boundaries) was obtained from the Association of Public Health Observatories website (APHO, 2008) and the explanatory variable used was the percentage urbanisation within each PCT.

Age

The percentage of general practice registered women aged 25–29 years old was retrieved from HSCIC (Health & Social Care Information Centre, 2010) to include in the model of cervical screening coverage in women aged 25–49 years old.

Programme-delivery Factors

PCT level data for the general practice characteristics described below were sourced from the HSCIC (Health & Social Care Information Centre, 2010).

Average Practice List Size

Average Practice List Size is the average number of patients registered at general practices in each PCT.

Single-handed General Practices

Single-handed general practices are the percentage of general practices in each PCT with only one working GP.

Practitioner Headcount

Practitioner Headcount is the number of all practitioners (excluding retainers and registrars) per 100,000 population per PCT.

Practice Staff FTE (full-time equivalent)

Practice Staff FTE (full-time equivalent) is the average number of practice staff who are neither general practitioners nor registrars at the general practice, including practice nurses and those involved in direct patient care (Health & Social Care Information Centre, 2012).

Practitioners Qualified outside the UK

Practitioners Qualified outside the UK is the percentage of General Medical Practitioners who attained their primary medical qualification outside the UK.

6.2.2 Statistical Analysis

Analysis was undertaken separately for cervical screening coverage in younger (25 to 49 years) and older (50 to 64 year) women. The statistical analyses to identify high- and low-performing PCTs were conducted by NM in R version 3.0.2.

Identify High- and Low-Performing PCTs

PCT-level coverage data (number of screened women; number of eligible women) were entered into a grouped logistic regression (Hilbe and Robinson, 2013). A generalised linear model with quasi-binomial error distribution was used to adjust for overdispersion (van Engelsdorp et al., 2013). This enabled the model to account for within-PCT extra-binomial variation. Continuous factors were mean centred and grouped into population and programme-delivery factors.

Univariate regression models for cervical screening coverage in younger and older women were fitted to consider which factors could be included in the full regression model. The criterion for inclusion was determined by Wald significance tests, p=0.01. Correlation was evaluated based on Pearson correlation coefficients. Differences in correlation coefficients between independent groups were assessed for significance by applying Fisher's z test on z-transformed correlations. Generalized variance-inflation factors for covariate coefficients (GVIF) were used to test for multicollinearity (Kabacoff, 2014). GVIF values of > 2 were taken as a general indication of multicollinearity.

Three regression models were then fitted to both cervical screening coverage in younger and older women data with i) population factors, ii) programme-delivery factors and iii) both population and programme-delivery factors. Factors which were significant at the 5% level in models i) and ii) were entered into the final model iii).

Funnel plots were constructed for the younger and older age groups using their respective cervical screening coverage, entered as a proportion of the number of women screened to the eligible population as the performance indicator (y-axis). The number of eligible women at PCT level was entered as the precision parameter (x-axis). The target value was equivalent to the mean national PCT coverage and 95% and 99.8% control limits were plotted around it.

The methodological approach adopted in this study was developed in conjunction with Dr Nathalie Massat[5].

6.3 Results

6.3.1 Descriptive Statistics

PCT-level data on cervical screening coverage for younger and older women are summarized in Table 9 for all PCTs in England and for PCTs in London only. Between-PCT variability in coverage was more pronounced in younger women (median 74.6, IQR 5.9) than in older women (median 77.5, IQR 3.5, Table 8). As expected, from our previous study, cervical screening coverage was lower in younger women than older women, and lower in London overall.

[5] Dr Nathalie Massat (NM), Senior Statistician at the Wolfson Institute of Preventive Medicine, Queen Mary University of London agreed to collaborate with me on seeking a suitable statistical method for identifying the high- and low-performing PCTs. I was fully involved in this process. I guided the research to meet my initial research question, and identified and sourced the data for analyses of the factors associated with cervical screening coverage.

Table 8. Descriptive statistics for PCT-level characteristics in England in 2011 (N = 151)

	Min–Max	Mean (SD)	Median (IQR)
Cervical Screening Coverage (%)			
Younger women (25–49 years)			
England (151 PCTs)	58.7 - 80.4	73.4 (4.4)	74.6 (5.9)
London (30 PCTs)	58.7 - 77.7	67.8 (4.6)	67.8 (5.7)
Older women (50-64 years)			
England	69.1 - 82.0	77.2 (2.5)	77.5 (3.5)
London	69.1 - 80.9	75.7 (2.8)	75.6 (3.1)
Population factors (PCT level)			
% Deprivation	6.8 - 33.8	16.2 (5.8)	15.3 (8.4)
% Without higher education	10.1 - 35.2	23.0 (5.1)	23.0 (6.8)
% Asian, Black, or Mixed ethnicity	1.3 - 67.6	15.1 (15.4)	8.9 (20.5)
% 'Other ethnic' minority	0.1 - 11.1	1.2 (1.6)	0.6 (1.3)
% Urbanisation	31.0 - 100.0	81.2 (21.5)	91.0 (35.03)
% Registered women aged 25-29	12.2 - 32.2	19.5 (4.2)	18.3 (5.2)
Programme-delivery factors (PCT level)			
Average practice list size	4026.4 - 9566.2	6656.2 (1371.2)	6537.1 (2236.0)
% Single-handed practices	0.0 - 41.0	13.45 (10.2)	11.0 (16.0)
Practitioner headcount per 10^5 population	50.9 - 95.3	68.7 (8.3)	67.7 (10.8)
Practice staff FTE	146.3 - 1884.2	513.7 (296.7)	424.0 (283.7)
% Practitioners qualified outside UK	3.0 - 70.0	26.4 (14.7)	25.0 (19.2)

FTE, Full-Time Equivalent; IQR: Inter Quartile Range; SD, Standard Deviation; SHA, Strategic Health Authority

Differences in correlation coefficients between independent groups were assessed for significance by applying Fisher's z test on z-transformed correlations (see Table 8).

Table 9. Correlations between population and general practice factors, and screening coverage, correlation coefficients, p-value

	% Urbani-zation	% Deprivation	% Asian, Black & Mixed ethnicity	% Other ethnicity	% No higher education	% Registered women aged 25-29	Average practice list size	% Single-handed practices	Practitioner headcount per 10^5 pop.	Practice staff FTE	% Practitioners qualified outside UK	Cervical 25-49
Population factors												
% Urbanization	-											
% Deprivation	.61,<.001	-										
% Asian, Black & Mixed ethnicity	.56,<.001	0.58,<.001	-									
% Other ethnicity	.48,<.001	0.39,<.001	.70,<.001	-								
% No higher education	-.002, .9	0.41,<.001	-.27, .001	-0.45,<.001	-							
% Registered women aged 25-29	.63,<.001	0.64,<.001	.62,<.001	0.60,<.001	-.11, 0.2	-						
General practice factors												
Average practice list size	-.50,<.001	-0.58,<.001	-.35,<.001	-0.40,<.001	-.26, .001	-.33,<.001	-					
% Single-handed practices	.49,<.001	0.46,<.001	.39,<.001	0.38,<.001	.21, .01	.30,<.001	-.75 <.001	-				
Practitioners headcount per 10^5 population	.02, .8	0.23,.006	.14, .1	0.14, .08†	-.25, .002	.26, .001	.06, .5†	-.35,<.001	-			
Practice staff FTE	-.51,<.001	-0.36,<.001	-.25, .002	-0.25, .002	-.04, .7	-.24,.004	.36 <.001	-.27, .001	.06, .4†	-		
% Practitioners qualified out UK	.42,<.001	0.54,<.001	.43,<.001	0.22, .006	.37, <.001	.21,.009	-.52 <.001	.61,<.001	-.35,<.001	-.36,<.001	-	
Screening coverage												
Cervical 25-49	-.60,<.001	-0.56,<.001	-.78,<.001	-0.78,<.001	.31, <.001	-.71,<.001	.42,<.001	-.41,<.001	-.19, .02	.34,<.001	-.29,<.001	-
Cervical 50-64	-.49,<.001	-0.47,<.001	-.24, .004	-0.45,<.001	.02, .8†	-.43,<.001	.39,<.001	-.28,<.001	-.14, .09	.37 <.001	-.18, .03	.68,<.001

FTE: Full Time Equivalent, † Not significant at 5% level

6.3.2 Factors Associated with Cervical Screening Coverage

Cervical Screening Coverage in Younger Women (25–49 years)

In univariate analyses, all of the population and programme delivery factors were significantly associated with cervical screening coverage in younger women (see Table 10). The population factors generally explained more of the deviance in the model than programme-delivery factors. When the population factors were ordered by those that explained the greatest deviance in the model, the ethnicity factors each explained 63% of the deviance, the percentage of younger women aged 25–29 years living in the PCT explained 53%, living in London and urbanisation explained 46% and 42% respectively, deprivation explained 41% and the percentage of women without higher education explained 7.3% of the deviance. For the programme-delivery factors, average practice list size and the number of full-time general practice staff each explained around 23% of the deviance, the percentage of single-handed practices explained 21%, the percentage of practitioners qualified outside the UK explained 14%, and finally the practitioner headcount per 100,000 population explained 7% of the deviance.

When the population factors were fitted into the model they collectively explained 79.5% of the deviance. Deprivation, the percentage of Asian, Black, Mixed and Other Ethnic groups and the percentage of women aged 25–29 years were negatively associated with cervical screening coverage in younger women. The percentage of women without higher education was associated with *higher* cervical screening coverage, but this was not statistically significant in the multivariate model. Living in more urban areas and living in a London PCT were negatively associated with cervical screening coverage, but these were no longer statistically significant.

When the programme-delivery factors were fitted into the model they collectively explained 46.4% of the deviance. The percentage of single-handed practices and practitioner headcount were negatively associated with cervical screening coverage and the number of full-time general practice staff was positively associated with cervical screening coverage in younger women. Average practice list size and the percentage of practitioners qualified outside the UK were no longer statistically significant.

When the remaining population and programme-delivery factors were fitted to the model they collectively explained 80.9% of the deviance (see Table 10). This was just 1.4% greater than the deviance explained by the population factors alone. Deprivation displayed some collinearity with other factors and was no longer statistically significant. Asian, Black and Mixed ethnicity, 'other ethnic' minority and the percentage of women aged 25–29 years were negatively associated with cervical screening coverage in younger women. The percentage of single-handed practices and practitioner headcount were no longer significantly associated with cervical screening coverage, however, the number of full-time general practice staff was positively associated with cervical screening coverage.

Table 10. Regression Modelling for Cervical Screening Coverage in Younger Women (25–49 years)

Model	Univariate			Population		Programme Delivery		Pop. & Prog. Delivery	
Population factors	OR (95% CI)	p-value (Wald, χ2)	Deviance explained	OR (95% CI)	p-value (Wald, χ2)	OR (95% CI)	p-value (Wald, χ2)	OR (95% CI)	p-value (Wald, χ2)
% Deprivation	0.98 (0.97–0.98)	<0.001	41.1%	0.99 (0.98–0.99)	0.03	–		1.00 (0.99–1.01)	0.52[$]
% Without higher education	1.01 (1.01–1.02)	0.001	7.3%	1.01 (1.00–1.01)	0.06	–		–	
% Asian, Black and Mixed ethnicity	0.99 (0.99–0.99)†	<0.001	63.3%	0.99 (0.99–0.99)†	0.004	–		0.99 (0.99–0.99)†	< 0.001
% 'Other ethnic' minority	0.90 (0.89–0.91)	<0.001	62.4%	0.96 (0.95–0.98)	<0.001	–		0.96 (0.94–0.97)	< 0.001
% Urbanization	0.99 (0.99–0.99)†	<0.001	41.9%	0.99 (0.99–1.00)	0.3	–		–	
London SHA	0.70 (0.65–0.74)	<0.001	46.2%	0.97 (0.90–1.05)	0.5	–		–	
% Registered women aged 25–29	0.97 (0.96–0.97)	<0.001	52.9%	0.99 (0.98–0.99)	0.002	–		0.98 (0.98–0.99)	<0.001
Programme delivery factors									
Average practice list size	1.00 (1.00–1.00)†	<0.001	23.3%	–		0.99 (0.99–1.00)	0.6	–	
% Single-handed practices	0.990 (0.98–0.99)	<0.001	20.6%	–		0.99 (0.98–0.99)	<0.001	0.99 (0.99–1.00)	0.06
Practitioners headcount per 10^5 population	0.99 (0.99–0.99)†	0.001	6.5%	–		0.99 (0.98-0.99)	<0.001	0.99 (0.99–-1.00)	0.06
Practice staff FTE	1.00 (1.00–1.00)†	<0.001	22.8%	–		1.00 (1.00–1.00)†	<0.001	1.00 (1.00–1.00)†	0.01
% Practitioners qualified outside UK	0.99 (0.99–0.99)†	<0.001	13.7%	–		0.99 (0.99–1.00)	0.2	–	
Deviance acc'td for by model				79.5%		46.4%		80.9%	

† CI range discernible at > 2 decimal places, CI: Confidence Interval; FTE: Full-Time Equivalent; SHA: Strategic Health Authority.

[$] The variance of the coefficient estimate is being inflated by multicollinearity with other factors (√GVIF = 2.8)

Cervical Screening Coverage in Older Women (50–64 years)

In univariate analyses, all of the population factors, with the exception of the percentage of women without higher education, and all of the programme delivery factors, with the exception of the practitioner headcount per 100,000 population, were significantly associated with cervical screening coverage in older women (see Table 11). When the population factors were ordered by those that explained the greatest deviance in the model, deprivation explained 31% of the deviance, urbanisation explained 26% of the deviance, the percentage of women aged 25–29 years explained 24% of the deviance, 'other ethnic' minority explained 20%, living in London and Asian, Black and Mixed ethnicity explained 11 and 10% respectively, and, finally, the percentage of women without higher education explained just 1% (and was not statistically significant) of the deviance in the model. For the programme delivery factors, average practice list size and the number of full-time general practice staff each explained around 20% of the deviance, the percentage of single-handed practices explained 13% of the deviance, the percentage of practitioners qualified outside the UK explained 8%, and, finally, the practitioner headcount per 100,000 population explained just 1% (and was not statistically significant) of the deviance in the model.

When all of the population factors were fitted into the model they collectively explained 44.6% of the deviance. Deprivation, 'other ethnic' minority and urbanisation were negatively associated with cervical screening coverage in older women and the percentage of Asian, Black or Mixed ethnicity was positively associated with coverage. Living in London and a percentage of women aged 25–29 years were no longer statistically significant.

When the programme-delivery factors were fitted into the model they collectively explained 26.7% of the deviance. Average practice list size and number of full-time General Practice staff were positively associated with cervical screening coverage. The percentage of single-handed practices and percentage of practitioners qualified outside the UK were no longer statistically significant.

When the remaining population and programme-delivery factors were fitted into the model they collectively explained 45.3% of the deviance. This was just 0.7% greater than the deviance explained by the population factors alone. Deprivation, 'other ethnic' minority and urbanisation were negatively associated with cervical screening coverage in older women, and Asian, Black and Mixed ethnicity was positively associated with coverage. Of the two remaining programme delivery factors, only the number of full-time General Practice staff was significantly associated with cervical screening coverage in older women.

Table 11. Regression Modelling for Cervical Screening Coverage in Older Women (50-64 years)

Model	Univariate			Population		Programme Delivery		Pop. & Prog. Delivery	
Population factors	OR (95% CI)	p-value (Wald, χ2)	Deviance explained	OR (95% CI)	p-value (Wald, χ2)	OR (95% CI)	p-value (Wald, χ2)	OR (95% CI)	p-value (Wald, χ2)
% Deprivation	0.99 (0.98–0.99)	<0.001	31.1%	0.99 (0.99–0.99)†	<0.001	–		0.99 (0.98-0.99)	<0.001
% No higher education	0.99 (0.99–1.00)	0.3	0.9%	–		–		–	
% Asian, Black and Mixed ethnicity	0.99 (0.99–0.99)†	<0.001	9.9%	1.01 (1.00–1.01)	<0.001	–		1.00 (1.00-1.01)	<0.001
% 'Other ethnic' minority	0.96 (0.95–0.97)	<0.001	19.6%	0.97 (0.95–0.99)	0.01	–		0.96 (0.95-0.98)	<0.001
% Urbanisation	0.99 (0.99–0.99)†	<0.001	25.5%	0.99 (0.99–0.99)†	0.01	–		0.99 (0.99–0.99)†	0.02
London SHA (Q36)	0.89 (0.84–0.94)	<0.001	10.6%	0.93 (0.87–1.00)	0.06	–		–	
% Registered women aged 25–29	0.98 (0.98–0.98)†	<0.001	23.5%	0.99 (0.99–1.00)	0.3	–		–	
Programme delivery factors									
Average practice list size	1.00 (1.00–1.01)†	<0.001	20.2%	–		1.00 (1.00–1.00)†	0.02	0.99 (0.99–1.00)	0.62
% Single-handed practices	0.99 (0.99–0.99)†	<0.001	13.1%	–		0.99 (0.99–1.00)	0.4	–	
Practitioner headcount per 10^5 population	0.99 (0.99–1.00)	0.2	1.2%	–		–		–	
Practice staff FTE	1.00 (1.00–1.00)†	<0.001	19.5%	–		1.00 (1.00–1.00)†	<0.001	1.00 (1.00–1.00)†	0.03
% Practitioners qualified outside UK	0.99 (0.99-0.99) †	<0.001	7.8%	–		1.00 (0.99–1.00)	0.5	–	
Deviance explained				44.6%		26.7%		45.3%	

† CI range discernible at > 2 decimal places, CI, Confidence Interval; FTE, Full-Time Equivalent; SHA, Strategic Health Authority

Comparison of the Association between Population and Programme-Delivery Factors with Cervical Screening Coverage across Both Age Groups

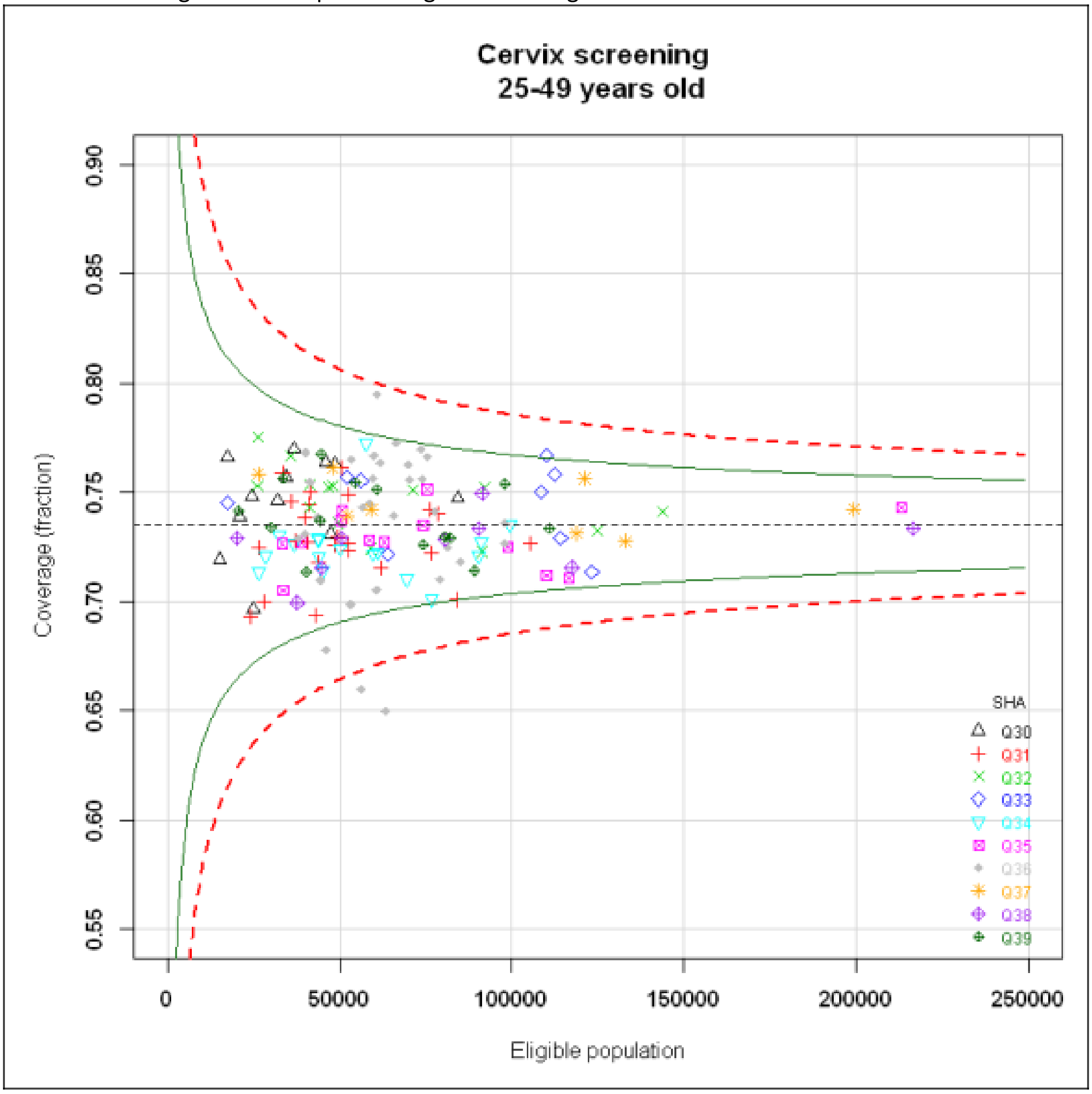
Population factors explained more of the deviance in cervical screening coverage in younger women (81%) and older women (45%) than programme-delivery factors for younger (46%) and older women (27%). However, both population and programme delivery factors explained more of the deviance in cervical screening coverage in younger women (81% and 46%, respectively) than for cervical screening coverage in older women (45% and 27%, respectively).

For younger women, Asian, Black and Mixed ethnicity, 'other ethnic' minority, the percentage of women aged 25–29 years remained negatively associated with cervical screening coverage and the number of full-time General Practice staff remained positively associated with cervical screening overage, when both population and programme-delivery factors were entered in the model. While for older women, deprivation, 'other ethnic' minority and urbanisation remained negatively associated with cervical screening coverage and the percentage of Asian, Black or Mixed ethnicity and the number of practice staff was positively associated with cervical screening coverage, when both population and programme delivery factors were entered into the model.

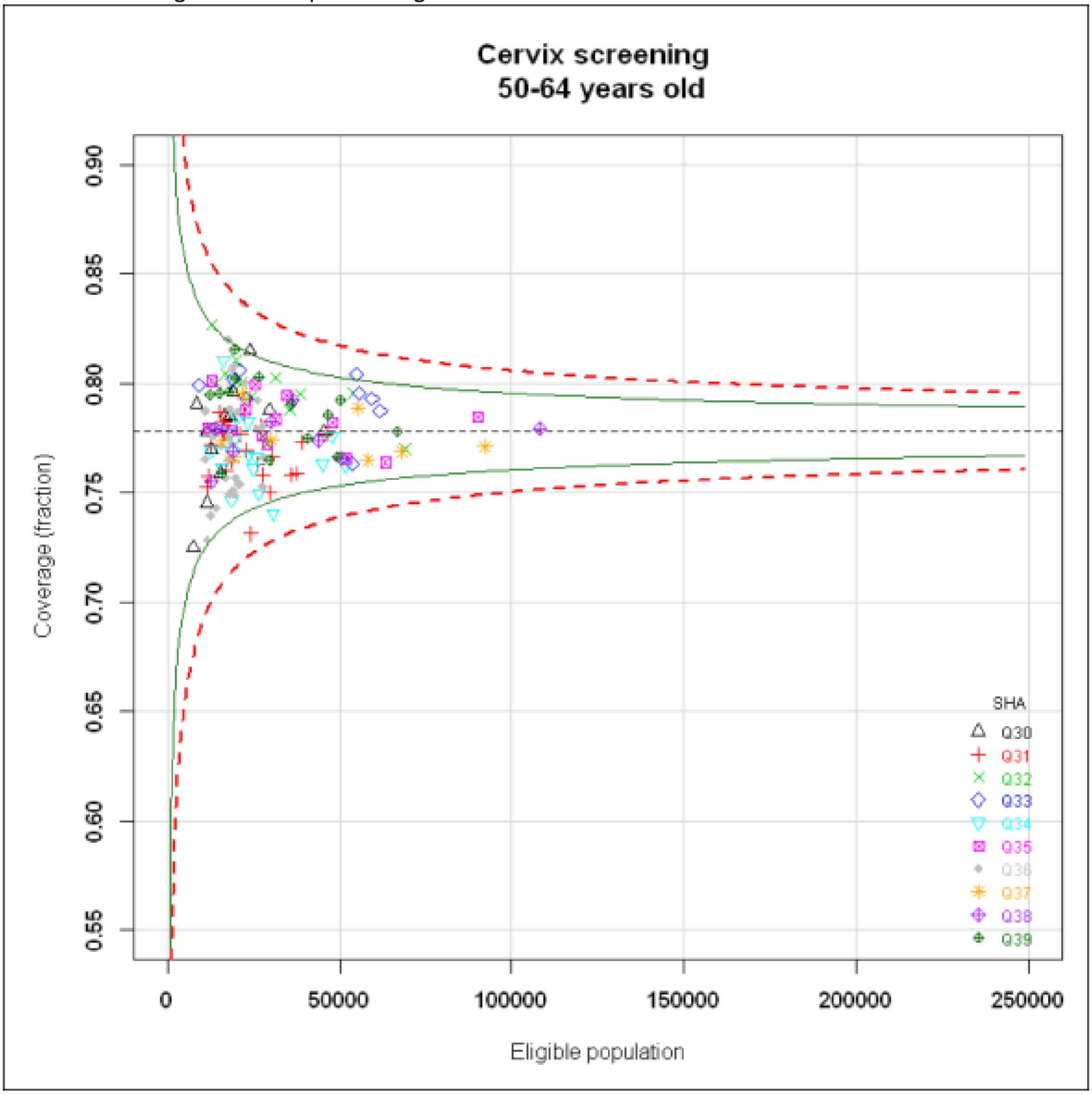
6.3.3 Identification of High- and Low-Performing PCTs

Funnel plots identified two high-performing PCTs and three low-performing PCTs for cervical screening coverage in younger women (see Funnel Plot 1) and five high-performing PCTs and two low-performing PCTs for cervical screening coverage in older women (see Funnel Plot 2). Characteristics of the high and low performing PCTs can be found in Appendix 6.

Funnel Plot 1. High- and Low-performing PCTs - Younger women



Funnel Plot 2. High- and Low-performing PCTs - Older women



<u>High- and Low-Performing PCTs for Younger Women</u>

When cervical screening coverage in younger women was adjusted for population and programme-delivery factors there were two PCTs that fell above the 95% control limits but none above the 99.8% limits. These high-performing PCTs were identified as Enfield PCT and Nottinghamshire County Teaching PCT.

When cervical screening coverage in younger women was adjusted for population and programme-delivery factors there was one PCT that fell below the 95% control limits and two below the 99.8% limits. These low-performing PCTs were identified as Harrow PCT, Hammersmith & Fulham PCT and Camden PCT and are all based in London.

<u>High- and Low-Performing PCTs for Older Women</u>

For cervical screening coverage in older women five high-performing PCTs were identified overall, after adjusting for population and programme-delivery factors. All of these PCTs fell above the 95% control limits, but none fell above the 99.8% control limits. These high-performing PCTs were identified as Enfield PCT and Nottinghamshire County Teaching PCT, North East Lincolnshire Care Trust, Waltham Forest and Sunderland Teaching PCT.

For cervical screening coverage in older women two low-performing PCTs were identified after adjusting for population and programme-delivery factors. Both PCTs fell between the 95% and 99.8% control limits. The low-performing PCTs were identified as Sefton and Birmingham East & North.

6.4 Discussion

The combination of risk adjustment modelling and funnel plots enabled the identification of PCTs that performed exceptionally well, or poorly, for cervical screening coverage after accounting for population and programme delivery factors known to affect coverage.

Two high-performing PCTs, Enfield and Nottinghamshire County Teaching Hospital PCTs, were identified in younger women. In older women, Enfield PCT and Nottinghamshire County Teaching PCT were also identified as high-performing PCTs, alongside North East Lincolnshire Care Trust, Waltham Forest and Sunderland Teaching PCT. This indicates that Enfield and Nottinghamshire are performing well for cervical screening coverage across both age groups. Further investigation of these PCTs may provide information about why they perform so well across both age groups.

Three low-performing PCTs, Harrow, Hammersmith & Fulham and Camden, were identified for in younger women, and two low-performing PCTs, Sefton and Birmingham East & North, were identified in older women. No PCTs were identified as poor performers in both the younger and older age groups. It may be that these PCTs require further support to improve their cervical screening coverage locally.

Risk adjustment modelling found population factors, rather than programme-delivery factors, were of particular importance for PCT coverage levels in both younger and older age groups. Although, it is also fair to say that both population and programme-delivery factors explained more of the deviance in cervical screening coverage in younger women, than for older women. For younger women, a higher percentage of Asian, Black and Mixed ethnic populations and 'other ethnic' minority populations, and a higher percentage of women aged 25–29 years were associated with poorer coverage after adjusting for both population and programme delivery factors. For older women, deprivation, proportion of people from 'other ethnic' minority populations and urbanisation were associated with poorer cervical screening coverage and Asian, Black and Mixed ethnic populations were associated higher cervical screening coverage, after adjusting for population and programme delivery factors.

Overall, these findings indicate that deprivation is negatively associated with cervical screening coverage. This supports previous findings for an association between cervical screening coverage and deprivation in England at PCT level (Bang et al., 2012). For younger women, the association between screening coverage and deprivation was significant when only the population factors were entered into the model. The difference between the two models may be explained by the significant, positive association between cervical screening coverage in younger women and the number of full-time general practice staff when programme delivery factors are entered into the full model. This finding is supported by evidence that suggests cervical screening coverage may improve in more deprived areas where there are higher numbers of practice nurses (Baker and Middleton, 2003).

Lower levels of education were associated with cervical screening coverage in younger women in univariate analyses, but were not associated with screening coverage when adjusted for other population factors. Lower educational attainment has generally been considered an important risk factor for lower cervical screening coverage (Moser et al., 2009; Sabates and Feinstein, 2006; Sutton and Rutherford, 2005), although these studies did not distinguish between cervical screening coverage in younger and older women. The percentage of women without higher education explained around 7% of the deviance in univariate analyses, while other population factors such as the percentage of ethnic minority populations and the percentage of younger women aged 25–29 years respectively explained around 63% and 53% of the deviance in the model. This may have contributed to the muted association between cervical screening coverage and education when the model was adjusted for other population factors.

In the fully adjusted model, the proportion of Asian, Black or Mixed ethnic minority populations was negatively associated with cervical screening coverage in younger women and positively associated with cervical screening coverage in older women. The percentage of 'other ethnic' minority populations was associated with poorer coverage, after accounting for population and programme delivery factors, for both younger and older women. This finding is more typical of other findings of a negative association between PCT level cervical screening coverage and ethnic minority populations (Bang et al., 2012). However, Bang et al., 2012 did not distinguish between the younger and older age groups, nor did they distinguish between different ethnic minority groups. Differences in cervical screening uptake by country of birth, including Arabic countries, have been reported (Webb et al., 2004). Ethnic variation in the knowledge of cervical screening and in emotional barriers to screening have been found (Robb et al., 2010) and these may also offer potential explanations for the difference in association between cervical screening coverage and the Black, Asian and Mixed populations and 'other ethnic' minority populations found in this study.

Living in London had a negative association with cervical screening coverage in both younger and older women, but was not statistically significant. It may be that other factors associated with London, are more discernible at smaller geographical units of measurement, for example, PCTs or LSOAs. London as a region is hugely diverse and therefore this measure may be too broad to represent the diversities of wealth, ethnic and cultural diversity (Leeser, 2011). Population diversity and population mobility may also contribute to the lower levels of cervical screening coverage found in London but these factors may not be unique to London and are likely to affect other large cities, albeit to a lesser extent (Millett et al., 2002).

Programme-delivery factors were less pertinent to cervical screening coverage for both age groups. The number of full-time practice staff was the only factor to be significantly associated with increased cervical screening coverage in both younger and older women, after adjusting for both population and programme delivery factors. This finding is supported by previously cited findings that more practice nurses are associated with higher cervical screening coverage (Baker and Middleton, 2003). The other programme-delivery factors were not significantly associated with cervical screening coverage in the fully-adjusted model. However, when adjusted for programme delivery factors only, the percentage of single-handed practices and percentage of practitioners per 100,000 population were negatively associated with cervical screening coverage in younger women, and average practice list size was negatively associated with cervical screening coverage in older women. The percentage of single-handed practices was negatively associated with cervical screening coverage in a population-based sample of women aged 30–64 years living in Manchester (Webb et al., 2004). The author is unaware of other studies that have used the percentage of practitioners per 100,000 population but other studies that have used similar factors to capture the ratio of GPs to patients have found conflicting results. Webb et al., 2004 found GPs with a higher number of patients to have poorer screening attendance, whereas Bang et al., 2012 did not find a significant association between the number of female patients per GP and cervical screening coverage at both PCT and practice-level. The percentage of practitioners qualified outside the UK was negatively associated with cervical screening coverage for both younger and older women in univariate analyses, but in both cases was no longer significant when entered into the model with other programme-delivery factors. It may be that the effect was explained by other factors entered into the multivariate model.

There were similarities and differences in the descriptive characteristics of the five high-performing PCTs. Enfield and Waltham Forest, both London based PCTs, were found to be high-performers even although their coverage for younger women was lower, and their coverage for older women was just slightly above, the national mean for all PCTs. However, this may be due to their ability to achieve these levels of coverage despite their relatively high levels of deprivation and a more ethnically diverse population, both factors known to adversely affect screening coverage (Bang et al., 2012). Conversely, Nottinghamshire County PCT and North East Lincolnshire PCT, with among the highest levels of coverage for both younger and older women overall, did not face these population level challenges as they had lower levels of deprivation, were less ethnically diverse and less urban. However, they had relatively higher levels of women without higher education, another factor generally associated with lower screening attendance (Sutton and Rutherford, 2005). Cervical screening coverage in Nottinghamshire County may also have been supported by its relatively high levels of full-time general practice staff (Baker and Middleton, 2003). Sunderland, with similar levels of urbanisation to the London PCTs, was much less ethnically diverse but had higher levels of deprivation from the national mean more women without higher education and therefore performed well despite these challenges. The high-performing PCTs therefore did not necessarily have the highest levels of coverage overall but did have relatively high levels of coverage given the challenges within their areas. Where, coverage among the highest levels achieved nationally, the PCTs were much less likely to comprise populations known to be less likely to attend cervical screening.

Low performing PCTs were broadly similar to each other. The three PCTs identified as low-performers for cervical screening coverage in younger women were all based in London and were subject to a number of challenges. Their populations were relatively more ethnically diverse, particularly in Harrow. Camden and Hammersmith & Fulham also had particularly high levels of women aged 25-29 years which may have contributed to their lower levels of screening coverage. All three PCTs had relatively fewer full-time general practice staff which may have compounded the known challenges of supporting ethnic minority populations and younger women to cervical screening. Although these PCTs comprised women with higher levels of education this did not seem to have compensated for their other challenges. The low-performing PCTs for cervical screening coverage in older women, Birmingham East & North and Sefton, were also urban PCTs, but differed on other population factors. Birmingham East & North had high levels of deprivation, fewer women without higher education and a more ethnically diverse population. Sefton however did not appear to have any of the well documented challenges to cervical screening coverage. In comparison with the mean levels for all England PCTs it had similar levels of deprivation and women without education, was not ethnically diverse. It had slightly fewer general practice staff working full-time than the national mean, but also its average practice list size was below average, which means the practices have fewer patients to support overall. This places Sefton as quite distinct from the other low performing PCTs as their challenges are more clearly evident. However, other low-performing PCTs tended to have a combination of challenging factors, at both population and programme-delivery level, and therefore may require additional support to overcome these barriers to higher cervical screening coverage.

6.4.1 Strengths and Limitations

Funnel plots based on crude cervical screening coverage data to determine the performance of PCTs may lead to the overestimation of the number of 'special cause' PCTs. Such overdispersion needs to be addressed a priori. A risk adjustment approach was chosen to identify high- and low-performing PCTs with unusually high or low coverage after adjustment for population and programme-delivery factors known to be associated with cervical screening coverage. PCTs with adjusted coverage values lying outside control limits are considered to display a behaviour which cannot solely be explained by the PCT-level factors investigated. However, there is also the potential that other factors may have contributed to the 'special cause' variation in coverage at that time. It is possible that high-performing PCTs had initiated particularly successful health-promotion campaigns during that year, or were better equipped to capitalise on the 'Jade Goody effect'. This type of data is not available routinely and thus could not be adjusted for within the model. To compensate for this weakness, Study 3 was set up to explore the views of health professionals on cervical screening coverage rates in their local area. This enabled factors, that are not available routinely or that may be particular to a given area, including issues related to health promotion to be considered.

The study is limited by the aggregated nature of the data, which may conceal ecological associations within PCTs. This could account for the weak association found between cervical screening coverage and programme-delivery factors. Programme-delivery factors had been considered as being particularly important for cervical screening coverage because general practices are involved in the process of appointment booking and conducting cervical screening. Bang et al., 2012 found significant associations between cervical screening coverage and GP characteristics, however, that study consisted of GP practice level data which would be overcome the ecological limitations of PCT level data. Therefore, the associations between cervical screening coverage and programme-delivery factors may have been underestimated in my study.

6.5 Conclusion

Identifying high- and low-performing PCTs and understanding the reasons why some PCTs perform better (or worse) than expected is complex. This study attempted to include some of the key factors that may affect PCT level screening coverage but was unable to adjust for all of the potential explanatory factors. High-performing PCTs appear to do so either because they do not have the same challenges as other PCTs or because they seem able to overcome them. Low-performing PCTs appear to have multiple challenges and may therefore require further support to improve cervical screening coverage.

Chapter 7: Health Professionals' Views of Cervical Screening Coverage (Study 4)

7.1 Introduction

To further understand the complex interplay of population and programme factors on cervical screening coverage and how they may act to support or hinder cervical screening coverage, I decided to draw upon the knowledge and expertise of professionals working in the NHS Cervical Screening Programme.

Health professionals themselves, are known to influence cervical screening coverage, for the better or worse (O'Connor et al., 2014; Armstrong et al., 2011) and their perspective can be helpful in understanding well documented issues. For example, health professionals were found to provide a programme-delivery perspective to seeking understanding about different barriers to cervical screening in women of different ages (Waller et al., 2011).

The studies carried out in this thesis so far, have all focused on PCT level coverage, essentially because PCTs were responsible for delivery of the NHS Cervical Screening Programme in their area, until 31st March 2013. This analysis enabled a broad consideration of a number of factors that may influence socioeconomic inequalities in cervical screening coverage. However, it was unable to consider the complexity in which these factors may manifest nor to reveal any new factors that had not been considered. It was therefore important that I was able to speak with health professionals who worked within PCTs to gain their insight into some of particular issues that may arise in their area. In this way, the interplay between the delivery of the programme and the characteristics of the population may be better understood.

The aims of this study therefore were to speak with professionals working within the NHS Cervical Screening Programme to draw upon their perspectives and inside knowledge to further understand the complex interplay between the delivery of the programme and the women it is intended for, with a view to ascertaining the factors that may act to support or hinder cervical screening coverage.

7.2 Methods

7.2.1 Participants

Twelve telephone interviews were carried out with professionals working in the cervical screening programme focusing on their views of factors that may influence cervical screening and colposcopy attendance within their local areas (see Table 19 for sample characteristics).

Table 12. Sample characteristics of health professionals

Sample characteristics of Health Professionals (n=12)	
Profession	
Screening Programmes Manager	3
Screening Programmes Co-ordinator	3
Screening Programme Quality Assurance Director	2
Public Health Intelligence Analyst	1
Public Health Screening Co-ordinator	1
Lead Colposcopist	1
Screening & Immunisation Co-ordinator	1
Sex	
Male	2
Female	10
Age	
30–39	1
40–49	4
50–59	6
60–65	1
Length of time working in the NHS Cervical Screening Programme	
1–10 years	5
10–20 years	4
20–40 years	3
Region	
North West	3
North East, Yorkshire & Humber	1
West Midlands	2
East of England	1
London	3
South West	2

7.2.2 Recruitment

Ideally, I would have liked to have recruited more participants to the study. However, this was greatly challenged by reorganisation of the NHS, such that PCTs ceased to exist on 1st

April 2013 (NHS Choices, 2015). This made it difficult to get in touch with relevant professionals in the new organisation within Public Health England (PHE) because it was unclear where people now worked or what their job role or responsibilities would be. I therefore decided to contact professionals working in Quality Assurance Reference Centres (QARCs) as a conduit. Given QARCs have responsibility for the audit of professional activity and the review of performance of the NHS Cervical Screening Programme (Public Health England, 2015), I thought they would be in a position to know who to contact. Contact details for professionals working in QARCs were easily available from online websites. My recruitment strategy utilised snowball techniques to contact other relevant professionals (Sadler et al., 2010). This turned out to be a reasonably successful means of recruitment, although it did limit the number of potential contacts I ultimately made because I relied on the QARCs as intermediaries to forward my recruitment letter. A recruitment letter was sent to cervical screening leads in ex-PCTs (some of whom I had initially contacted in late 2012) and to other contacts identified via QARCs. Participants willing to take part in interviews were asked to contact me via e-mail, telephone or post. Ethical approval was sought and obtained from the University College London Research Ethics committee prior to recruitment (UCL Ethics Project ID: 4594/001) (see Appendix 7).

7.2.3 Interview Materials

The interviews were in-depth and were structured using a topic guide. The topic guide was developed with reference to the existing literature on cervical screening coverage, as already discussed in earlier chapters (see Table 18 for the topic guide). The topic guide was considered to be an appropriate tool for the interviews because it offered structure and flexibility. I wanted to be sure that factors considered in Study 3 would be further explored with the health professionals but I also wanted to incorporate flexibility to open a space in which the dialogue of the interview could flow naturally. This was important as it encourages more discussion which may lead to the revelation of new information that I had not anticipated.

Table 13. Topic Guide for Interviews

Topic Guide

1. **Introduction**
   - Background and aims of the study
   - Confidentiality
   - Timing and tape recording
   - Use of data (reports; papers; data sharing)

2. **Job Role**

Role
   - Which PCT were you aligned with prior to April 2013?
   - Responsibility for screening programme delivery
   - Responsibility for achieving coverage rates

Transfer from PCT to Public Health England (PHE)
   - Views on benefits for screening programme delivery and coverage
   - Views on challenges for screening programme delivery and coverage

3. **Screening Programme Delivery**

Issues that support or hinder cervical screening delivery/coverage in the local area
   - GP practice characteristics (single handed practices, staffing levels)
   - GP practice incentives (QOF, local incentives)
   - Geography of PCT (rural/urban)
   - Endorsement of screening programme by GPs (reluctance/willingness/other priorities)

4. **Population Characteristics**

Views on how local demographics affect cervical screening uptake (support/challenge)
   - Age
   - Ethnic minority populations
   - Socioeconomically deprived populations
   - Other?

Local health promotion activities
   - Targeting of health promotion activities (to particular group, or to national/local issue)

5. **Closing the Interview**
   - Thanks
   - Reassure about anonymity
   - Give debrief

7.2.4 Procedure

The interviews were generally around 1 hour in length (minimum 45 minutes, maximum 1 hour). Participants were given the option to be interviewed by telephone or in an interview room at UCL. All opted for a telephone interview. Participants were asked to complete a consent form and brief demographic questionnaire (see Appendix 7) prior to the interview.

The topic guide was structured to provide a logical flow in the conversation from an initial introduction of myself and the study, to allow the participant to introduce themselves before moving onto the main discussion related to the delivery of the NHS Cervical Screening Programme and the characteristics of the population within their area. The topic guide, however, was used in the context of a semi-structured interview, and as such the precise order of topics varied according to the dynamic of the particular conversation. In these situations the topic guide was a useful checklist to see if any topics of interest had been missed. A general overview of the process is explained in greater detail below.

After the initial introduction to the study, the first section of the topic guide covered information about the professionals' role and responsibilities in the NHS Cervical Screening Programme. This enabled them to provide worthwhile background information on themselves and was a good way to establish rapport.

Participants were then asked how they thought the recent reorganisation of the NHS had affected programme delivery and other issues relevant to cervical screening coverage. It was anticipated that this would enable me to contrast issues that may have affected cervical screening coverage in the past but which may be handled differently in the new organisation.

The next section covered factors related to the delivery of the NHS Cervical Screening Programme, including general practice characteristics, financial incentives and any other issues that participants considered important. This section was designed to shed more light on the ways in which programme-delivery factors may support or hinder higher cervical screening coverage.

The fourth section asked how participants thought the local demographic of women eligible for screening contributed to coverage rates in their own area. This was included to allow them to consider the different factors that may affect screening coverage for different social groups. This also afforded the opportunity to discuss the effect of local health promotion activities and, where relevant, national campaigns.

The final section closed the interview with an expression of thanks to the health professional for their participation and offered them a final opportunity to make any outstanding remarks or comments. I then debriefed the participants on the study.

7.2.5 Analyses

All interviews were recorded by electronic recorder and transcribed verbatim. To ensure I was fully immersed in the data I interviewed all participants, transcribed three of the transcripts and coded all of the transcripts. Those transcripts not transcribed by myself were transcribed by Devon Transcriptions [6] – a transcription service found to produce quality transcripts and recommended by colleagues in my department. Once the transcription process was complete, I read and re-read the transcriptions of all interviews, taking notes of points of interest along the way. If found this a useful process to re-familiarise myself with the data.

The data were analysed thematically using guidelines outlined by Braun and Clarke (Braun and Clarke, 2006). The analysis was aided by the NVivo software package (version 10a, a software package designed to aid qualitative data analyses) (QSR International Ltd, 2015). The transcripts were uploaded into the software in preparation for coding.

After familiarisation with the transcripts and notes, I generated initial codes driven by the data. As new codes were generated some codes split into two or more codes as the meanings in the data became more nuanced. This initial coding was at a very detailed level to allow me to identify all the available information. From there I began to group the initial codes of data into broad themes and groups where items related to similar topics or where I could identify a relationship between different codes and themes. A reiterative

[6] www.devontranscription.co.uk

process ensued where I would review the initial codes, perhaps making some modifications to more clearly express the meaning. Then I reviewed the larger themes again to ensure that they remained appropriate and modified them where I considered it necessary. From there I drew an initial thematic map to visually represent the data and allow me to consider the wider meaning of the data and its inter-relationships. At this point, I was able to stand back and look at the data again and then further refine the codes, sub-themes and overarching themes. This process was influenced by my research question relating to gaining an understanding of the factors that support or hinder higher cervical screening coverage. That is to say, that while the initial codes and emergent themes were driven by the data, I acknowledge that the role that I played as a qualitative researcher in shaping the framework of the results was influenced by the over-arching desire to seek information in the data that related to the programme-delivery and population characteristics. During this process I sought advice from my supervisor JoW and we discussed my approach and the resultant themes. Earlier versions of the analyses were shared and discussed and modifications made before the ultimate set of themes and sub-themes were finalised.

7.3 Results

Programme-delivery factors and Population Factors were the two overarching themes of the factors that support or hinder cervical screening coverage. These themes consisted of four and five subthemes and are visually represented in Figures 22 and 23 respectively.

Figure 22. Programme-Delivery Factors

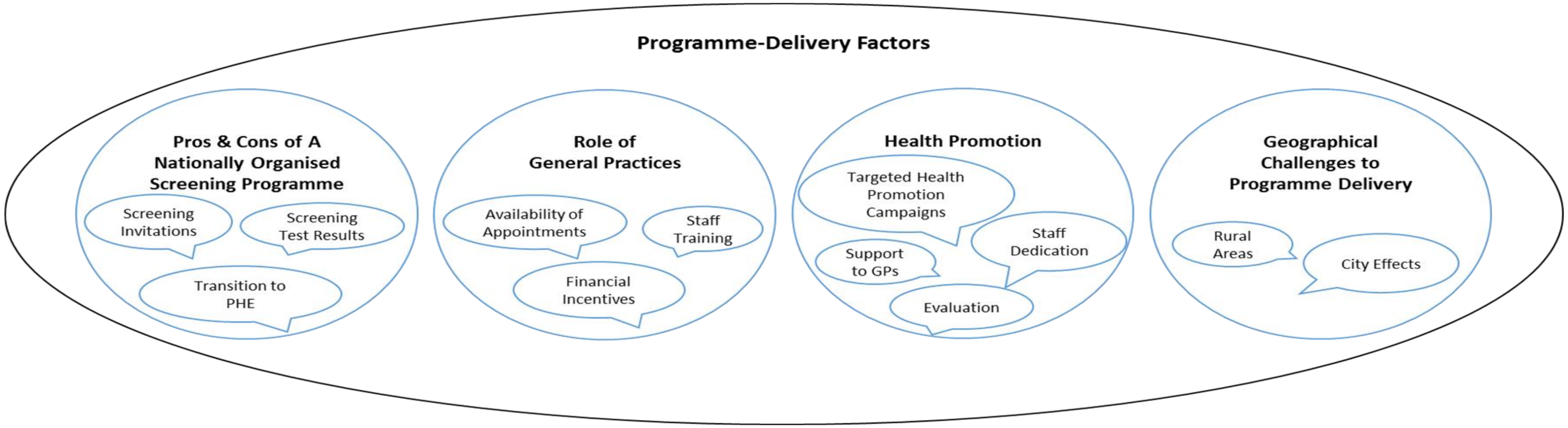
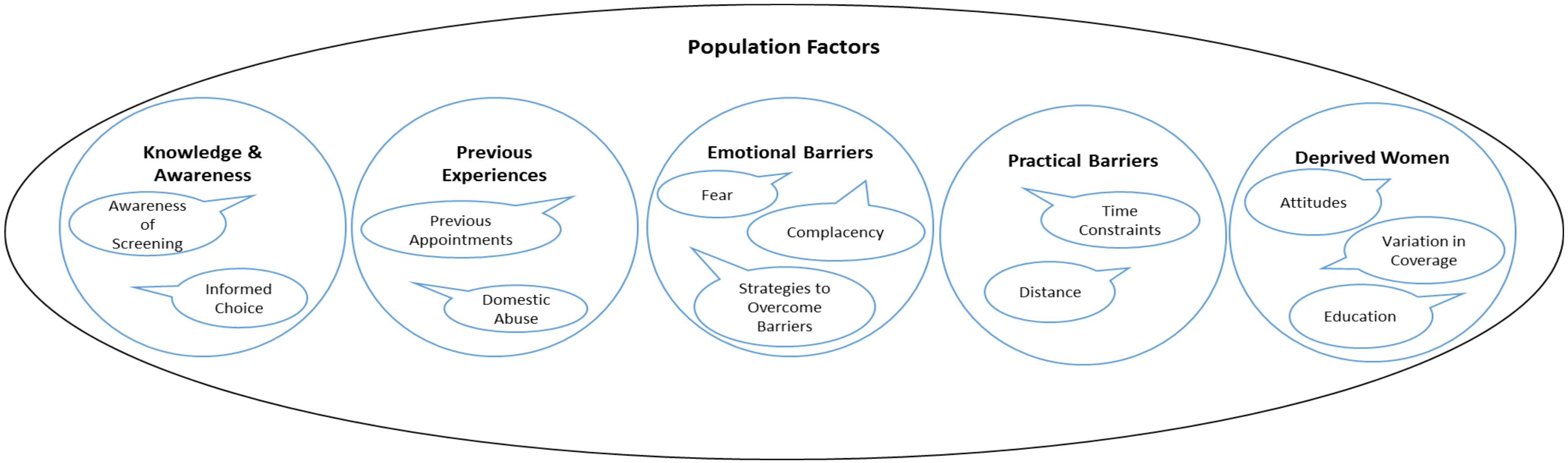


Figure 23. Population Factors



7.3.1 Screening Programme Delivery

This theme consisted of four subthemes: Pros and Cons of a Nationally Organised Screening Programme; Role of General Practice; Health Promotion and Geographical Challenges to Programme Delivery.

Pros and Cons of a Nationally Organised Screening Programme

Screening Invitations

The screening invitation process was discussed by many of the health professionals, mainly with respect to the content and delivery mode of the invitation letter and leaflet. Some participants felt it was important to have a standardised letter to maintain consistency in the information being sent out to women, while other participants considered it important to be able to tailor these to the needs of their local population, particularly where these related to language barriers or literacy barriers.

A Screening Programme Manager who had responsibility for more than one PCT spoke of the dangers of general practices sending out their own letters. Her concerns related to the volume of letters that may be sent, the effect this may have on the decision to attend cervical screening and the content of bespoke letters.

> *'Then they're also getting letters from their practice and they're getting inundated with information and we were aware that in some cases this was actually putting women off. You know they thought they were being bombarded or bullied into attending. Plus, we've got no control over what is contained in those letters that GPs send out. So we would hope that the letters themselves are not frightening, em, but give enough information to enable the women to make their own choice. That is a concern of ours cos we have seen some shocking letters.'*
> (Screening Programme Manager, ID3)

This example illustrates that the accumulative effect of a women receiving letters from her general practice in addition to the standard letter sent as part of the Call Recall process may overwhelm the participants and have the undesired effect of putting them off. The

Screening Manager was also concerned that some bespoke letters may inadvertently scare women or not portray the necessary information in a suitable manner to support women to make an informed choice.

However, a Screening Programme Manager and a Screening Programme Co-ordinator also raised concerns that there was insufficient flexibility within the invitation process.

> *'I must admit, the offer is made that the leaflets are in different languages, but it only goes out in English, the letter itself. So unless the person actively rings up for some explanation, they are not going to get it in any other language.'*
> (Screening Programme Manager, ID 12)

> *'I mean that's important to maintain some consistency but, I mean, in terms of freedom and to reach out to woman locally… I think it's quite difficult to be able to innovate within the service.'*
> (Screening Programme Co-ordinator, ID 10)

The following two examples highlight some of the ways in which the invitation or accompanying leaflet has been modified to target a particular social group. Across the interviews, the various social groups which may require targeted intervention included younger women, ethnic minority women, women with learning disabilities and gay women.

In this first example, an invitation letter is modified in an attempt to appeal to younger women.

> *'I know that in Camden and Islington they looked at the younger age group. They sort of tailored the invitation letter and they made it like a magazine to try and make it a bit trendy.'*
> (Screening Programme Manager, ID 12)

In this example, leaflets were modified to contain more information in graphic format to overcome language or literacy barriers.

> *'We put our own leaflet together with pictures in it… GP surgeries were using those leaflets because they found them a lot easier than the national leaflet,*

> *particularly when they were talking to patients with language difficulties and from different groups, ethnic mixed groups. So they were saying that they were useful in having those conversations with women about attending for screening.'*
> (Screening Programme Co-ordinator, ID 13)

Health professionals also considered the mode of invitation to be important. SMS text messaging was considered to be a helpful and fairly popular tool for reminding women of screening appointments, but suggested this could also be extended to the cervical screening test invitation. Younger women were highlighted as a group who may engage more readily with the screening programme using this method of invitation, rather than a standard letter.

> *'But maybe the age group, now with the technology, maybe we should be thinking about texts rather than letters. If that was the way of working, people want that, sort of, information accessibility straightaway rather than, you know, getting a letter and throwing it in the pile of unanswered letters, whatever. That could be some of the problem with that younger age group.'*
> (Screening Programmes Manager, ID 12)

Screening Test Results

Participants also felt that the 14-day turnaround[7] for results of screening was an important factor for supporting repeated cervical screening attendance.

> *'Women get their result letters within two weeks which is a big thing… So that has actually helped things in the context that you go for a test and you will get your result.'*
> (Screening Programmes Manager, ID 3)

[7] As part of its drive for better efficiency The Cancer Reform Strategy (Department of Health, 2007) mandated that women should receive the results of their cervical screening test within 14 days by 2010. National policy indicates that 98% of women should receive their results within 14 days, and the actual percentage delivered is reported annually in the Cervical Screening Programme Statistics report (Health and Social Care Information Centre, 2014).

Transition to Public Health England

These interviews took place within one year of the NHS reorganisation and, as such, the transition of the NHS Cervical Screening Programme to Public Health England was still being embedded. Many health professionals discussed the transition to working in Public Health England and the effects this would have on the role of those who previously supported training within PCTs. Their perceived benefits and challenges of the new structure to support the NHS Cervical Screening Programme were discussed.

A Screening Programme Co-ordinator felt that the benefits of the changes would become evident as the new practices come into place.

> *'Now that we've been told what these structures are, and the people who've been put into these structures have actually started working against their remit, I feel that the system is regaining some stability. … I think a good structure is being created there, which I think will support the service appropriately.'*
> (Screening Programmes Co-ordinator, ID 8)

The pros and cons of the new structures impact on running health campaigns was also discussed by a Cancer Screening Quality Assurance Director.

> *'In the past, we would have worked with PCTs on local initiatives to improve uptake and coverage, but now I don't see that anymore. I think it will be, sort of, nationally led, …in one respect, nationally led is quite good because it saves a lot of, sort of, individuals repeating work that's been done elsewhere…, the problems that I've seen in the past are that national campaigns tend to target the wrong women.'*
> (Cancer Screening Quality Assurance Director, ID 1)

The preceding example has similarities to the earlier views on the rigidity of the invitation process, that is, the merits and limitations of a standardised process. While standardisation may be more efficient in terms of manpower and reducing duplication of effort, it may be in itself failing to reach specific groups – one size does not fit all.

Other health professionals were sceptical of the benefits of the transition to Public Health England. Some considered that the transition and the new structure may have a negative impact on cervical screening coverage, at least, in the shorter term. The points raised included the resource capacity of the new structure to meet the demands of supporting local areas and the loss of local area knowledge.

> *'Whereas before, they [referring to the Lead Screening Nurse previously available in each PCT] were visiting surgeries, doing a bit of training, a lot of them were nurses, so they were doing extra clinics, things like that, they can no longer do the clinics, they can't visit surgeries because they've got to be more high level, they can't, sort of, be more locally involved. So I think that's a loss, really. And I think, as I say, it may well show in the figures that we see coming out this year.'*
> (Screening Programmes Manager, ID 12)

The preceding quotation echoes the views of other health professionals who considered that their position with Public Health England made them more remote from the areas they had to help. Other professionals were also concerned that their job role had expanded to include screening and immunisation, and therefore they had less time to dedicate to cervical screening.

However, some of the issues raised could be seen in terms of being temporary or transient problems. That is, that large-scale change of this nature means that there will be a transition period in which staff renegotiate their role and that of others around them. In the following example, the health professional discusses the difficulties for some staff transitioning to the new structure within Public Health England.

> *'They've [those employees in the newly appointed Screening and Immunisation Lead roles] had to, sort of, negotiate a whole new structure with very patchy staffing and it has been really challenging.'*
> (Cancer Screening Quality Assurance Director, ID 11)

In this final example, the loss of local knowledge is considered to be detrimental to the identification of areas with specific needs within the new Clinical Commissioning Group areas.

> *'And it's the local knowledge that you need to, sort of, understand how we can best tackle it [cervical screening coverage]. And in part, that's down to people*

> *who, in the past, would have been people in public health who would have known, you know, specifically, you know, we should target these particular places.'*
> (Cancer Screening Quality Assurance Director, ID 1)

<u>The Role of General Practice</u>

The significant role that general practices play in the delivery of the cervical screening programme is highlighted in this theme. Health professionals spoke of the responsibility of GPs and the challenges they can face in delivering the cervical screening programme. These included the availability of appointments, staff training and financial incentives, including how the General Medical Services (GMS) contract, also known as the Quality Outcomes Framework[8] (QOF), can affect cervical screening uptake.

Availability of Appointments

Health professionals discussed the availability of cervical screening test appointments with respect to time and location. Timing issues were highlighted in terms of the duration of the appointments, the limited number of appointments available and the lack of out-of-hours appointments.

In this first example, a Screening Programmes Co-ordinator discussed how appointment times can be quite 'rigid'. In other examples within this theme (not quoted), health professionals suggested that even varying the day of the week in which cervical screening appointments take place can make them more accessible to women.

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[8] The Quality Outcomes Framework (QOF) is a rewards contract for general practices, and other providers of primary care, to set standards and promote improvement to the delivery of medical services (Health & Social Care Information Centre, 2014a). The contract is negotiated annually by NHS Employers and the General Practitioners Committee (GPC) of the British Medical Association (BMA). For Cervical Screening, General Practices currently receive points for the following: 1) The general practice should have a protocol for the management of cervical screening including staff training, management of patient call/recall, exception reporting and monitoring of inadequate sample rates; 2) the percentage of women aged 25 years or over and under 65 years who have had a cervical screening test in the last 5 years; and 3) a policy for auditing inadequate cervical screening tests at individual sample-taker level every 2 years.

> *'I think GP practices can be quite rigid and, in terms of you know, you might be given a 5 or a 10 minute appointment… some of these woman need a 15 minute appointment and we [speaking on behalf of practice nurses or other sample-takers] want to make the service accessible and try and encourage uptake.'*
> (Screening Programmes Co-ordinator, ID 10)

In this next example, a Cancer Screening Quality Assurance Director highlights that the number of appointments available can lead to problems for women who call to make an appointment but are unable to be given an appointment at that time. Other health professionals also suggested that delayed appointments can have knock-on effects where women may realise that the future appointment will clash with her period. This may lead to further rescheduling, delay or even unintended non-attendance.

> *'And I've heard lots of anecdotal reports of people saying that, you know, they can't book an appointment with the sample taker because there are just such a limited number of slots.'*
> (Cancer Screening Quality Assurance Director, ID 11)

The scheduled time of appointments were also considered to directly impact some women's ability to attend screening, particularly where a women worked shifts or had other practical barriers to 'normal hours' appointments.

> *'And these people, who were given less access because of the nature of their work for taking time off for screening, or perhaps worked in jobs that required different shift patterns, so it was more awkward for them to fit into the normal "going to the surgery" working hours, or whatever.'*
> (Screening Programmes Co-ordinator, ID 8)

The availability of screening tests was also highlighted in terms of women having more flexible alternatives to the GP surgery. Alternative options included having a drop-in screening test clinic in town centres or opening up the provision to sexual health clinics.

> *'if woman had a preference or had the options of either going to their surgery or somewhere more neutral in the town centre… a lot of woman who comment about it say, it's just thinking about it, if I could just do it impetuously, if I was out shopping and there was a surgery next to Tesco's and I could just go in and have it done.'*
> (Screening Programmes Co-ordinator, ID 10)

Some health professionals thought that women would welcome the opportunity to have their cervical screening test at a local sexual health clinic. They discussed how cervical screening has become less common in sexual health clinics explaining that the focus of sexual health clinics and the financial incentives for conducting cervical screening tests were not supportive.

> *'We had some cases where some services [sexual health clinics] were getting a bit fed up about the amount of women that were coming for cervical screening to those services, and they were saying, "Actually, we're going to limit these women." We had one service that did that and they had an instant six-week wait and they were saying, "Well, we're not here just to provide cervical screening all the time. The GPs are getting paid for this; we're not."'*
> (Screening Programmes Manager, ID 2)

A colposcopist also offered an explanation for lower attendance for follow-up colposcopy appointments. A woman may be invited to a follow-up colposcopy appointment and subsequent treatment for cervical abnormalities. Follow-up appointments may comprise an HPV test as a 'test of cure'. These appointments normally take place in a colposcopy clinic, which is hospital based.

> *'My feeling is that it's better for the women to have the follow-up samples done in General Practice because it's more convenient.'*
> (Cancer Screening Quality Assurance Director, ID 1)

Staff training on issues affecting cervical screening uptake

GP staff training was deemed important for a variety of general practice staff including sample takers, practice managers, administrative staff and receptionists.

> *'I used to visit all the practices all the time. I used to teach the receptionist and teach the clinicians, and there were some days you'd bring them right up to date with the HPV, the vaccination that is now up and running. You'd go in there, "How are you getting on?" You were demonstrating this. "Do these women understand about the virus?" You were educators. That's all been taken away.'*
> (Public Health Screening Co-ordinator, ID 11)

The promotion of cervical screening was considered to be a task for all general practice staff and staff training by those working at PCT level was considered an important factor in maintaining the focus on cervical screening within general practice staff.

> *'A lot of practice staff are under the impression that it's nothing to do with us... You know, we just send the letters out and book the appointments and everything else but we wanted to highlight to them [through training sessions] that they have a key role in raising awareness amongst their population.'*
> (Screening Programmes Manager, ID 3)

Training was also considered necessary in order to tackle misconceptions about the relevance for particular groups of women or to support staff who may feel uncomfortable tackling certain issues. In this example, the need for staff to be able to talk about the relevance of cervical screening to gay women is highlighted.

> *'"So why do I need to have a smear? I've never slept with a man." GPs and nurses don't want to talk about being gay. Not all of them, but a lot of them don't. So that gives you yet another barrier.'*
> (Public Health Screening Co-ordinator, ID 14)

Financial incentives to improve cervical screening uptake

Participants discussed the different incentive schemes that have been in place to encourage GPs to facilitate cervical screening, including the current Quality Outcomes Framework (QOF).

There was concern that some general practices would not follow the criteria set for exception reporting [9] women for cervical screening. This could lead to the illusion that their cervical screening rates were better than they were.

> *'There was a big issue within doctors' surgeries that they didn't understand about data and about coding of women. If they didn't get any response from that patient within a certain allocated time, say, a month, then they would be exception reported. And so that took a lot of education because they thought they were actually performing a lot better than they were.'*
> (Screening Programme Co-ordinator, ID 7)

There was also some concern that cervical screening coverage is not sufficiently incentivised under the current GMS contract and that earlier GMS QOF contracts offered greater incentives. This was considered as a contributory factor to the overall decline in cervical screening coverage seen in recent years.

> *'In the screening programme, pre the GMS contract that's in place now, there was a real incentive payment for GPs to get 80% coverage in the screening programme. And they would do initiatives to get that… So actually, they no longer needed to do all of that work because they were going to get those points anyway.'*
> (Screening Programmes Manager, ID 2)

<u>Health Promotion</u>

The health professionals discussed a number of local and national initiatives aimed at increasing cervical screening coverage. Local area initiatives were often targeted to specific population groups, for example, younger women or ethnic minority groups. Other

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[9] The Call Recall process of the screening programme invites all eligible women to cervical screening (North West Cervical Screening QARC, 2013). Where, after a given period, no screening test result is indicated on the Call Recall system the general practice will be informed. GPs should send additional invitations to the women to attend screening. If the women still does not attend the GP may 'exception report' this women from their Quality Outcome Framework (QOF) report, such that the women is not counted in the GP's QOF criteria related to payment for the percentage of eligible women who have attended screening at their practice. As a consequence, the percentage of women who are considered to attend cervical screening via QOF may appear higher than the official returns reported in the annual coverage figures.

initiatives sought to support general practice to achieve higher levels of coverage, for example offering general practice staff training or providing the administrative support for a period of 'list cleansing' [10] of the GP's records. Health promotion was often discussed as being supportive of improved cervical screening coverage but was also found to have some inherent challenges, such as poor evaluation of previous campaigns, the limitation of desired outcome and the associated cost.

Targeted Health Promotion Campaigns

Lower screening attendance and the need for focused initiatives were discussed in relation to a number of population groups based upon their demographic, social or economic profile. Younger and older women, those who are socio-economically disadvantaged, ethnic minority women, lesbian and gay women, women with learning difficulties, women who have been sexually or physically abused and those living in travelling communities or in military communities were all considered important social groups with specific needs or barriers. Earlier, in the section on screening invitations, I discussed the efforts made by some PCTs to tailor the invitation letter and accompanying information leaflet to specific social groups. Similar concerns were raised with respect to local campaigns.

[10] List cleansing is a process in which the general practice registered list of patients is updated with patients' current contact details. Patients who have moved out of the area but not notified the GP, also known as 'ghost records' may be removed.

Staff Dedication

However, one of the key components to the success of improved cervical screening coverage in a given areas was considered the quality and energy of PCT-level staff to deal with issues in their areas.

> *'They had a very motivated public health screening lead, and they also had a really good screening coordinator there who got involved with lots of those types of issues [socially deprived communities] and did this work. But they invested in it, and you could see, you know... Loads of really innovative things…You could see the difference in the coverage as well, where you could start to see a rise in coverage where the PCT actually invested in the programme'*
> (Screening Programmes Manager, ID 2)

Support to General Practices

The health professionals also spoke about health promotion in relation to cervical screening in terms of supporting the GPs to deliver the programme. This might be support to help in the administration of the system or by acting as a central point for gathering and sharing best practice across the PCT.

Where issues are common across the PCT, health promotion staff were able to lend a hand to general practices in the area to address key issues. The following example is one such initiative.

> *'I was involved in one of the projects where we went round to different [general] practices, me and another GP that I worked for at the time. We did it across our PCT, and we got rid of ghost patients on the lists, and then we invited in women. Again, we invited them in saying about a pre-counselling appointment, if they wanted and they were given longer appointments, as well. So it was a real push to get women in'*
> (Screening Programmes Manager, ID 2)

The PCTs were able to act as a central point to gather and share best practice. This co-ordination of this activity at PCT level was seen as a means to provide tailored solutions to the common challenges GPs may face.

> *'We identified key areas where barriers were in place and then looked at other areas that had overcome those barriers by doing certain pieces of work. The toolkit that we put out actually has a whole section on barriers to uptake. We've got them under separate headings, so it'd be like accessibility, barriers to women with learning disabilities and physical disabilities and it sort of gives you, you know, here's the barrier here's what you can do to correct it. We've used that as well as part of the training sessions that I've done with practices to highlight with them.'*
> (Screening Programmes Manager, ID 3)

The professionals either implicitly or explicitly stated that different types of initiatives were necessary to improve coverage, and that health promotion is most successful where a 'full-systems approach' is applied.

> *'The thing that you realise with coverage it has to be a full-system approach. So, you could get somebody advertising for people to come in for screening but actually if there aren't the appointments there to facilitate that person going for the screening, then it stops there.'*
> (Screening Programmes Manager, ID 2)

Evaluation of Health Promotion

The professionals largely discussed health promotion initiatives within the context of their perceived level of success. There was a general view that evaluation of health promotion is either difficult to achieve or not undertaken.

> *'To say yes well we introduced this and as a direct result of that we have, you know, a kind of effect of 5% uptake [increase]. It's really difficult to evaluate whether something that you have implemented has actually made a direct effect.'* (Screening & Immunisation Co-ordinator, ID 4)

However, even where health promotion activities were viewed as successful, they were also considered to support a temporary increase in coverage. Jade Goody was often cited as an example of the powerful yet transient nature of increased cervical screening coverage.

> *'The Jade Goody effect and that's all worn off now. But um yes so lots and lots of young people came when something like that happens... it can be quite influential but it's maintaining that which is the problem.'*
> (Screening & Immunisation Co-ordinator, ID 4)

<u>Geographical challenges to delivery of the programme</u>

Rural areas

Health professionals discussed the barriers to cervical screening coverage in both rural and urban areas. It was considered that living in rural PCTs could sometimes present difficulties in relation to travel or familiarity with GP staff.

> *'Cumbria where you've got small areas of population in a vast geographical area so that created its own problems. …women living in say a small village probably are friends with the local doctor or the local nurse and that was actually putting them off.'*
> (Screening Programmes Manager, ID 3)

The preceding example is also related to issues of embarrassment – not wanting to be screened by someone they know – and through the lack of alternative screening options. However, this was not found to be a uniform barrier in more rural areas.

Urban areas – city effects?

Challenges for achieving higher cervical screening coverage in cities were highlighted by some health professionals. These included population mobility and the knock on effect of 'ghost records' [11] on GP registers, and the number of women who may opt for private cervical screening.

[11] 'Ghost records' may be described as records held on a general practice register of patients who no longer live in the area. This routinely happens as, for example, people move house and there may be a time lapse to registering with a new GP. This issue is exacerbated in areas with high population mobility and can lead to list inflation, where a GP's list of registered patients appears higher than it actually is.

> *'I think the other thing that has a huge impact is the mobility of the population. So when you look at the inner city areas – Manchester, Liverpool, Blackpool are our worst-performing areas in coverage and that's because it's a very mobile population there, people coming and going, and higher rates of ethnicity, as well. So it doesn't seem to follow that the rural areas suffer; I would say it's more on social deprivation and the mobility of the population.'*
> (Screening Programmes Manager, ID 2)

In the following example, the Public Health Screening Co-ordinator highlights some of the work her team has undertaken to address the administrative issues for the delivery of the cervical screening programme in London.

> *'Well, because of the diversity and actually maintaining the amount of data for London. It's got a very dense population. There's also the figures of what we call ghost patients. A lot of work has been done with call and recall on ghost women.'* (Public Health Screening Co-ordinator, ID 6)

The same health professional also considered lower cervical screening coverage in London to be attributed, in part, to higher levels of women attending cervical screening at private clinics.

> *'And of course, the other problem is that women go privately for smears, don't they?'*
> (Public Health Screening Co-ordinator, ID 6)

A similar point was also made by a colposcopist who stated that some women referred to colposcopy following an abnormal cervical screening test result opt to have the colposcopy appointment at a private clinic. This may occur even where the women's originating cervical screening appointment may have been as a routine invitation to the NHS Cervical Screening Programme.

7.3.2 Population Factors

This theme consisted of the five subthemes: Knowledge and Awareness; Previous Experiences; Emotional Barriers; Practical Barriers and Issues Related to Socio-economically Deprived Women.

Knowledge and Awareness

Knowledge and awareness of cervical screening was discussed in different contexts. In some instances, it was about raising the awareness of screening and its relevance to different groups of women. Knowledge of changes in the screening programme was also considered as a potential contributor to cervical screening attendance. Finally, having sufficient information about screening was also considered important for informed decision-making.

Awareness of Screening

Variations in the levels of awareness of the screening programme were considered to occur across different social groups, and for different reasons. Broadly, the social groups discussed in the interviews in relation to this point included women living in socially deprived areas, ethnic minority women, gay women, and women with issues surrounding fertility or recent child-birth.

In this first example the Screening Programme Manager discusses how community workers had been employed within their area to raise awareness of cervical screening in a socially deprived area of the Manchester.

> *'We [PCT health promotion team] did some work with some community workers who were working in Manchester [in socially deprived areas] at the time to get screening [coverage] up… It's getting that message across that they can understand in a positive way and making it a priority to come forward for screening.'*
> (Screening Programmes Manager, ID 2)

Women who are not familiar with the UK health care system or cervical screening may also have other barriers to attendance.

> *'Also you've got the Asians and the Somalis, and the people coming from other countries where they don't promote the screening programme. … they don't see the benefit of screening because they've not had it in their country and don't possibly understand the language, don't understand the setup of the GP surgeries, let alone screening programmes.'*
> (Screenings Programme Co-ordinator, ID 7)

There was also consideration that greater awareness of changes in the screening programme may prompt more women to attend screening.

> *'But it seems very interesting to me that since the introduction of HPV Triage, we've been doing it since March, the uptake for screening, we feel, has improved greatly, and I wonder if it's because…, this HPV test has brought it to the fore a bit more – perhaps brought it more forward in people's minds.'*
> (Screening Programmes Co-ordinator, ID 8)

Informed Choice

Decision-making was largely discussed in the context of women having sufficient information to make an informed choice, and also where non-participation can be accepted as informed choice.

> *'It's just making sure that she's making an informed choice to either attend or not to attend, particularly if she's decided not to attend that she's aware of the risks but it's how that is relayed to women.'*
> (Screening Programmes Manager, ID 3)

> *'You know, some women just definitely do not want to have a cervical screening test. … well that's up to the women and she's made an autonomous decision to decline and you have to respect that'*
> (Screening and Immunisation Co-ordinator, ID 4)

This point was also raised in relation to the information provided to women in their screening invitation letter and accompanying booklet. However, the health professionals clearly considered that the intention to provide further information was an ongoing activity, rather than something that should occur at a particular point in time.

Previous Experiences

Previous Appointments

Previous experience at the cervical screening test and colposcopy was found to be very important for future attendance. This included negative experiences such as physical pain or discomfort, psychosexual issues or the way in which the screening test or colposcopy examination/treatment was carried out.

> *'For some women they had the test before and it was painful, that have had one bad experience… and they'll never come again.'*
> (Public Health Intelligence Analyst, ID 5)

In this example, a bad experience at cervical screening is considered as a potential explanation as to why some women will attend cervical screening but not attend colposcopy following an abnormal screening test result.

> *'You've got two pinch points in the process in terms of the first smear that you have and the first colposcopy that you have as to how good that experience is with the woman. So even if you have had a smear test and it's a god awful experience, even if there's an abnormality, they might not go to colposcopy.'*
> (Colposcopist, ID 9)

Factors related to the colposcopy clinic itself, such as its layout or whether it was a dedicated space for gynaecological procedures, were also considered to put women off attending colposcopy. This may be because the women had experienced these issues directly or because they had heard about them through word of mouth.

> *'To give you an example …a colposcopy waiting area shared with endoscopy. So you have women, in the main, young women, in a state of undress, waiting in a corridor, and opposite are the men waiting to have their colonoscopy examinations. .. Things like that that needs to be sorted out… people in the community know what hospital wards and departments are like.'*
> (Cancer Screening Quality Assurance Director, ID 1)

Other experiences, such as, opportunistic screening of other health measures was seen to deter some women from returning at future appointments.

> *'And there are certain things which definitely put women off... "I've been invited for a cervical smear, I go in and they want to take my blood pressure and weigh me!"'* (Cancer Screening Quality Assurance Director, ID 1)

Domestic Abuse

Finally, other experiences, such as domestic violence or abuse may also deter women from accepting their invitation to cervical screening.

> *'Woman who'd have either very difficult domestic experience, emotionally or physical; who'd suffered some sort of sexual abuse, domestic abuse found it really difficult to come forward for screening.'*
> (Screening Programmes Co-ordinator, ID 10)

Emotional Barriers

Emotional issues were cited as barriers to both screening and colposcopy attendance. These included fear, anxiety and embarrassment.

Fear

Fear was most often mentioned in relation to its role as a barrier to attending cervical screening. However in this example, a Screening Programmes Manager explains how she believes fear may act as a barrier to colposcopy attendance following an abnormal screening test result.

> *'I think a lot of people do attend for screening never believing there's actually going to be anything wrong. How anxious women are, really, really anxious coming for colposcopy. I suppose it's that thing of, when they don't turn up, maybe they're just not facing up to actually there is something wrong.'* (Screening Programmes Manager, ID 2)

Complacency

However, not feeling concerned was also cited as a potential reason for the lower attendance rates found for women with follow-up colposcopy appointments.

> *'So your follow up is at a much higher DNA [Do Not Attend] rate [than first referral to colposcopy]… and I think that's due to complacency in the patient. They think they think are fine, I've been treated, it's not so important, they no longer have that letter saying your smear test shows abnormal cells if left untreated.'* (Colposcopist, ID 9)

Strategies to overcome emotional barriers

Health professionals discussed a variety of different emotions that women may experience in relation to their cervical screening appointment. Here, health professionals discuss different ways in which women can cope with the anxiety or embarrassment of attending cervical screening. In this first example, having a friend accompany them to the GP surgery or speaking with someone else about going to screening is considered one possible strategy.

> *'Maybe some kind of coping strategies if they are anxious about going, what to do or to take a friend. And hopefully it's given them a bit more confidence to either go along to have their smear or to actually go and speak to somebody else about the importance of it.'*
> (Screening Programmes Co-ordinator, ID 13)

Anonymity was considered an important issue for some women. Professionals suggested that some women may prefer to have their cervical screening test at another clinic, rather than at their own GP.

> *'Yeah and I mean some women probably don't what to go to their own GP because of the embarrassment factor don't they; they'd rather go to a clinic where no one knows them'*
> (Public Health Intelligence Analyst, ID 5)

Other professionals considered developing trust between the woman and the health professional to be important factors in overcoming barriers to attendance.

> *'It's the trust in that nurse. …So if you've got a good nurse in a poor area that can strut her stuff and care enough, there's a bit of commitment there, it will work. It will work.'*
> (Screening Programmes Co-ordinator, ID 10)

<u>Practical Barriers</u>

The practical barriers included not having the time and, in some instances, distance to travel.

Time constraints

This particular example is related to the difficulties for women in finding the time to attend screening. It may also be compared to the earlier point made when discussing the fact that the availability of cervical screening appointments and how inflexible appointments may act as practical barriers to screening attendance.

> *'the reasons for women not going. Some of it was, you know, they just didn't have the time and busy lives, and it didn't fit in… You know – they've got children to look after, can't get to the surgery, it's far more difficult for them to arrange the time when they can go on their own. So childcare problems, that sort of thing.'*
> (Screening Programmes Manager, ID 12)

Distance to Travel

Distance to travel was mentioned as a barrier to screening. This is also related to the earlier theme on rural issues, where women may have to travel further than in larger towns or cities. However, this is not necessarily a barrier that is specific to rural areas, or one that in itself may be detrimental to attendance. For example, this issue had also been mentioned in relation to lower attendance at follow-up colposcopy appointments where lower incentive to attend the appointment combined with a potentially inconvenient journey may reduce attendance.

> *'I think, unfortunately, the clinics that are available, say, for example, in Sussex, they are quite widely spaced out, so for women who do want to go to a clinic, they've quite often got to travel that bit further.'*
> (Screening Programmes Manager, ID 12)

<u>Socio-economically deprived women</u>

Those participants who discussed social deprivation agreed that screening coverage is generally lower in women of lower socioeconomic status or in those who live in socially deprived areas. The themes of this discussion focused upon why coverage is lower in socioeconomically deprived women and explanations why some PCTs with high levels of deprivation have higher coverage than would be expected given their level of deprivation.

Attitude to Cervical Screening

The reasons why coverage may be lower in more deprived women included practical barriers, lower awareness of screening or competing priorities. However, the health professionals did not seem to think that these were exclusive to more deprived women. However, attitudes to health and cervical screening were raised as potential issues.

> *'I suppose what priority they give to their health and how they view screening, really, isn't it?'*
> (Screening Programmes Manager, ID 2)

Variation in Coverage in Deprived Areas

Participants were asked about why some deprived areas had better coverage than may be expected given their level of deprivation. The explanations given were within the context of professionals working as 'active agents' to effect change in that area and the role of education.

This item is similar to the Staff Dedication theme mentioned earlier within the health promotion section. It is mentioned again here that health professionals considered this as a key driver to improving cervical screening coverage in more deprived areas within their PCTs.

> *'It's the commitment of the individual working in the area. That makes one hell of a difference. …And that's why they do well. It's about the commitment of the individual and good health promotion.'*
> (Public Health Screening Co-ordinator, ID 6)

Education is Protective

Another participant highlighted that coverage may be higher in more deprived areas where the inhabitants may be more educated than would be expected given the level of deprivation, indicating that this anomaly could be explained at the population level.

> *'So although it's economically quite a crummy area, it might have a lot of over 25s, poor but well-educated people living in it and things like that. …But there's clearly a lot more to it than just access to GP appointments.'*
> (Cancer Screening Quality Assurance Director, ID 11)

7.4 Discussion

Building on the work undertaken in Study 3, this study aimed to explore the factors that hinder or support cervical screening coverage in PCTs in England. The opportunity to interview twelve health professionals who work in the NHS Cervical Cancer Screening Programme enabled me to investigate these factors in much greater depth.

7.4.1 Screening Programme Delivery

Health professionals considered a broad variety of factors to be important for cervical screening coverage. Some factors such as good general practice staff training and dedicated staff were considered to be unequivocally supportive of higher cervical screening coverage. The role of GP staff has been found to be important to women and can support their willingness to attend cervical screening (O'Connor et al., 2014) and their experience of the actual test (Armstrong et al., 2011). Whereas restricted flexibility in the provision of cervical screening appointments and the effects of high population mobility were found to be detrimental to higher cervical screening coverage. Difficulty making appointments has been found to be affect cervical screening attendance, even among women who are positively inclined towards cervical screening (Waller et al., 2011, 2009), while population mobility is considered to be a particular issue for large cities (Millett et al., 2002). Issues related to population mobility are compatible with the lower levels of screening coverage found in London PCTs in studies 1, 2 and 3.

However, many other programme-delivery factors were more ambiguous. This included the standardisation of screening invitations which were welcomed as a means to ensure good quality information was sent to all women, yet they were also thought to impede higher cervical screening coverage by failing to engage with particular groups of women. There has been a great deal of research over the years about what information should accompany an invitation to cervical screening, of which many studies have sought to improve the quality of information available to both support screening attendance and informed decision-making (Everett et al., 2011; Davey et al., 1998; Forbes and Ramirez, 2014). However, there are also many concerns about the appropriateness of a standard invitation to different population groups as they may be unable to overcome language barriers in ethnic minority groups and may contribute to the lower levels of awareness of the purpose of cervical screening in ethnic minority groups (Marlow et al., 2015a, 2015b)

Health promotion was similarly ambiguous, to the extent that, while health professionals often considered them to be valuable tools to improve cervical screening coverage, they were simultaneously considered as often having been poorly evaluated or not evaluated at all. Even where health promotion campaigns were evaluated as helpful their impact was considered transient or time-limited. The "Jade Goody effect" may be considered as one such example of health promotion, albeit as the result of a tragic, real-life story, rather than a manufactured health promotion campaign (MacArthur et al., 2011). The effect of her story visibly increased cervical screening coverage. However, the impact of her story is now dissipating, as reflected in the results in Studies 1 and 2, where cervical attendance is now in decline since its peak in 2009/10.

The factors gathered under the overarching theme of programme-delivery factors varied greatly from the type of information I was able to use in Study 2 when using quantitative measures. Measures such as the number of full-time practice staff, size of the practice, practitioner headcount, or the ethnicity of the general practitioner or sample taker were found to be statistically significant, at least in univariate analyses for cervical screening coverage for younger and/or older women. However, these factors were not often mentioned in these studies. This may be due to the difficulty in interpreting the meaning behind some of these quantitative measures and how they may impact cervical screening coverage in a meaningful way that may be observed by those working in the programme. However, the need for general practice staff who are well-trained in the importance of supporting cervical screening coverage and helping women to overcome barriers was discussed at some length in this qualitative study. Therefore, both studies in their own ways identified the importance of general practice staff in achieving higher cervical screening coverage.

The reorganisation of the NHS was considered by many health professionals to have an effect on the delivery of the NHS Cervical Screening Programme. While a few health professionals considered the new structures to be advantageous, or even that this may settle down, there were many concerns that the health professionals were more distant from the areas that they support. This insight into the perceived effects of organisational change on screening coverage is novel. As far as the author is aware, these views have not been reported elsewhere.

It was interesting to note that health professionals who worked in different cities in England considered there to be specific factors that impacted cervical screening coverage. London, in particular, was highlighted, but also were the inner city areas of Birmingham, Manchester and Liverpool. The factors considered salient were population mobility and a higher percentage of ethnic minority groups living in these areas. This is supportive of my earlier findings that suggested that there could be specific factors that converge within London, at least, to impede improved cervical screening coverage.

7.4.2 Population Factors

Evidence from the study suggests that knowledge and awareness of the cervical screening programme is very important to support cervical screening coverage across all social groups, and was also highlighted as one of the contributing factors for lower attendance of women in more deprived areas. This is supported by findings that women of lower SES may have lower awareness of the benefits of screening (Lostao et al., 2001; Sutton and Rutherford, 2005; Wardle et al., 2004). Previous bad experiences including domestic violence (Cadman et al., 2012), emotional barriers and practical barriers (Waller et al., 2009) were considered by health professionals in this study to hinder higher cervical screening coverage and have also been associated with lower cervical screening coverage in other studies. It was interesting to note that a number of factors were considered to explain lower attendance both at cervical screening and at colposcopy. Many factors, including a women's engagement with screening and the ways in which emotional and practical barriers could be overcome, were openly discussed and potential solutions proposed. Many of these solutions related to programme-delivery factors that could be improved, such as good training of staff, or increased flexibility of appointment times. These latter options highlight the inter-relations between programme-delivery factors and engagement with the population for whom the programme assists.

It is interesting to note that ethnic minority women, women living in deprived areas, those with lower levels of education, younger women and those living in more urban areas were all mentioned by the health professionals in this study as groups of women or particular factors that may require particular attention to achieve higher cervical screening coverage. All of these factors were found to be significantly associated with cervical screening in Study 2. With regards to ethnic minority groups, the quantitative study (Study 2) was able to decipher clear differences in association between cervical screening coverage and particular ethnic minority groups, because I was able to include measures related to Asian, Black and Mixed ethnic minorities and 'other' minor ethnicities. However, this study (Study 3) was able to provide further explanation as to why screening may be lower in these groups. In particular, one of the health professionals considered higher levels of education to be a protective factor in more deprived areas. PCTs identified as high-performing in Study 2 were also found to have areas of deprivation associated with areas with a higher percentage of educated women.

7.4.3 Strengths and Limitations

The use of in-depth interviews in this study enabled the participants' views of factors associated with cervical screening coverage to be explored openly and without the constraints of surveys or questionnaires. The inclusion of participants who worked in the NHS Cervical Screening Programme also provided an insider's perspective, and for many participants who had been responsible for cervical screening delivery in one or more PCTs, they were able to provide a full-programme overview of how the screening programme was delivered and how changes in one part of the programme may impact other parts.

The study, however, was limited as I was unable to explore the health professionals' views in relation to high- and low-performing PCTs because of the restructuring of the NHS following the 2012 Health and Social Care Act. I had originally wanted to do this to enable me to produce an in-depth analysis of the variations in cervical screening coverage across England, specifically with reference to PCTs that have been identified as having exceptional coverage. The vision was that I would be able to explore the issues more fully with in-depth interviews with people who work on the screening delivery side. This may have formed the basis of case studies to use as examples of best practice or to identify PCTs that would benefit from further support.

The study was limited by the number of participants recruited to the study. Unfortunately, political events overtook my study when the coalition government, at the time, announced that the NHS would be reorganised, and as part of that reorganisation PCTs would no longer be in effect as of 1st April 2013 (NHS Choices, 2015). At that time, I was still working on the analyses to identify the high- and low-performing PCTs. Towards the end of 2012 I decided that I would contact some health professionals working in the NHS Cervical Screening Programme, even though I had not yet identified if they were working in high- or low-performing PCTs. However, my attempts to arrange interviews in late 2012/early 2013 were either met with silence or with responses to suggest that I contact them again towards late summer/early autumn 2013 when things had 'settled down' again following the impending reorganisation of the NHS. This further delayed the start of this study and also ultimately posed challenges to the recruitment of participants, as the reorganisation itself meant the disbanding of PCTs and displacement of many staff from their original posts, and that others, as I later found out, left the NHS altogether. Therefore, the sample was also largely dictated by who I could contact, rather than on any purposive sampling to explore the differences between high and low performing areas. This is acknowledged as a limitation of the study. In combination with the small sample size, this has meant that my findings are unlikely to have reached saturation, and therefore, the findings may be limited in their capacity to uncover all salient points.

Exploring the views of health professionals working in the NHS Cervical Screening Programme could still contribute to my understanding of the complex relationship between the many factors known to affect cervical screening coverage. There is still a great deal of crossover between PCTs and the new Clinical Commissioning Groups (CCGs) so some of the PCT-specific points raised in the interviews continue to have some relevance. Further, the reorganisation of the NHS also opened up the opportunity to explore how organisational change may be considered to affect screening coverage. Of course, this did not affect the interpretation of findings from the quantitative studies, as these changes were subsequent to the periods included in the earlier studies. Yet, they still provided a vehicle for the health professionals to consider how the organisational structure of the NHS, and now Public Health England, may affect screening coverage.

7.5 Conclusion

This study provided an opportunity to consider the views of health professionals in the NHS Cervical Screening Programme and, as far as I am aware, is the only study to address the impact of the NHS reorganisation on the delivery of the NHS Cervical Screening Programme. Screening programme delivery was considered to be strongly supported by dedicated staff and good staff training. The standardisation of screening invitations and supporting information was considered to have both positive and negative effects on screening coverage. However, any recommendations for changes to the delivery of the NHS Cervical Screening Programme, even at a smaller area-level, need to be considered in relation to their effect on other parts of the programme. Health promotion initiatives were considered to require greater evaluation. Many of the populations already identified as being associated with lower screening coverage (deprived, ethnic minority, younger women) and levels of knowledge and awareness, previous experiences and emotional and practical barriers were considered important areas for consideration.

Chapter 8: Potential Mediators of the Association between SES and Screening Attendance (Study 5)

8.1 Introduction

In Study 3, I investigated the relationship between area-level cervical screening coverage and income deprivation, and other area-level factors that may explain the variation in cervical screening attendance. In Study 4, I sought further explanation for the variation in PCT-level cervical screening coverage by analysing the views of professionals who work in the NHS Cervical Screening Programme. This enabled me to consider the local factors that may affect cervical screening attendance, gather evidence of other factors that are either not available through routine data or that may not yet have been considered relevant, and to see if the views of the professionals help further explain the evidence I had found to date. In this study I sought to consider women's individual beliefs about the cervical screening programme, and if they mediate the association between socioeconomic status and cervical screening attendance.

A psychological approach was considered appropriate as this addresses the role that eligible women's own perceived benefits of cervical screening play in influencing cervical screening attendance.

Advances in the understanding of health behaviour have been supported by the use of social cognition models, an array of theories that have been developed to promote understanding of the choices and actions that people make in relation to their health (Stephens, 2008). Broadly, these psychological approaches seek to establish the extent to which an individual's beliefs, knowledge and awareness affect health behaviour. A full introduction of social cognition models is beyond the scope of this thesis but I will provide an overview of two of the most prominent models within its realm: the Health Belief Model; and the Theory of Planned Behaviour. This is intended to provide the general theoretical framework in which this study operated.

The Health Belief Model suggests that health behaviour decisions are based on an individual's perception of disease, their perceived severity of the disease and of their own susceptibility to it; the balance of the perceived benefits of taking preventative action and the barriers to such action (Becker and Maiman, 1975). The ultimate likelihood of the health behaviour being actioned is also subject to external cues such as health promotion campaigns (local or national) and advice from others. One simplistic interpretation of how the Health Belief Model may frame cervical screening attendance could be to suggest that attendance would be higher in women who perceive cervical cancer as a personal threat, and that any barriers to screening attendance would be outweighed by the women's overall perception of the benefit of cervical screening as a means to prevent cervical cancer.

The Theory of Planned Behaviour, an extension of the Theory of Reasoned Action, suggests inter-related concepts such as attitudes towards a behaviour, perceived behavioural control and subjective norms form the basis of an individual's intentions, and that intentions predict behaviour (Ajzen, 1991). The translation from intention to action is central to the theory. Intentions are considered to be constrained, or supported, by an individual's access to resources including money, availability of time or even support from others. In this respect, a health behaviour may be actioned on the basis that the person has access to the necessary opportunities or resources for performing the action, and has formed the intention of doing so. One simplistic interpretation of how the Theory of Planned Behaviour may frame cervical screening attendance could be to suggest that attendance would be higher in women who have formed the intention to attend screening based on their perception that cervical screening is beneficial, that they have the means to attend and that they know their friends also attend screening. This intention to attend screening would form the basis upon which we could predict their actual attendance.

The Theory of Planned Behaviour has both similarities to, and differences from, the Health Belief Model (Gerend and Shepherd, 2012). They both take an individual-level approach and are largely based upon the assumption that people are rational decision-makers. The concept of perceived barriers from the Health Belief Model may be considered to be similar to the perceived behavioural control of the Theory of Planned Behaviour, insofar as they both reflect the extent to which an individual believes they are able to carry out the behaviour. This could also be interpreted as representing the individual's perceived self-efficacy in performing the health behaviour. The main difference between the models is the integration of intention as a predictor of health behaviour in the Theory of Planned Behaviour; although, it has been considered that perceived susceptibility and perceived barriers in the Health Belief Model could be viewed as precursors of intention, although they are not explicitly declared as such in the model (Gerend and Shepherd, 2012).

Von Wagner's et al's conceptual framework of the psychosocial determinants of socioeconomic inequalities in cancer screening participation, draws upon social cognition models, as it considers attitudes to mediate the association between socioeconomic status and screening attendance (C. von Wagner et al., 2011). These attitudes include women's response efficacy regarding the beneficial effects of screening (for example, knowledge of the benefits of cancer screening and early detection). These attitudes are then counterbalanced with the person's ability to process the information available to them (for example, levels of health literacy) and how their overall intentions, or intention to attend screening is translated into action. This is a useful framework for the wider consideration of how socioeconomic status may be associated with variation in cancer screening attendance.

I was able to test the mediating role of perceived benefits using data that had been collected as part of a population-based survey conducted in 2009. The survey had been designed to collect data on the Cervical Cancer Awareness Measure (Simon et al., 2011). Inevitably, the data items available for use were limited, but they included some items about the perceived benefits of cervical screening. These items provided me with the opportunity to explore potential mediators of the association between socioeconomic status and cervical screening attendance.

Evidence has suggested that perceived benefits of cervical screening may be associated with cervical screening attendance. Women who believe 'there's no point in going for screening without symptoms' (Waller et al., 2009), 'I don't want to know if they have cervical cancer' (Lo et al., 2013), or 'I don't trust the cervical screening test' (Sutton and Rutherford, 2005) are more likely to be overdue for cervical screening, while women who believe that cervical screening is effective are more likely to attend (Sutton and Rutherford, 2005). Other studies indicate that women of lower socioeconomic status are less aware of the benefits of screening (Lostao et al., 2001; Sutton and Rutherford, 2005; Wardle et al., 2004) and therefore may be less likely to perceive screening attendance as a worthwhile health behaviour.

The aim of the study was therefore to investigate whether perceived benefits of cervical screening mediate the association between socioeconomic status and self-reported cervical screening attendance.

8.2 Method

8.2.1 Recruitment

The survey was conducted by the social research agency, TNS BMRB[12], using random location sampling. The survey runs weekly and comprises of different modules from various clients merged into one questionnaire. Participants are recruited using stratified random location sampling and are interviewed at home using Computer Assisted Personal Interviewing (CAPI) in the presence of trained interviewers (Stubbings et al., 2009). The sample size was 1392 English-speaking women; of whom 933 were between 25 and 64 years old (i.e. eligible for cervical screening). Of these, 51 women reported having had a hysterectomy, 5 did not know their screening status, 6 declined to answer the screening status question, 4 said they had not been invited for a test, 1 did not provide her education level, and 2 did not provide their housing tenure; these women were excluded from the analyses. Women aged 25 years (n = 22) were also excluded because they may not have received their first screening invitation. This left a sample of 842.

[12] www.tns-bmrb.co.uk

No identifiable information was collected from respondents so the data were anonymous and therefore exempt from ethical approval. This is in accordance with the UCL Research Ethics Committee Exemptions guidelines, which state that 'Research involving the use of non-sensitive, completely anonymous educational tests, survey and interview procedures when the participants are not defined as "vulnerable" and participation will not induce undue psychological stress or anxiety' is exempt (UCL Research Ethics Committee, 2015).

8.2.2 Measures

Perceived Benefits of Cervical Screening

As part of a longer interview which included the Cervical Cancer Awareness Measure (Simon et al., 2011), some results of which are reported elsewhere (Low et al., 2012), perceived benefits of cervical screening were assessed. Respondents were asked to indicate how much they agreed or disagreed with three statements: 1) '*the chances of curing cervical cancer are better when the disease is discovered at an early stage'; 2) 'cervical screening can pick up cell changes that can go on to become cervical cancer'*; and 3) *'cervical screening is effective in preventing cervical cancer',* with response options ranging from 'Strongly Agree' to 'Strongly Disagree' on a 5-point Likert scale. Respondents could also indicate 'Don't Know' or refuse to answer the question; these responses were coded as missing and were not included in the analyses. Responses were dichotomised to 'Agree' (Strongly agree/Agree) vs 'Do not agree' (all other responses).

Screening Status

Women were asked if they had taken part in cervical screening, and how recently, from which a screening status of 'up-to-date' or 'overdue' was determined. For women aged 26–49 years 'up-to-date' was defined as having been screened within the last 3 years, and for women aged 50–64 years 'up-to-date' was defined as having been screened within the last 5 years. Respondents who exceeded these limits, or who had never had a test, were classified as 'overdue'.

SES and Demographic Factors

Included items to assess age, ethnicity, marital status and occupational status (employed full-time, employed part-time, or not working/unemployed). The number of participants in any one ethnic minority group was low, so these respondents were grouped together to create a dichotomous variable of white or non-white. Marital status was defined as married (including living as married), single and other (including separated/divorced/widowed).

Markers of SES included housing tenure (own outright/with mortgage, rent privately/from a housing association), car ownership (yes/no), education and social class. Education was grouped into higher-level (degree); mid-level (A levels/Highers, higher education below degree, other or still studying); and low-level (O Level/GCSE, ONC, BTEC and no formal qualifications). Women who responded 'other' were placed in this group as they did not give evidence of qualifications.

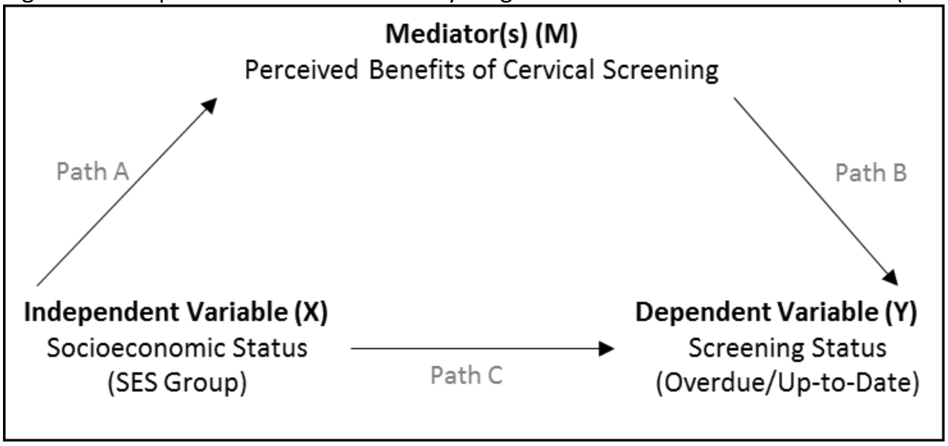
In Studies 1, 2 and 3, I used the income domain of the IMD as an area-level marker of SES but income was not available in the survey data. It was preferable to use the available individual-level markers of SES, particularly in light of the analyses of individual-level psychosocial data. I explored using different markers of SES. One approach used individual level occupational social grade as a measure of SES (see Appendix 8). In this chapter, three other markers of SES available (housing tenure, car ownership and education) were used to create an index of socioeconomic status, similar to the Townsend Material Deprivation Index scores (Townsend et al., 1986). As discussed in Chapter 2, the Townsend Index is an index of area-level socioeconomic deprivation derived from census information on housing tenure, car ownership, unemployment and over-crowded households. Using multiple indicators of SES may more ably represent the wider social determinants of health, rather than purely focusing on income deprivation (Marmot, 2005). Using the individual-level SES data from the survey, SES was indexed by allocating 1 point each for owning a home or having a car, plus one point for mid-level education and 2 points for higher-level education. This resulted in scores ranging from 0 (lower SES) to 4 (higher SES), which is similar to composite SES measures used in other studies (K. A. Robb et al., 2009; Wardle et al., 2004). However, in the analyses the two lower SES groups (0 and 1) were combined into Group 1 to balance cell sizes. This resulted in an SES index ranging from 1 to 4.

8.2.3 Analyses

A rim weighting technique, created by TNS BMRB, was used to achieve a demographic profile within the full sample (n = 1392) that was representative of women in England aged 16 years and over. The weights were calculated to give a mean weight of 1 for the full sample. Target profiles were set for occupational status, parity, age group, social grade and geographical region. Analysis of the weighted data was carried out using the Complex Samples Function in SPSS v21. Chi-square tests were used to assess the demographic differences across the SES for both weighted and unweighted data (unreported). Weighted data were used for the analysis of the subsample of data (n = 797). The mean weight of the subsample, was no longer equal to one so when weights were applied, this reduced the sample size to 797. The reduction in sample size was due to the adjustments of the weightings and not to missing data within the subsample.

Mediation analysis was carried using the Baron and Kenny approach (Baron and Kenny, 1986). Figure 24 outlines Baron and Kenny's four-step criteria for mediation, described using the variables included in this analyses. Criterion 1: there should be a statistically significant relationship between SES and Screening Status (Path C). Criterion 2: variation in the socioeconomic status variable (SES Group) should be significantly associated with variation in the potential mediator(s), that is, perceived benefits of cervical screening (path A). Criterion 3: variation in the perceived benefits of cervical screening should be significantly associated with variation in Screening Status (Dependent Variable), (path B). Criterion 4: that the statistically significant relationship (path C) should no longer be significant, or reduced, when Path A and Path B are controlled for. The method of Freedman et al. (1992) was used to estimate the percentage of the effect of SES on screening status mediated by the belief variables (Freedman et al., 1992).

Figure 24. Adapted from Baron and Kenny Diagram of Statistical Mediation Model (1986)



Chi-square tests were used to assess associations between i) screening status and SES group, ii) perceived benefits of cervical screening and screening status, and iii) perceived benefits and SES group. The effects of potential mediating variables were examined in four logistic regression models on the odds ratios associated with being overdue for screening. Model 1 included univariate analyses of SES and the demographic variables (Age, Marital Status and Work Status) found to be statistically significantly associated with both screening status and SES. Variables that were significant at the 5% level in the univariate analysis were included in the subsequent multivariate analysis and Wald tests used to determine which remained significant, given the presence of other independent variables. Models 2 and 3 modelled the independent effects of each belief variable, and Model 4 included both belief variables. A reduction in the Wald tests and odds ratios associated with being overdue for screening when other variables were added was taken to indicate that these variables mediated some of the effect of SES on screening status. The size (percentage) of the mediating effect of SES on screening status was calculated for each model (Freedman et al., 1992).

8.3 Results

8.3.1 Sociodemographic Characteristics

Table 14 details the sample characteristics using weighted data, grouped by SES group. Analyses reported here use the weighted data. Participants were aged 26–64 years (M = 42.0). Lower SES groups were more likely to be younger (χ^2 = 23.42, df = 6, p = 0.003), from non-white ethnic backgrounds (χ^2 = 15.99, df = 3, p = 0.001), single (χ^2 = 90.78, df = 6, p < 0.001), and not working (χ^2 = 41.09, df = 6, p < 0.001).

Table 14. Demographics and SES (1 = lowest SES and 4 = highest SES), (Weighted n = 797)

	SES Group				
	1 (n=180) Low SES	2 (n=265)	3 (n=178)	4 (n=174) High SES	Stat. test of group difference
Age %					
26–35yrs	38.6	21.5	23.6	28.4	χ^2 = 23.42, df = 6, p = 0.003
36–49yrs	38.1	40.2	42.6	43.8	
50–64yrs	23.3	38.3	33.8	27.8	
Ethnicity %					
White	81.2	92.6	90.9	89.5	χ^2 = 15.99, df = 3, p = 0.001
Non-white	18.8	7.4	9.1	10.5	
Marital Status %					
Married	46.8	82.7	78.6	76.9	χ^2 = 90.78, df = 6, p < 0.001
Single	32.3	8.5	8.4	10.9	
Other	20.9	8.7	13.0	12.2	
Work Status %					
Full-time	21.8	29.6	47.2	40.8	
Part-time	35.2	41.3	28.4	37.5	χ^2 = 41.09, df = 6, p < 0.001
Not working/ unemployed	43.1	29.1	24.4	21.6	

N.B. Weighted (n = 797)

8.3.2 Screening Status, SES and Demographic Variables

There was a significant association between SES and screening status (see Table 15). This satisfies criterion 1 of the four-steps to mediation (Path C in Figure 24). Women in lower SES groups were more likely to be overdue for screening than women in higher SES groups (28% in lowest SES vs 12% in highest SES group), but the effect was not linear across the intermediate groups. Younger women were more likely to be overdue than older women (23% of 26–35 year-olds vs 14% of 50–64 year-olds). Single women were more likely to be overdue than other marital status groups (28% single vs 18% married/other). Women in full-time work were more likely to be overdue than those working part-time (22% vs 14%). Ethnicity was not significantly associated with screening status.

Table 15. Screening Status, SES and Demographic Factors ł, (Weighted n = 797)

	Screening Status		
	Overdue % (n = 154)	Up-to-date % (n = 643)	Test for association
SES			
1 – Lowest SES Group	27.7 (50)	72.3 (130)	$\chi2$ = 16.86, df = 3, p = 0.002
2	16.8 (44)	83.2 (220)	
3	22.0 (39)	78.0 (139)	
4 – Highest SES Group	12.0 (21)	88.0 (154)	
Age			
26–35 years	23.4 (51)	76.6 (167)	$\chi2$ = 8.93, df = 2, p = 0.016
36–49 years	21.2 (69)	78.8 (258)	
50–64 years	13.5 (34)	86.5 (218)	
Ethnicity			
White	18.6 (131)	81.4 (576)	$\chi2$ = 3.15, df = 1, p = 0.066
Non-white	26.3 (23)	73.7 (65)	
Marital Status			
Married	18.0 (104)	82.0 (473)	$\chi2$ = 6.22, df = 2, p = 0.046
Single	27.7 (32)	72.3 (83)	
Other	18.1 (19)	81.9 (86)	
Work Status			
Full-time	22.0 (54)	78.0 (192)	$\chi2$ = 6.38, df = 2, p = 0.047
Part-time	14.1 (37)	85.9 (224)	
Not working/unemployed	20.7 (44)	79.3 (168)	

ł May not add to 100% (797) due to rounding or missing values

Potential explanatory variables (age, marital status and work status) were all associated with both SES and screening status so these variables were considered for inclusion in the multivariate analyses. The associations between these explanatory variables are reported in Table 16. The variables were tested for collinearity using the Tolerance and Variance Inflation Factor (VIF) in SPSS. All variables were in the range 0.799 – 0.951 for Tolerance and 1.051 – 1.252 for VIF and therefore collinearity was not detected.

Table 16. Inter-relationship between potential explanatory variables and belief variables

	Age	Ethnicity	Marital Status	Work Status	The chances of curing cervical cancer are better...	Cervical screening can pick up cell changes…
Age	-					
Ethnicity	χ2=30.27, df=2, p<.001	-				
Marital Status	χ2=97.38, df=4, p<.001	χ2=17.89, df=4, p<.001	-			
Work Status	χ2=12.40, df=4, p=.015	χ2=15.32, df=4, p<.001	χ2=23.58, df=4, p<.001	-		
The chances of curing cervical cancer are better...	χ2=21.69, df=4, p<.001	χ2=38.36, df=2, p<.001	χ2=15.46, df=4, p=.004	χ2=6.28, df=4, p=.180	-	
Cervical screening can pick up cell changes….	χ2=31.90, df=4, p<.001	χ2=87.89, df=2, p<.001	χ2=10.88, df=4, p=.028	χ2=16.13, df=4, p=.003	χ2=171.37 , df=4, p<.001	-
Cervical screening is effective…	χ2=8.73, df=4, p=.068	χ2=6.05, df=2, p=.048	χ2=4.59, df=4, p=.332	χ2=2.84, df=4, p=.585	χ2=118.09 , df=4, p<.001	χ2=87.06 df=4, p<.001

8.3.3 SES Differences in Perceived Benefits of Cervical Screening

Associations between SES and the belief variables are shown in Table 17. Of the highest SES group, 99% agreed the ‘chances of curing cervical cancer are better when the disease is discovered at an early stage’ compared with 88% of the lowest SES group and 96% vs 83% agreed that ‘cervical screening can pick up cell changes that can go on to become cervical cancer’. Agreeing that ‘cervical screening is effective in preventing cervical cancer’ was not significantly associated with SES. The perceived benefits ‘the chances of curing cervical cancer are better when the disease is discovered at an early stage’ and ‘cervical screening can pick up cell changes that go on to become cervical cancer’ satisfied Criterion 2 of the four-step criteria for mediation (Path A).

Table 17. Perceived benefits of cervical screening by SES ƚ, (Weighted n= 797)

	% (n)				
	SES 1 (n = 180) Low	SES 2 (n = 265)	SES 3 (n = 178)	SES 4 (n = 174) High	Test for association
The chances of curing cervical cancer are better when….					
Agree	88.0 (158)	93.6 (248)	97.6 (174)	99.1 (172)	χ2=26.33, df=3, p < 0.001
Disagree/Neither	12.0 (21)	6.4 (17)	2.4 (5)	0.9 (2)	
Cervical screening can pick up cell changes….					
Agree	83.2 (148)	90.5 (240)	95.3 (168)	96.4 (167)	χ2=25.47, df=3, p < 0.001
Disagree/Neither	16.8 (30)	9.5 (25)	4.7 (8)	3.6 (6)	
Cervical screening is effective in preventing cervical cancer					
Agree	85.1 (153)	74.9 (198)	80.3 (143)	82.8 (144)	χ2=8.55, df=3, p=0.06
Disagree/Neither	14.9 (27)	25.1 (66)	19.7 (35)	17.2 (30)	

ƚ Numbers may not agree with total due to rounding or missing values

8.3.4 Screening Status and Beliefs about Cervical Screening

The next set of analyses examined the association between screening status and the perceived benefit variables (see Table 18). Two of the three perceived benefits of cervical screening showed significant associations with screening status. Women who were up-to-date were more likely to agree that the 'chances of curing cervical cancer are better when the disease is discovered at an early stage' than those who were overdue (96% vs 89%). They were also more likely to agree that 'cervical screening can pick up cell changes that can go on to become cervical cancer' (93% vs 85%). There was no significant association with agreeing that 'cervical screening is effective in preventing cervical cancer'**.** The perceived benefits 'the chances of curing cervical cancer are better when the disease is discovered at an early stage' and 'cervical screening can pick up cell changes that go on to become cervical cancer' satisfied Criterion 3 of the four-step criteria for mediation (Path B).

Table 18. Perceived benefits of cervical screening by screening status ɫ, (Weighted n = 797)

	Overdue (n = 154)	**Up-to-date (n = 643)**	**Test for association**
The chances of curing cervical cancer are better When the disease is discovered at an early stage			
Agree	89.0 (137)	95.8 (615)	$\chi2 = 11.53$, df = 1, $p < 0.001$
Disagree/Neither	11.0 (17)	4.2 (27)	
Cervical screening can pick up cell changes that can go on to become cervical cancer			
Agree	85.2 (130)	92.6 (593)	$\chi2 = 9.02$, df = 1, $p = 0.002$
Disagree/Neither	14.8 (23)	7.4 (47)	
Cervical screening (the smear or Pap test) is effective in preventing cervical cancer			
Agree	76.0 (117)	81.1 (521)	$\chi2 = 2.13$, df = 1, $p = 0.154$
Disagree/Neither	24.0 (37)	18.9 (121)	

ɫ Numbers may not agree with total due to rounding or missing values

8.3.5 Mediational Analyses of the Relationship between SES and Screening Status

Four logistic regression models with screening status (overdue/up-to-date) as the dependent variable tested mediation. Odds ratios (OR) for being overdue are shown in Table 19.

Model 1

Model 1 included univariate analyses of SES, age, marital status and work status (with Wald F, p-values and ORs for the variables shown in Table 19). Age was significantly associated with being overdue for screening, Wald F (3.829), p = 0.022. Women aged 50-64 years were less likely to be overdue for screening (OR = 0.37, 95% CI: 0.20 – 0.69) in comparison to younger women aged 25-35 years. Marital Status was significantly associated with being overdue for screening, Wald F (3.089), p = 0.046. Single women were more likely to be overdue for screening than married women (OR = 1.75, 95% CI: 1.12-2.74), p = 0.046. Work Status, overall, was not significantly associated with being overdue for screening, Wald F (2.833), p = 0.059, although there were indications that women who worked part-time were less likely to be overdue for cervical screening than those who worked full-time (OR = 0.58, 95% CI: 0.36 – 0.94).

SES was significantly associated with being overdue for screening, Wald F (5.461) p= 0.001. The lower SES groups were significantly more likely to be overdue for screening than the highest SES group (reference category), with the exception of SES Group 2 where the size of the effect was non-significant (OR = 1.64, 95% CI: 0.88–3.07). The OR for being overdue for screening in the lowest SES group was 3.34 (95% CI: 1.77–6.29). This satisfied Criterion 1, that there should be a statistically significant relationship between SES and Screening Status, of the four-steps of mediation (Path C, Figure 24).

Model 2

Model 2 included SES, the control variables that had been statistically significant in Model 1 (age and marital status), and the perceived benefit of screening ‘the chances of curing cervical cancer are better when the disease is discovered at an early stage'. Neither Age nor Marital Status were significantly associated with screening status, Wald F (2.237), p = 0.107 and Wald F (0.522), p = 0.594 respectively.

The perceived benefit was associated with screening attendance, where the OR for being overdue for screening was statistically significant for those who disagreed or neither agreed nor disagreed with the statement (OR = 2.19, 95% CI: 1.20–3.99), Wald F (6.578), p = 0.010.

This model showed a reduction in the odds ratios associated with being overdue across SES groups in comparison with Model 1 and a reduction in statistical significance, Wald F (3.166), p = 0.024. The OR for being overdue for screening in the lowest SES group was 2.31 (95% CI: 1.26–4.27). This indicates that this variable may mediate some of the association between SES and screening status to a small degree.

This satisfied Criterion 4, that the statistically significant relationship (Path C, Figure 24) should no longer be significant, or should be reduced, when the potential mediators and other control variables are accounted for. Freedman's estimate for the percentage of the association between deprivation in the lowest SES group (SES Group 1) and screening status mediated by this perceived benefit variable is 30.8%.

Model 3

Model 3 included SES, the control variables that had been statistically significant in Model 1, and the perceived benefit 'Cervical screening can pick up cell changes that can go on to become cervical cancer'. Neither Age nor Marital Status were associated with screening status, Wald F (2.220), p = 0.109 and Wald F (0.547), p = 0.579 respectively.

The perceived benefit variable was associated with screening status, where the odds for being overdue for screening for screening were statistically significant for those who disagreed or neither agreed nor disagreed with the statement (OR = 1.77, 95% CI: 1.05–3.00), Wald F (4.664), p 0.031. Women in SES groups 1 and 3 had significantly increased odds of being overdue for screening compared with women in the highest SES group. The odds ratios were lower in this model in comparison with Model 1 and there was a reduction in statistical significance, Wald F (3.045), p = 0.028.

This result could be considered to have satisfied Criterion 4, that is, that the statistically significant relationship (Path C, Figure 24) should no longer be significant, or should be reduced, when the potential mediators and other control variables are accounted for. Freedman's estimate for the percentage of the association between deprivation in the lowest SES group (SES Group 1) and screening status mediated by this perceived benefit variable is 31.7%.

<u>Model 4</u>

Model 4 included SES and both perceived benefit variables, but no longer included Age and Marital Status as they were no longer significantly associated with Screening Status in Models 3 and 4).

The perceived benefit of screening 'the chances of curing cervical cancer are better when the disease is discovered at an early stage' remained significantly associated with screening status where those who disagreed or neither agreed no disagreed were more likely to be overdue for screening (OR = 2.01, 95% CI: 1.04 – 3.89), Wald F (4.337), p = 0.038. However, the perceived benefit 'Cervical screening can pick up cell changes that can go on to become cervical cancer' was no longer significantly associated with screening status, Wald F (2.020), p = 0.156.

Women in SES groups 1 and 3 had significantly increased odds of being overdue for screening compared with women in the highest SES group. The odds ratios were lower in this model in comparison with Model 1 and there was a reduction in statistical significance, Wald F (3.531), p = 0.015.

This satisfied Criterion 4, that the statistically significant relationship (Path C) should no longer be significant, or should be reduced, when the potential mediators and other control variables are accounted for. Freedman's estimate for the percentage of the association between deprivation in the lowest SES group (SES Group 1) and screening status mediated by this perceived benefit variable is 31.1%.

Table 19. SES and perceived benefit predictors for being overdue for screening [1]

	Overdue % (n)	Model 1 **Wald F, p** OR (95% CI)	Model 2 Incl. Chances of Cure.. **Wald F, p** OR (95% CI)	Model 3 Incl. Screening Picks Up… **Wald F, p** OR (95% CI)	Model 4 Both Variables **Wald F, p** OR (95% CI)
SES Group		**F (5.461), 0.001**	**F (3.166), 0.024**	**F (3.045), 0.028**	**F (3.531), 0.015**
1 (n = 180)	27.7 (50)	3.34 [1.77–6.29]	2.31 [1.26–4.27]	2.28 [1.23–4.21]	2.30 [1.26–4.19]
2 (n = 265)	16.8 (44)	1.64 [0.88–3.07]	1.46 [0.80–2.69]	1.49 [0.81–2.74]	1.36 [0.74–2.49]
3 (n = 178)	22.0 (39)	2.48 [1.30–4.72]	2.10 [1.12–3.94]	2.15 [1.15–4.02]	2.04 [1.09–3.83]
4 (high SES, n = 174)	12.0 (21)	1.00	1.00	1.00	1.00
Age		**F (3.829), 0.022**	**F (2.237), 0.107**	**F (2.220), 0.109**	
26–35 years	23.4 (51)	1.00	1.00	1.00	
36–49 years	21.2 (69)	0.96 [0.63-1.48]	0.98 [0.65-1.49]	0.96 [0.63-1.47]	
50–64 years	13.5 (34)	0.37 [0.20-0.69]	0.60 [0.36-1.01]	0.60 [0.36-1.01]	
Marital Status		**F (3.089), 0.046**	**F (0.522), 0.594**	**F (0.547), 0.579**	
Married	18.0 (104)	1.00	1.00	1.00	
Single	27.7 (32)	1.75 [1.12-2.74]	1.29 [0.79-2.11]	1.30 [0.79-2.14]	
Other	18.1 (19)	1.01 [0.59-1.72]	1.02 [0.58-1.79]	1.04 [0.59-1.82]	
Work Status		**F (2.833), 0.059**			
Full-time	22.0 (54)	1.00			
Part-time	14.1 (37)	0.58 [0.36-0.94]			
Not working/unemployed	20.7 (44)	0.78 [0.50-1.24]			
The chances of curing cervical cancer…			**F (6.578), 0.010**		**F (4.337), 0.038**
Disagree/Neither Agree Nor Disagree	11.0 (17)		2.19 [1.20–3.99]		2.01 [1.04–3.89]
Agree	89.0 (137)		1.00		1.00
Cervical screening can pick up cell changes…				**F (4.664), 0.031**	**F (2.020), 0.156**
Disagree/Neither Agree Nor Disagree	14.8 (23)			1.77 [1.05–3.00]	1.53 [0.85–2.74]
Agree	85.2 (130)			1.00	1.00

1. Reference Category (Up To Date) n = 643, overdue n = 154.

8.4 Discussion

As expected from the results found in Study 1 and Study 2, being overdue for cervical screening was more common in women from lower socioeconomic backgrounds. The finding is also consistent with previous research which has associated lower levels of cervical screening attendance with women of lower socioeconomic status (Baker and Middleton, 2003; Bang et al., 2012; Moser et al., 2009).

The statements 'The chances of curing cervical cancer are better when the disease is discovered at an early stage' and 'Cervical screening can pick up cell changes that can go on to become cervical cancer' were endorsed more readily by those who were up-to-date with screening and in the higher SES groups. Using the Baron and Kenny approach, it is possible to infer that the two beliefs explained 31% of the association between SES and screening status; consistent with the idea that socioeconomic differences in beliefs about screening might be a pathway to socioeconomic differences in screening behaviour. However, it is acknowledged that these findings should be interpreted cautiously given that causality cannot be inferred with cross-sectional data.

The results are consistent with existing evidence of disparities in perceived benefits of cervical screening (Lo et al., 2013; Robb et al., 2010; Sutton and Rutherford, 2005; Wardle et al., 2004). In particular, the view that cervical cancer is better diagnosed at an early stage was more readily endorsed by higher SES groups in both Model 2 and Model 4. It may be that women of lower socioeconomic status are more likely to know of someone who has died of cervical cancer, as mortality rates of cervical cancer are higher and survival rates are poorer for this group. This may contribute to this group being less likely to endorse the benefits of cervical screening. Hence, the more sceptical views of the lowest SES group may explain, at least is some small part, their lower attendance at cervical screening. Lower SES groups have been found to be more fatalistic about cancer and place lower value on its early detection (Beeken et al., 2011).

Current research of socioeconomic variation in known barriers to screening may broaden the potential avenues in which to explore other individual-level mediators of socioeconomic status and cervical screening attendance. Cancer fatalism, a belief that death is inevitable when cancer is diagnosed, has been found to mediate the association between socioeconomic status and colorectal cancer screening (Miles, Rainbow, & Wagner, 2011). SES differences in fatalistic beliefs are also implicated in socioeconomic variation in the perceived value of early detection of cancer and in help seeking with a potential symptom of cancer (Beeken, Simon, Wagner, Whitaker, & Wardle, 2011).

A recent study of positively and negatively framed cancer beliefs found significant variation in the endorsement of negatively framed cancer beliefs across SES groups (Quaife et al., 2015). However, there was little SES variation in positive cancer beliefs, of which one stated ‘cancer can often be cured’. This may help explain the results of this study. It may be that while the positively framed messages used in this study were significantly associated with screening status, it may be that a negatively framed cancer belief may have explained a higher percentage of the association between SES and screening status.

Cancer fear, a multifaceted construct, has been associated with colorectal cancer screening, however, different aspects of cancer fear appear to support or hinder screening attendance (Vrinten, Waller, Wagner, & Wardle, 2015). This may be because some aspects of cancer fear may act to support the intention to attend screening, while others aspects have more relevance to the translation of those intentions into action (Power et al., 2008). However, cancer fear has been found to be particularly prevalent among women rather than men, and in those with lower levels of education (Vrinten, Jaarsveld, Waller, Wagner, & Wardle, 2014) rendering the exploration of its potential relationship with cervical screening attendance to be an important avenue for further investigation.

Health literacy may be another contender for further investigation. Higher levels of wealth (Kobayashi, Wardle, & von Wagner, 2014) and higher levels of education are associated with better health literacy and may act as a mediator of better health (Galobardes, Shaw, Lawlor, Lynch, & Smith, 2006). Lower health literacy has been associated with lower levels of information seeking and confidence to participate in cancer screening (von Wagner, Semmler, Good, & Wardle, 2009), and has also been identified as a barrier to colorectal cancer screening uptake (Kobayashi et al., 2014). As far as I am aware, neither cancer fatalism, cancer fear nor health literacy have been explored as a potential mediators of the association between SES and cervical screening attendance.

Younger women and women in full-time work were more likely to be overdue for cervical screening. This may suggest that life difficulties and practical barriers play a part in undermining screening attendance. In the previous chapter, Study 4, professionals who work in the NHS Cervical Screening Programme considered women's busy lives, lack of time and difficulty getting childcare as barriers to cervical screening attendance. Younger women, rather than older women, were found to raise practical issues more commonly than other barriers to screening in a qualitative study (Waller et al., 2011). This was supported by findings in a related qualitative study of professionals' views of barriers to cervical screening attendance where difficulties in finding time to attend screening were considered to be a particular challenge for younger women who were working and/or had children to look after (Waller et al., 2011). Findings from a population-based survey carried out in England in 2008–09 found practical barriers to be predictive of cervical screening attendance (Waller et al., 2009). It is not known if practical barriers mediate the association between socioeconomic status and cervical screening attendance but, given the apparent relevance of these issues to cervical screening attendance, further research in this area may be warranted.

The consideration of social cognition models in this study has provided a useful framework for understanding health behaviour. However, social cognition models can be limited in the extent to which an individual's actions are set within a social and cultural context (Crossley, 2000). Although some social cognition models do take into account the effects of peer-group pressure or social norms these may not reach the level of sophistication required to fully understand socioeconomic patterns of health behaviour. Social cognition models have been criticised for their over reliance on the rational evaluation of health choices and therefore may not sufficiently accommodate for behaviours that do not appear logical. This may marginalise the wider inclusion of emotional factors, socio-cultural factors and issues of power or freedom of choice. One example in which cultural factors may affect screening may be where a woman needs to seek permission from a spouse to attend screening, or hide their attendance from their partner (Holroyd et al., 2004), although given the predominantly white sample in this survey this consideration, and other socio-cultural or religious factors were not considered relevant to this study.

8.4.1 Strengths and Limitations

The primary focus of the survey was to collect data on the Cervical Cancer Awareness Measure (Simon et al., 2011), and it was not specifically designed to explore SES and cervical screening. This limited the study in two key areas: the sample size; and the availability of relevant independent variables.

With regards to the sample size, it was important that the beliefs about cervical screening were gathered from women who were eligible for the programme at the time of the survey. As a consequence, a subsample of eligible women (n = 842) from the full survey sample (n = 1392) were selected for analysis. This number was further reduced when weights, constructed by BMRB for the full sample, were applied to the subsample. However, sensitivity analyses undertaken to assess the demographic differences across the SES for both weighted (n = 797) and unweighted data (n = 842) found no significant differences.

The study was also limited in its ability to test the mediating effects of other belief variables or other pathways to socioeconomic variation in cervical screening attendance. In particular, it would have been interesting to have explored any potential differences in SES variation in the endorsement of positive and negatively framed beliefs on screening status, or to include other items that may have explored cancer fear or fatalism.

The use of the SES index may have limited the findings in this study. This may be due to critique of the individual components of the index or the combined effect of these individual components may not adequately represent an individual's socioeconomic status, or both (Braveman PA et al., 2005). The SES index comprised car ownership, home ownership and education. Asset based SES indictors such as car ownership and home ownership may be subject to different interpretations across place or time, as wider economic circumstances vary. The Townsend Index uses similar area-level measures

(Townsend et al., 1986). However, the mediation effects were also analysed using individual level occupational social grade (see Appendix 8) with similar results.

While the Baron and Kenny approach to mediation has been used extensively, it has been subject to criticism (Krause et al., 2010; Zhao et al., 2010) which may limit the interpretation of the potential mediating effects. Two key areas of criticism relate to the criteria set by Baron and Kenny: 1) that a statistically significant relationship needs to be determined between the independent and dependent variable before commencing with the mediation analyses (Path C, Figure 24). In this study that relates to the association between SES and screening status; and 2) that the aforementioned statistically significant relationship becomes non-significant when the potential mediator variables are entered into the model (Krause et al., 2010).

In relation to 1) it is argued that a significant relationship between the independent and dependent variables may not be discernible if the association is subject to either suppression or dilution (Krause et al., 2010). Suppression is where two or more mediators may cancel each other, for example, where one mediator may support a positive association between SES and screening status and another mediator may support a negative association between SES and screening status. In this study, the relationship between SES and cervical screening behaviour was statistically significant and therefore this point may not be relevant. However, even if it were not statistically significant, both beliefs entered into the model had the same directional effect. Dilution may occur should the association between the SES and screening status be distant, perhaps where more than one mediator is linked. For example, it may be considered that perceived benefits of cervical screening and practical barriers to cervical screening may be linked in a pathway from SES to screening status. For example, perhaps perceived benefits of cervical screening are linked to the motivation to overcome practical barriers to cervical screening attendance, and that it is this linked association that more accurately describes the relationship between socioeconomic status and cervical screening attendance. If this were the case, then the association between SES and screening status may be found to be weaker or, indeed, not statistically significant.

Point 2) is in relation the Baron and Kenny criteria that the statistically significant relationship between the independent and dependent variables (Criterion 4, see Analyses section) should become non-significant to demonstrate that the variable(s) being tested do indeed mediate the association, in this case between SES and screening status. This is considered to be problematic since the difference may be trivial if the initial direct effect relationship was only marginally significant, for example $p = 0.049$. However, in this instance used in this example, mediation was inferred if the Odds Ratios were reduced, and the extent of the mediating effect estimated using Freedman's method (Freedman et al., 1992).

Other criticisms of the Baron and Kenny approach suggest that the individual criteria as laid out in the steps to mediation are not necessarily independent and that structural equation models (SEM) that estimate the overall effect simultaneously may be a superior method to determine mediation (Zhao et al., 2010). Finally, since the data in the study were derived from a cross-sectional survey, causation cannot be assessed. Longitudinal data may be better placed to identify robust mediational effects because it can consider if the effect is maintained over time, or if it may be subject to particular conditions (MacKinnon et al., 2007).

Further limitations of the study include that the cervical cancer screening status was self-reported, and therefore may be subject to recall bias. A meta-analyses of self-reported cancer screening attendance in the USA indicated that national survey data may underestimate actual screening attendance (Rauscher et al., 2008). I am unable to accurately report a response rate for this survey as TNS do not record the number of households they attempt to recruit from.

8.5 Conclusion

This study provided an opportunity to consider the beliefs of women eligible for an invitation to the cervical screening programme within my thesis. Beliefs about the benefits of cervical screening were found to mediate the association between socioeconomic status and screening attendance. The study demonstrated an alternative approach to further understanding of socioeconomic inequalities in cervical screening attendance. This approach may uncover salient factors that mediate the association between socioeconomic status and screening attendance, and therefore it has the potential to inform future strategies for intervention. This is useful because it may be considered relatively easier to address downstream issues, such as perceptions of screening, than upstream factors such as income deprivation or lower levels of education.

Chapter 9: Socioeconomic Variation in Attendance at Colposcopy [13] (Study 6)

9.1 Introduction

As highlighted in Chapter 1, colposcopy is an essential part of the NHSCSP. Women who receive an abnormal screening result are referred to colposcopy for further diagnosis and treatment. Non-attendance increases risk that cervical abnormalities are not treated and, consequentially, increases risk of cervical cancer incidence and mortality. Cervical screening is only protective if further advice, or medical intervention when required, is followed.

National colposcopy attendance rates are published annually by the NHS Cervical Screening Programme (NHSCSP) (Health and Social Care Information Centre, 2012a). The attendance data are sourced from colposcopy clinics using what is known as the KC65 return. The KC65 was introduced in 2001 as part of the NHS Cancer Information Strategy which aimed to improve the delivery of care to those with cancer, or suspected cancer (HSCIC, 2013). The data gathered by the KC65 are used as a quality assurance measure of the colposcopy clinic performance at local, regional and national levels, and also informs the progress of the government's target to reduce invasive cervical cancer incidence. The minimum data required by the KC65 include the number of women referred to colposcopy by referral indication (screening test or clinical indication) and result of referral screening test (inadequate, borderline changes, mild/moderate/severe dyskaryosis, severe dyskaryosis/?invasive carcinoma, ?glandular neoplasia, and other); time from referral to first appointment (less than or equal to two weeks, two to four weeks, four to eight weeks, eight to twelve weeks, over twelve weeks); first attendance by type of procedure (no treatment, diagnostic biopsy (punch), excision, ablation and biopsy result, if known) and result of referral; waiting times for time from biopsy to informing patient of result; and biopsies by type and outcome. Where time from referral to first (and subsequent) appointment is recorded, the appointment type (first appointment, treatment or follow-

[13] A version of this paper has been published in the British Journal of Cancer and can be found in Appendix 10 (Douglas, Wardle, Massat & Waller, 2015).

up) is also reported, alongside the appointment status (attended, cancelled by patient – in advance, cancelled by patient – on the day, cancelled by clinic, did not attend (DNA) – no advance warning, DNA – arrived late, DNA – left without being seen). These data enabled attendance at appointment level, including patient and clinic cancellations, to be monitored (HSCIC, 2013).

9.1.1 Colposcopy Attendance

In England almost 440,000 colposcopy appointments were made in 2012–13 (Health and Social Care Information Centre, 2013). These comprised new referrals following an abnormal screening result, return for treatment and follow-up appointments. Approximately 205,000 new referrals to colposcopy were made in England in this year, of which around 30,000 appointments (14.8%) were cancelled by either the patient or the clinic and around 16,000 appointments (7.6%) were not attended by the patient without advance warning (Health and Social Care Information Centre 2012). There were approximately 33,000 return for treatment appointments, of which around 4,300 (12.9%) were cancelled by the patient or clinic and around 1,300 (4%) were not attended. The lowest levels of attendance were reported for follow-up appointments where around 41,000 (20.5%) of the 200,000 follow-up appointments were cancelled by the patient or clinic, and around 27,000 (13.5%) were not attended without advance warning.

While access to the NHS Cervical Screening Programme, including colposcopy, is free at the point of access, there are substantial costs attached to the programme to carry out cytological surveillance, and further diagnoses and treatment where necessary (TOMBOLA Group, 2009). I am unaware of any published costs that are specific to missed colposcopy appointments, however, in 2012–13, it was estimated that missed outpatient hospital appointments cost the NHS around £108 per appointment (NHS England, 2014). Non-attendance at colposcopy is therefore likely to represent a substantial, financial burden to the NHS, in addition to the aforementioned health risks for women.

The patterns of cancellation and non-attendance reported in 2012 –13 (Health and Social Care Information Centre, 2013) are reflective of data reported in other annual reports (Health and Social Care Information Centre, 2012a; NHS Information Centre, Screening and

Immunisations Team, 2011). These data indicate that the percentage of appointments that are cancelled or not attended may vary according to the appointment type: first referral, return for treatment, or follow-up. Across all types of appointments cancellations were more frequent than non-attendance without advance notice. First referral and follow-up colposcopy appointments have particularly high cancellation and non-attendance rates. However, these appointment-level data do not provide the opportunity to assess patient-level attendance. That is, to assess if a women who cancels one appointment does attend a subsequent appointment within a reasonable timeframe.

A review of non-attendance at colposcopy from 1986 to 1997 sought clarity on non-attendance rates by reviewing a number of studies that tracked both patient and appointment-level attendance (Lester and Wilson, 1999). Like the KC65 reported data, the scale of non-attendance was found to vary according to the type of appointment: first referral, assessment/treatment, or follow-up. However, the authors found the extent of non-attendance difficult to clearly establish for a number of reasons. Firstly, the definition of non-attendance varied widely across studies. Non-attendance may be referred to as default, patient compliance, patient adherence, treatment refusal and dropout. Secondly, the measure of what constituted non-attendance was defined by the attendance rate definition, which was also found to be subject to wide variation. Attendance rate definitions included, but were not limited to, the following: the proportion of women who attended within 18 months of appointment; the proportion of women who attended within 6 months of *original* appointment; the proportion of women who *ever* attended; and the proportion of women who *eventually* attended. It was difficult to meaningfully compare the extent of non-attendance across the studies and, therefore, to meaningfully generalise national rates of attendance/non-attendance. Despite these difficulties the authors suggested that non-attendance rates may be in the realms of 3%, 11% and 12% for what they respectively term assessment/treatment, first and second follow-up appointments (Lester and Wilson, 1999).

Generalisability of the extent of non-attendance may also be hampered by the pragmatic way in which many research studies gather data. Since there is no central database of patient-level colposcopy attendance, research studies are dependent upon access to data from individual colposcopy clinics or as part of other clinical trials that are not necessarily set up to specifically address colposcopy non-attendance. A study of colposcopy non-attendance in an Aberdeen clinic in 1989–1991 found around 12% did not attend their first follow-up appointment and 20% did not attend their second follow-up appointment (Flannelly et al., 1994). Another study using data from a colposcopy clinic in Fife, Scotland in 1999 found colposcopy non-attendance rates of around 10% for assessment, 19% for first follow-up and 20% for second follow-up (Patterson et al., 1995). In 1999–2002, the Trial of Management of Borderline and Other Low-grade Abnormalities (TOMBOLA), a randomised control trial, was set up within the Cervical Screening Programme across three areas in the UK – Grampian and Tayside in Scotland, and Nottinghamshire in England – to evaluate if cytological surveillance or colposcopy was the most efficient strategy for the management of borderline and low-grade abnormalities (Cotton et al., 2006). As such, it provided a good opportunity to assess a number of issues related to colposcopy attendance across multiple locations and colposcopy clinics. Non-attendance rates of the 2,213 women randomised to colposcopy within the trial were around 7%. This figure differs somewhat from the aforementioned non-attendance rates within Scottish colposcopy clinics and, indeed, from those suggested in Lester and Wilson's (1999) paper. The differences may be due to differences in the way the data were collected.

9.1.2 Socioeconomic Variation in Colposcopy Non-attendance

Evidence for socioeconomic or sociodemographic variation in colposcopy attendance is scarce. TOMBOLA did, however, investigate the association between socio-demographic and lifestyle characteristics and colposcopy attendance in the colposcopy arm of the trial. Older women (aged 40–59 years) and those who had received post-school education were more likely to attend colposcopy, while women who were not in paid employment and those who were current smokers were significantly less likely to attend colposcopy. A retrospective study of appointment records from a colposcopy clinic in Wales in 1996–1998 found younger women more likely to not attend colposcopy (Kiran and Jayawickrama, 2002). Another retrospective study of attendance at a colposcopy clinic in Newcastle, England in 1989–90 found women who did not attend were significantly more likely to be younger, of lower social class and to be resident in more deprived areas (Sanders et al., 1992). Late attendance at follow-up cervical cytology tests (another arm of the TOMBOLA trial) was associated with non-attendance at a subsequent follow-up appointment, and has also been associated with lower levels of post-school education (Sharp et al., 2012b).

The TOMBOLA group also investigated variation in attendance by ethnic group but did not find any significant difference between white and non-white participants (Sharp et al., 2012a). However, their study population was 95% white and therefore may not have been able to detect any underlying differences. However, ethnicity was found to have a linear association with colonoscopy uptake following a positive faecal occult blood test result in the NHS Bowel Cancer Screening Programme (Morris et al., 2012).

9.1.3 Non-attendance at Colposcopy as a Risk Factor for Cervical Cancer

The NHSCSP audit of invasive cervical cancer states that a delay in colposcopy attendance following referral from an abnormal cytology result is particularly significant as this suggests delay in providing diagnosis and treatment, or the return of a previously treated cervical abnormality (NHS Cancer Screening Programme, 2011). A ‘screen detected’ cervical cancer is defined by the audit as ‘a cancer that is diagnosed after a referral to colposcopy, where that referral is due to a cytology test taken at least 3 weeks, and no more than 4 months, prior to diagnosis’.

The Colposcopy and Programme Management Guidelines (2nd Edition) state that default rates should be no more than 15% (NHS Cancer Screening Programme, 2010). Cancer policy requires colposcopy clinics to have written protocols for the management of non-attenders and sets standards for the recommended duration between referral to colposcopy and first offered appointment (NHS Cancer Screening Programme, 2011). The policy states that at least 90% of all women should be offered a colposcopy appointment within eight weeks of referral, and more quickly if the cytology results suggest moderate or severe dyskaryosis (within four weeks of referral) or severe/?invasive or ?glandular neoplasia (within two weeks of referral). In 2012–13, the NHSCSP in England met all these objectives: 98% of all referrals were offered an appointment within 8 weeks; 97% of referrals with moderate or severe dyskaryosis were offered an appointment within 4 weeks; 94% of referrals with severe/?invasive were offered an appointment within 2 weeks; and 93% of referrals for ?glandular neoplasia were offered an appointment within 2 weeks.

To recap, the literature suggests that there may be variation in colposcopy attendance. It is unclear if this may be due to the ways in which the data were gathered (smaller datasets gathered at individual colposcopy clinics versus larger datasets gather as part of a randomised control trial) or if it may indicate geographical variation in colposcopy attendance, as was been found with cervical screening coverage in Chapters 4 and 6. National colposcopy data are gathered at appointment level and are likely to overestimate patient level colposcopy attendance, but nonetheless there are indications of a variation in appointment level colposcopy attendance (Health and Social Care Information Centre, 2014). Emerging evidence suggests that colposcopy attendance may also be subject to socioeconomic variation, with studies cited here using measures such as education, employment, social class and area-level deprivation.

Given the variation in non-attendance for first referral, treatment and follow-up appointments, an analysis of colposcopy non-attendance needs to be clear about the appointment type under investigation. Lower attendance rates in first referral colposcopy appointments may be considered particularly problematic since women are required to attend these appointments for further investigation following an abnormal screening result and may, therefore, be at risk of delayed diagnoses and treatment. National appointment-level data for England showed that 77% of referrals to colposcopy following an abnormal screening test in 2012–13 were attended; but this underestimates attendance at the individual level, because it fails to account for women who miss or cancel one appointment but attend a second one soon afterwards (Health and Social Care Information Centre, 2013). Appointment-level data may mask demographic patterns of attendance if certain groups are disproportionately likely to rearrange yet subsequently attend appointments.

9.1.4 Aims of the Study

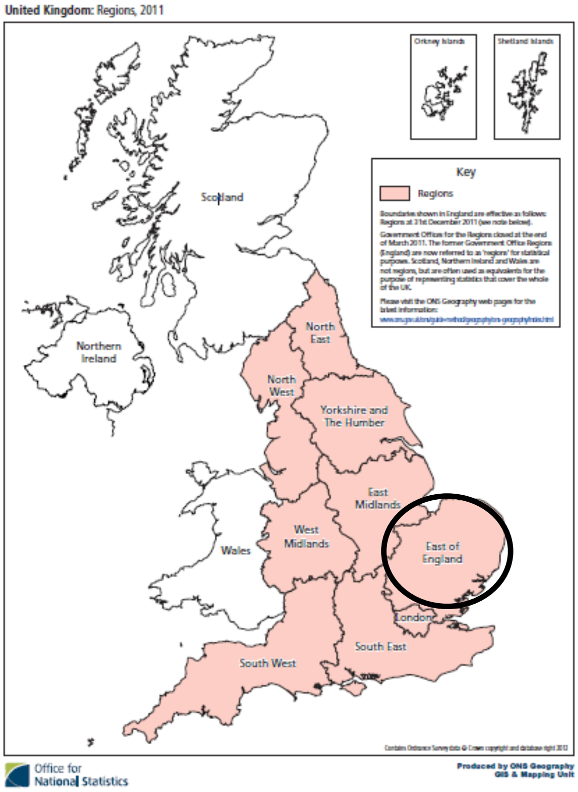
The aims of this study were to explore, using patient level data, socioeconomic variation in attendance at first referral to colposcopy following an abnormal screening test result. The study may shed further light on the rates of patient level non-attendance at colposcopy in England. It may also indicate if socioeconomic variation in colposcopy attendance may be an additional pathway to understanding why women of lower socioeconomic status may go on to have poorer cervical cancer outcomes.

9.2 Methods

9.2.1 Patient-level Colposcopy Data

The recent adoption of the Cyres Colposcopy Software for colposcopy management in some regions in England provides the opportunity to access anonymised patient level appointment data (Cyres Ltd, 2013). The availability of such data enables patient-level colposcopy attendance to be assessed. This system has been adopted by the East of England region and data from this region have been sourced by the author. The East of England region covers a screening eligible population of approximately 1.5 million women (O. ONS, 2014). It lies to the North East of London and its southern region is within London commuter territory (see Figure 25). Anonymised data were extracted from the East of England Cyres Colposcopy database for all women referred to colposcopy between 2006 and 2013.

Figure 25. Regions of England



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9.2.2 Measures

<u>Colposcopy attendance</u>

The rationale for analysing colposcopy attendance eight weeks after referral was that 98% of all women referred to colposcopy following an abnormal screening result are offered an appointment within 8 weeks of receiving an abnormal screening result (NHS Cancer Screening Programme 2011). From within this population, 97% of women with moderate or severe dyskaryosis were offered an appointment within 4 weeks, and 94% of women with severe dyskaryosis/ ?invasive carcinoma and 93% of women with ?Glandular neoplasia were offered an appointment within 2 weeks. Therefore, an eight week post referral period was considered the shortest reasonable time in which all women could be expected to have attended their appointment.

The rationale for analysing colposcopy attendance within four months of referral was that this is the timeframe in which, if diagnosed, cervical cancer would be deemed 'screen detected'. Thereafter, untreated abnormalities may be considered to contribute to higher rates of interval cervical cancer (Herbert et al., 2009). This timescale would also widen the scope to consider women who may have not been able to attend within the 8 week period, perhaps due to rescheduling of their initial appointment, and could therefore act as a form of sensitivity analyse to the eight week post referral measure of attendance.

Attendance rates are anticipated to be lower than the four month time point since women will have had less opportunity to reschedule their allocated colposcopy appointment, should they wish to do so. However, given the majority (98%) of women are offered an appointment within eight weeks and, therefore, at least have been provided with an opportunity to attend, it would be interesting to ascertain if early indications of a socioeconomic variation in attendance could be detected within this time frame.

Colposcopy attendance was ascertained by tracking a patient from her initial referral for colposcopy to her appointment status eight weeks post-referral. Women were categorised as 'attenders' (attended within eight weeks) or 'non-attenders' (did not attend within eight weeks, regardless of subsequent attendance). A secondary analysis examined attendance using a four month time-frame (so 'attenders' were those who had attended within four months of referral).

Age

Age at time of referral was downloaded from the East of England Cyres Colposcopy database for all women. Age was included in the analyses because it has been found to be associated with cervical screening coverage and therefore may be relevant for colposcopy attendance. Age was transformed into a categorical variable, categorised as 25–34 years, 35–44 years and 45–64 years.

Income Deprivation

For each individual, data were downloaded on Lower Super Output Area (LSOA) for the post code of their home address at the time of referral. The LSOA data were used to link to publicly available area-level data on deprivation (the income domain of the Index of Multiple Deprivation, IMD) (Department for Communities and Local Government, 2011).

LSOA-level income is likely to be fairly homogenous and therefore may describe individual-level income reasonably well (ONS, 2007). However, it is acknowledged that limiting the measurement of deprivation to income alone may be considered as a weakness of this study (as discussed in earlier chapters). Therefore, sensitivity analyses using the full Index of Multiple Deprivation score was conducted.

The income domain score of the IMD was transformed into a categorical variable. IMD scores were divided into quintiles based on national data downloaded from the Office for National Statistics (Knowledge & Information Team, Public Health England, 2011). National quintiles were chosen to enable the results to reflect a national perspective of deprivation, and therefore to have relevance beyond the East of England region.

Ethnicity

The aforementioned LSOA data were used to link publicly available area-level data on ethnic diversity (percentage of the population from white ethnic backgrounds) (ONS, 2014b). Ethnicity was controlled for in the analysis because it had been found to be a significant factor in the variation in cervical screening coverage in Study 2, and was often associated with deprivation. Ethnic diversity (the percentage of white population) was divided into quintiles based on national data downloaded from the Office of National Statistics. (Knowledge & Information Team, Public Health England, 2011). National quintiles were chosen to enable the results to reflect a national perspective of ethnicity, and therefore to have relevance beyond the East of England region.

Cervical Screening Indicators

The cytology indicator from the originating abnormal screening test was downloaded from the East of England Cyres Colposcopy database for all women as follows: Inadequate; Negative; Low-grade dyskaryosis; Borderline (squamous); High-grade (moderate); High-grade (severe); High-grade ?invasive; and ?Glandular neoplasia.

The NHS Screening Programme guidelines require that women with more severe cervical screening indicators are given priority when colposcopy appointments are scheduled (NHS Cancer Screening Programme, 2011). The Screening Test Indicators were transformed into a categorical variable that grouped the screening test indicators according to their invitation period, categorised as Appointment Within 8 Weeks (borderline and low-grade dyskaryosis); Appointment Within 4 Weeks (high-grade moderate or severe cervical) and Appointment Within 2 Weeks (high-grade ?invasive or ?Glandular neoplasia). Inadequate and Negative screening indicators were excluded from the analyses because these did not present a clear indication of the cervical cytology.

9.2.3 Analyses

Differences in colposcopy attendance by area-level quintiles of deprivation, individual age (grouped as mentioned previously), area-level quintiles of ethnicity and cervical screening indicator were tested using chi-square tests. Univariate and multivariate logistic regression was used to regress colposcopy attendance status (using eight week and four month cut-offs) against the income domain of the IMD, age, ethnicity and cervical screening indicator. Interactions of deprivation and age were also tested. It was hypothesised that patterns of attendance would mirror those in primary cervical screening, with younger women, women of lower SES and women from areas with a lower percentage of white population less likely to attend. Women whose cervical screening result indicated more advanced cervical abnormalities were expected to attend sooner than those with less advanced abnormalities as they were invited to attend colposcopy sooner. Attendance was expected to be at higher four months after first referral than at eight weeks after referral as that will allow more time for women to attend.

9.3 Results

9.3.1 Descriptive Statistics

There were 27,193 women referred for colposcopy during the time period. For women who were referred to colposcopy on more than one occasion, only the first referral was included in the sample. The women in the sample had a mean age of 35 years (standard deviation = 9.1) (see Table 20). Only 8.5% were resident in the most deprived areas (Q1) and 5.6% were resident in areas with the least percentage of white population. Women lived predominantly in less deprived areas with a higher percentage of white population (quintiles 2–5). The majority of women (55.2%) had low-grade or borderline screening test indications. The percentage of the sample who were excluded (Inadequate and Negative) or had no data for the Cervical Screening Indicator (Missing) was 4.7%.

Table 20. Sample characteristics of women referred to colposcopy

	% (n)	Min–Max	Mean	Std Dev
Income domain (IMD) Quintiles				
Q1 – Least Income	8.5 (2305)	0.236–0.538	0.306	0.064
Q2	22.3 (6064)	0.142–0.235	0.182	0.026
Q3	26.7 (7255)	0.088–0.142	0.114	0.016
Q4	22.5 (6115)	0.056–0.088	0.070	0.009
Q5 – Most Income	20.1 (5454)	0.005–0.055	0.039	0.012
Age at referral				
25–34 years	55.0 (14949)	25–34	29	2.9
35–44 years	27.7 (7539)	35–44	39	2.9
45–64 years	17.3 (4705)	45–64	51	5.2
Ethnicity (% White population)				
Q1 – Lowest % White	5.6 (1529)	41.8–71.7	69.8	7.6
Q2	26.9 (7304)	77.8–91.9	87.0	3.7
Q3	29.3 (7965)	92.0–96.3	94.4	1.2
Q4	20.2 (5502)	96.4–98.0	97.3	0.5
Q5 – Highest % White	18.0 (4893)	98.1–99.8	98.7	0.4
Cervical Screening Indicator (invitation period)				
Low-grade/borderline (8 weeks)	55.2 (15,004)	-	-	-
Moderate/severe (4 weeks)	38.2 (10,380)	-	-	-
?invasive/?Glandular neoplasia (2 wks)	1.9 (514)	-	-	-
Inadequate/Negative/Missing (N/A)	4.7 (1295)			

9.3.2 Colposcopy Attendance and Explanatory Variables

Colposcopy attendance was 89.3% at eight weeks after referral (see Table 21). Area-level income deprivation was statistically significantly associated with colposcopy attendance. Attendance was lowest in the quintile with least income (Q1, 86.6%) and higher in the quintile with most income (Q5, 89.1%); however, attendance was highest in Q4 where 90.2% attendance was observed. Age was not significantly associated with colposcopy attendance at eight weeks after referral. There was a linear association between colposcopy attendance at eight weeks after referral and area-level ethnicity, where attendance was lowest in the quintile with the lowest percentage of white population (Q1, 85.0%) and highest in the quintile with the highest percentage of white population (Q5, 92.7%). There was a linear association between colposcopy attendance at eight weeks after referral and the cervical screening indicator. Colposcopy attendance was lowest in those with low-grade and borderline abnormalities (88%) where the women will be offered an appointment within eight weeks of referral, and progressively higher for the remaining two categories where women will be offered a colposcopy appointment within four weeks (93%) and two weeks respectively (95%).

Colposcopy attendance was 94.1% when observed respectively at four months after referral (see Table 21). Area-level income deprivation was statistically significantly associated with colposcopy attendance at both times. Attendance was lowest in the quintile with least income (Q1, 92.5%) and higher in the quintile with most income (Q5, 94.1%); however, attendance was highest in Q4 where 94.4% attendance was observed. Age was significantly associated with colposcopy attendance at four months after referral. There was a linear association between colposcopy attendance at four months after referral and area-level ethnicity, where attendance was lowest in the quintile with the lowest percentage of white population (Q1, 91.8%) and highest in the quintile with the highest percentage of white population (Q5, 96.0%). Colposcopy attendance was lowest in those with low-grade and borderline abnormalities (94%) where the women will be offered an appointment within eight weeks of referral, and progressively higher for the remaining two categories where women will be offered a colposcopy appointment within four weeks (95%%) and two weeks respectively (95%).

Table 21. Variables associated with colposcopy attendance within eight weeks of referral

	Attendance at eight weeks row % (n) 89.3 (24,294)	Test of linear association	Attendance at four months row % (n) 94.1 (25, 594)	Test of linear association
IMD quintiles				
Q1 – Low income	86.6 (1996)		92.5 (2131)	
Q2	89.6 (5434)	χ^2=23.98,	94.5 (5731)	χ^2=13.97,
Q3	89.4 (6486)	df=4,	94.1 (6828)	df=4,
Q4	90.2 (5517)	p<0.001	94.4 (5771)	p=0.007
Q5 – High income	89.1 (4861)		94.1 (5133)	
Age at referral				
25–34 years	89.5 (13372)	χ^2=4.63,	93.9 (14038)	χ^2=9.28,
35–44 years	88.8 (6691)	df=2,	94.0 (7083)	df=2,
45–64 years	89.9 (4231)	p=0.099	95.1 (4473)	p=0.010
Ethnicity				
Q1 – Lowest % White	85.0 (1299)		91.8 (1403)	
Q2	87.5 (6391)	χ^2=124.89,	93.5 (6826)	χ^2=54.44,
Q3	89.0 (7085)	df=4,	93.9 (7476)	df=4,
Q4	90.6 (4983)	p<0.001	94.3 (5191)	p<0.001
Q5 – Highest % White	92.7 (4536)		96.0 (4698)	
Cervical Screening Indicator (invitation period)				
Low-grade/borderline (8 wks)	88.1 (13,220)	χ^2=160.34,	93.9 (14,082)	χ^2=9.08,
Moderate/severe (4 wks)	92.7 (9625)	df=2,	94.7 (9829)	df=2,
?invasive/?Glandular (2 wks)	94.9 (488)	p<0.001	95.3 (490)	p=0.011

Colposcopy attendance within eight weeks of referral

Colposcopy attendance eight weeks after referral was predominantly higher in less deprived areas. In the unadjusted analyses, women in the most deprived area were significantly less likely to have attended colposcopy eight weeks after referral (86.6% compared with 89.1% in the least deprived quintile, OR = 0.79, 95% CI: 0.68-0.91), see Table 22. Age was not associated with colposcopy attendance. There was no interaction between age and deprivation (p=0.151).

Women living in areas with a lower percentage of white population were progressively less likely to attend colposcopy across all quintiles, such that 85.0% of women living in areas with the lowest percentage white population attended colposcopy in comparison with 92.7% in areas with the highest percentage white population (OR = 0.45, CI: 0.37-0.53).

Women with indication of more advanced cervical abnormalities were progressively more likely to attend colposcopy, with 94.9% of women with a ?invasive/?glandular screening result indication attending within eight weeks in comparison with 88.1 of women with low-grade or borderline indicators (OR = 2.53, CI:1.70-3.77).

In multivariate analyses colposcopy attendance remained significantly less likely in women in the most deprived areas when compared to the least deprived areas (OR = 0.73, 95% CI: 0.59-0.90). Women living in areas with a lower percentage of white population were progressively less likely to attend colposcopy across all quintiles, such that 85.0% of women living in areas with the lowest percentage white population attended colposcopy in comparison with 92.7% in areas with the highest percentage white population (OR = 0.51, CI: 0.42-0.62). Women with indication of more advanced cervical abnormalities were progressively more likely to attend colposcopy in comparison with those with low-grade or borderline indicators, such that women with a ?invasive/?glandular screening result had an OR = 2.52, CI:1.69-3.76.

Colposcopy attendance within four months of referral

Colposcopy attendance four months after referral was lower in the most deprived quintile (Q1) (see Table 23). In the unadjusted analysis, women living in the most deprived areas were significantly less likely to attend colposcopy (92.5% compared with 94.1%; OR = 0.76, 95% CI: 0.63–0.93). Women aged 45–64 years were significantly more likely to attend colposcopy than women aged 25–34 years (95.1% compared with 93.9%, OR = 1.25, 95% CI: 1.08–1.45). There was no interaction between income deprivation and age (p=0.650).

Women living in areas with a lower percentage of white population were progressively less likely to attend colposcopy across all quintiles in comparison with areas with the highest percentage white population, such that 91.8% of women living in areas with the lowest percentage white population attended colposcopy in comparison with 96.0% in areas with the highest percentage white population (OR = 0.46, CI: 0.37-0.58). Women with indication of moderate/severe cervical abnormalities were more likely to attend colposcopy within four months (94.7% versus 93.9% of women with low-grade or borderline indicators, OR = 1.17, CI: 1.05-1.30).

In the multivariate model, income deprivation was no longer significantly associated with colposcopy attendance within four months of referral. Older women (45-64 years) were more likely to attend colposcopy than younger women (OR = 1.26, 95% CI: 1.07 – 1.47). Women living in areas with a lower percentage of white population were progressively less likely to attend colposcopy, such that women living in areas with the lowest percentage white population had an OR = 0.48, CI: 0.37-0.61. Women with indication of moderate/severe cervical abnormalities were more likely to attend colposcopy within four months (OR = 1.19, CI: 1.06-1.32).

Sensitivity Analyses using the Full Index of Multiple Deprivation (IMD)

Similar results were found when the models were run using the full IMD. The results are reported in Appendix 9.

Table 22. Variables associated with colposcopy attendance within eight weeks of referral, * p <0.05

	Sample column % (n) 100 (27,193)	Attendance at eight weeks row % (n), 89.3 (24,294)	Unadjusted models OR (95% CI)	Unadjusted models p-value	Adjusted model OR (95% CI)	Adjusted model p-value
Income Domain quintiles						
Q1 – Low Income	8.5 (2305)	86.6 (1996)	0.79 (0.68–0.91)	0.001*	0.79 (0.68–0.92)	0.003*
Q2	22.3 (6064)	89.6 (5434)	1.05 (0.94–1.19)	0.400	1.04 (0.91–1.18)	0.569
Q3	26.7 (7255)	89.4 (6486)	1.03 (0.92–1.15)	0.622	0.92 (0.81–1.04)	0.147
Q4	22.5 (6115)	90.2 (5517)	1.13 (1.00–1.27)	0.053	1.03 (0.91–1.18)	0.629
Q5 – High Income	20.1 (5454)	89.1 (4861)	1.00	–	1.00	–
Age at referral						
25–34 years	55.0 (14949)	89.5 (13372)	1.00	–		
35–44 years	27.7 (7539)	88.8 (6691)	0.93 (0.85–1.02)	0.111		
45–64 years	17.3 (4705)	89.9 (4231)	1.05 (0.94–1.17)	0.353		
Ethnicity						
Q1 – Lowest % White	5.6 (1529)	85.0 (1299)	0.45 (0.37-0.53)	<0.001*	0.51 (0.42-0.62)	<0.001*
Q2	26.9 (7304)	87.5 (6391)	0.55 (0.49-0.63)	<0.001*	0.63 (0.55-0.72)	<0.001*
Q3	29.3 (7965)	89.0 (7085)	0.63 (0.56-0.72)	<0.001*	0.67 (0.58-0.76)	<0.001*
Q4	20.2 (5502)	90.6 (4983)	0.76 (0.66-0.87)	<0.001*	0.74 (0.64-0.86)	<0.001*
Q5 – Highest % White	18.0 (4893)	92.7 (4536)	1.00	-	1.00	-
Cervical Screening Indicator (invitation period)						
Low-grade/borderline (8 wks)	55.2 (15,004)	88.1 (13,220)	1.00	-	1.00	-
Moderate/severe (4 wks)	38.2 (10,380)	92.7 (9625)	1.72 (1.57-1.88)	<0.001*	1.72 (1.58-1.90)	<0.001*
?invasive/?Glandular (2 wks)	1.9 (514)	94.9 (488)	2.53 (1.70-3.77)	<0.001*	2.52 (1.69-3.76)	<0.001*

Table 23. Variables associated with colposcopy attendance within four months of referral, * p <0.05

	Sample column	Attendance at four months	Unadjusted models		Adjusted model‡	
	% (n), 100 (27,193)	**row % (n),** 94.1 (25, 594)	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Income Domain Quintiles						
Q1 – Low Income	8.5 (2305)	92.5 (2131)	0.76 (0.63–0.93)	0.006*	0.86 (0.71-1.06)	0.160
Q2	22.3 (6064)	94.5 (5731)	1.08 (0.92–1.26)	0.362	1.13 (0.95-1.33)	0.145
Q3	26.7 (7255)	94.1 (6828)	1.00 (0.86–1.16)	1.000	0.96 (0.81-1.12)	0.587
Q4	22.5 (6115)	94.4 (5771)	1.05 (0.89–1.23)	0.549	1.00 (0.85-1.18)	0.980
Q5 – High Income	20.1 (5454)	94.1 (5133)	1.00	–	1.00	–
Age at referral						
25–34 years	55.0 (14949)	93.9 (14038)	1.00	–	1.00	–
35–44 years	27.7 (7539)	94.0 (7083)	1.01 (0.90–1.13)	0.893	1.03 (0.92-1.17)	0.533
45–64 years	17.3 (4705)	95.1 (4473)	1.25 (1.08–1.45)	0.003*	1.26 (1.07-1.47)	0.005*
Ethnicity						
Q1 – Lowest % White	5.6 (1529)	91.8 (1403)	0.46 (0.37-0.58)	<0.001*	0.48 (0.37-0.61)	<0.001*
Q2	26.9 (7304)	93.5 (6826)	0.59 (0.50-0.70)	<0.001*	0.61 (0.51-0.73)	<0.001*
Q3	29.3 (7965)	93.9 (7476)	0.64 (0.54-0.75)	<0.001*	0.64 (0.53-0.76)	<0.001*
Q4	20.2 (5502)	94.3 (5191)	0.69 (0.58-0.83)	<0.001*	0.68 (0.57-0.83)	<0.001*
Q5 – Highest % White	18.0 (4893)	96.0 (4698)	1.00	-	1.00	-
Cervical Screening Indicator (invitation period)						
Low-grade/borderline (8 wks)	55.2 (15,004)	93.9 (14,082)	1.00	-	1.00	-
Moderate/severe (4 wks)	38.2 (10,380)	94.7 (9829)	1.17 (1.05-1.30)	0.005*	1.19 (1.06-1.32)	0.002*
?invasive/?Glandular (2 wks)	1.9 (514)	95.3 (490)	1.34 (0.88-2.03)	0.171	1.32 (0.87-2.00)	0.192

9.4 Discussion

This study explored socio-demographic variation in patient-level colposcopy attendance following an abnormal screening result in the NHS Cervical Screening Programme in England. The sample comprised 27,193 women from the East of England who had been referred to colposcopy between 2006 and 2012. Attendance was examined using two separate measures: attendance within eight weeks of referral, and attendance within four months of referral. Attendance within eight weeks of referral was chosen as an initial measure of attendance because national appointment level statistics indicate that 98% of women will have had the opportunity to attend during this time period. Attendance within four months of referral was chosen as an alternative measure of attendance because this is the time period in which cancer, if detected, is considered to be screen-detected.

Colposcopy attendance was high at both the eight week post referral point (89.3%) and four months post referral point (94.1%) indicating that the non-attendance rates meet the Colposcopy and Programme Management Guidelines (2nd Edition) recommendation that non-attendance rates should not exceed 15%. The rates of attendance at four months post referral for women with low-grade/borderline indicators (93.9%) are comparable to the attendance rates of 93.3% for women with low-grade abnormalities randomised for immediate colposcopy (non-attendance was failure to attend two appointments) found within TOMBOLA, the multi-centre population-based randomised controlled trial nested in the NHS Cervical Screening Programme (Sharp et al., 2012a). This particular arm of the TOMBOLA trial offers a reasonably good comparison to my sample because it includes data collected at regional level, across many colposcopy units, and measures women's attendance at colposcopy following an abnormal result. However, it should be noted that TOMBOLA is specific to women considered to have low-grade abnormalities. In my sample, women with moderate/severe (94.7%) and ?invasive/?Glandular (95.3%) cervical screening indicators were found to have even higher rates of attendance. Not surprisingly, attendance levels in this study were higher than the 77% national attendance rates, or 80% East of England attendance rates, reported annually for this type of colposcopy appointment (first referral) since they are reporting appointment level attendance. This suggests that a significant proportion of women may be re-booking their original colposcopy appointment. High levels of attendance have also been reported for referral to colonoscopy following a positive faecal occult blood test (FOBT) in the colorectal cancer screening programme where colonoscopy uptake was 88% (Morris et al., 2012). These findings suggest that once an invitation to take part in cancer screening is accepted then compliance with recommended follow-up and treatment is likely to be high.

There were high levels of colposcopy attendance overall, yet women from more income deprived areas were significantly less likely to attend cervical screening at both eight week and four months post referral. This trend was consistent even where the effects of area-level ethnicity and screening indication were taken into consideration. However, there was no interaction between deprivation and age on colposcopy attendance. The TOMBOLA study did not look at the association between colposcopy attendance and area-level deprivation, but did find attendance was lower in women with no post-school education, another marker of lower socioeconomic status (Sharp et al., 2012b). Other British studies that did look at an association between colposcopy attendance and area-level deprivation did not specifically address first referral colposcopy appointments (Balasubramani et al., 2008; Sanders et al., 1992). However, if socioeconomic variation in these appointments is apparent then it could substantiate my own findings, and also offer some indication of a continuing pattern of socioeconomic variation in treatment and follow-up care for the prevention of cervical cancer. Sanders et al. (1992) retrospectively examined patient level data from a colposcopy clinic in Newcastle and found women living in the two most deprived areas (quartiles of area-level deprivation, linking women's postcode to the Townsend Index) were significantly less likely to attend any of the colposcopy appointments (referral, treatment or follow-ups). The same study also found colposcopy attendance to be lower among women of lower social class (Social class 4 and 5) (Sanders et al., 1992). Balasubramani et al. (2008) measured intention to attend a return to treatment colposcopy appointment in women recruited from two colposcopy clinics in England and found women living in the two most deprived areas (quintiles of area-level deprivation, linking the women's postcode to the Carstairs Index) were significantly less likely to intend to attend colposcopy.

Interestingly, when the association between colposcopy attendance and income deprivation is contrasted with the association between cervical screening coverage in women and deprivation it is evident that the association is more linear between cervical screening coverage and deprivation. In my sample, which included women aged 25–64 years, women who lived in the middle-income areas (quintiles 2, 3 and 4) were more likely to attend colposcopy (at both eight weeks and four months post referral) than women living in the least deprived area. Although this was not statistically significant, it does indicate a different pattern of association from that found between cervical screening coverage and deprivation, certainly when all eligible women are included in the sample. It is feasible that women living in less deprived areas, who are content to attend cervical screening as part of the NHS Cervical Screening Programme, may opt for a colposcopy appointment at a private colposcopy clinic, hence the lower attendance in these women in comparison to those living in middle-income quintiles. There is not, to the best of my knowledge, any published evidence to support this theory. However, as part of my qualitative interview study of professionals' views of factors associated with cervical screening coverage (Chapter 7), a lead colposcopist confirmed that a number of women cancel their first referral to colposcopy following an abnormal screening result citing their preference to be seen privately. It was not possible to quantify the extent to which this occurs, nor the socioeconomic status of the individual women. However, it may be considered reasonable to suppose that where it does occur it is women with the financial means to pay for private colposcopy who are able to make this choice. If this were to be the case, and could be accurately recorded, then the association between colposcopy attendance and income deprivation may be more classically linear.

The lower attendance at colposcopy in women of lower SES found in this study is a cause for concern. The sample included women who have received an abnormal screening test result following routine cervical screening and was inclusive of all referral indications from borderline/mild dyskaryosis through to potentially severe/invasive carcinoma with urgent clinical indications. The percentage of women who received either a treatment or procedure at their first referral to colposcopy was 63.5% for all of England, and 67.1% for East of England region, in 2012–13 (Health and Social Care Information Centre, 2013). This indicates that around two-thirds of the women referred to colposcopy following an abnormal result go on to have some sort of treatment or procedure at colposcopy. For women of lower SES, who, as was discussed in Chapter 1, may be more likely to be high-risk HPV positive, this presents a real risk that cervical abnormalities are not treated. Therefore, while the difference observed in this study may only be around 2%, this may translate to a few thousand women across England. This will inevitably expose these women to greater risk of development of cervical cancer, and may help to explain at least some of the socioeconomic variation in cervical incidence discussed in Chapter 1.

Older women (aged 45–64 years) were generally more likely to attend colposcopy than younger women for colposcopy attendance four months after referral. Older women were more likely to attend colposcopy in a number of other studies, including attendance in the colposcopy arm of the TOMBOLA trial (Sharp et al., 2012a), across all types of colposcopy appointments in a Newcastle colposcopy clinic (Sanders et al., 1992) and in a colposcopy clinic in Fife (Patterson et al., 1995). It is interesting, however, that the age difference only became apparent in the four months post referral analyses. While women aged 45–64 years may be more likely to eventually attend colposcopy, it is feasible that their delayed colposcopy attendance could be due to lower levels of concern about cervical cancer. An analysis of age differences in primary cervical screening attendance suggests that older women may have a lower perceived risk of cervical cancer (Waller et al., 2011). This same study found older women less likely to express difficulties in making an appointment or finding time to attend screening as a barrier to attendance. However, gaining further understanding of delayed attendance is an important avenue for future research since 'late attenders' at first referral to colposcopy may be more likely to miss subsequent colposcopy appointments (Sharp et al., 2012b).

Lower attendance at colposcopy was most striking for women living in areas with a lower percentage of white population. This linear trend was significant at both eight weeks and four months post referral and after taking the effects of deprivation, age and cervical screening indication into account. The TOMBOLA trial indicated that non-white women may be more likely to default from colposcopy but this was not statistically significant (Sharp et al., 2012a). However, this may have been because only 4% of their study sample identified as non-White. My study indicates that women living in more ethnically diverse populations are at particular risk of missing out on the diagnostic and treatment benefits offered by colposcopy. In one study, colposcopy attendance in inner-city Manchester was increased by the provision of an information leaflet in multiple languages (Tomlinson et al., 2004), therefore consideration of how this may be implemented more widely may be useful.

Women with moderate/severe and ?invasive/?Glandular, that is more advanced cervical screening indications, were more likely to attend colposcopy than those with low-grade/borderline indications. This trend is likely to be due to the priority given to women with more advanced cervical screening indicators when colposcopy appointments are scheduled, 4 weeks and 2 weeks respectively, and the perceived importance of attending among women. However, at four months post referral, attendance in women with ?invasive/?glandular indications (with a 2 week invitation period) was no longer statistically significantly higher than other groups. This is most likely to be due to the efforts by colposcopy clinic staff to prioritise the attendance of those with the most severe indicators and for the increased time for women with low-grade/borderline indications (and lower priority colposcopy appointment invitation) to attend.

Non-attendance in itself may be problematic as missed appointments lead to appointment delay. Appointment delay is where there is a longer duration from the point of referral and the proposed colposcopy appointment date. Appointment delay is considered to exacerbate missed appointments, where women either cancel the appointment or do not attend without prior notice (Lester and Wilson, 1999; TOMBOLA Group, 2009). Unfortunately, the higher the number of missed appointments, the greater the delay between referral to colposcopy and the scheduled appointment. Thus, a negative feedback loop of increased non-attendance and appointment delay may ensue.

The revised Colposcopy and Management Guidelines of the NHS Cervical Screening Programme state that colposcopy units are required to audit the records of non-attenders to inform strategies to improve colposcopy attendance (NHS Cancer Screening Programme, 2010). The guidelines suggest non-attendance may occur due to fear or anxiety related to cancer or to the procedure itself, menstruation, work or childcare responsibilities, transport to the clinic, lengthy waiting times and forgetting the appointment. These reasons are generally supported in research literature but less is known about their potential association with socioeconomic status.

Women's anxiety may be related to fear or apprehension of the diagnostic outcome of the test, or to anticipation of the pain or discomfort that may occur during the colposcopy procedure itself (Lester and Wilson, 1999). Referral to colposcopy following an abnormal cervical screening test result was associated with distress and anxiety in women recruited from a colposcopy clinic in Ireland (Kola and Walsh, 2012). A study of women recruited via an English cervical cytology laboratory, explored the psychological effects of receiving an inadequate screening test and found women with higher levels of anxiety were at greater risk of not attending a future screening test appointment (French et al., 2004). However, in studies carried out as part of TOMBOLA, anxiety was not associated with attendance (Sharp et al., 2012a), nor were higher levels of anxiety associated with markers of SES (level of education and employment status) (Gray et al., 2006). Emotional barriers to cervical screening, while commonly cited by women as reasons for non-attendance, were not found to predict cervical screening uptake in a population-based survey (Waller et al., 2009). It is therefore plausible that emotional barriers to colposcopy may not provide an explanation for socioeconomic variation in colposcopy attendance, but further research in this area would provide further clarification.

In an audit of colposcopy attendance at a clinic in Thailand, benchmarked by the NHS Cervical Screening Guidelines for the management of colposcopy, menstruation was also cited as a reason for non-attendance (Kietpeerakool et al., 2011). Naturally, this would be likely to affect younger women, rather than older women.

Childcare commitments were cited as one of the specific reasons for non-attendance at colposcopy in a retrospective analyses of colposcopy attendance in a Newcastle colposcopy clinic, where 93% of non-attenders had childcare responsibilities (Sanders et al., 1992). Childcare commitments were raised as reasons for lower attendance at cervical screening in Chapter 7, and it is feasible that this may act as a barrier to colposcopy attendance. While childcare commitments were cited as a reason for not attending cervical screening in focus groups of women living in deprived areas in Northern Ireland (Logan and McIlfatrick, 2011), they were not found to be socially patterned (measured as level of education) in a population study of barriers to cervical screening (Waller et al., 2009).

Practical barriers, such as a shorter travel time to the clinic, have also been associated with colposcopy attendance (Balasubramani et al., 2008). Shorter distance to breast screening units have also been associated with higher breast screening coverage (Maheswaran et al., 2006). Breast screening units, like colposcopy clinics, are often based in local hospitals and therefore neither has the convenience of taking place in a local general practice. The cost of travel has also been associated with lower colposcopy attendance (Brooks et al., 2002), and feasibly exerts a more prohibitive pressure on more deprived women. Difficulty arranging transport was associated with adults of lower SES in a population-based survey of barriers to seeking medical advice (K. Robb et al., 2009), although it is unclear if this would also be reflected in barriers to colposcopy attendance.

Forgetting appointments has been cited in as a reason for colposcopy non-attendance in a number of studies (Brooks et al., 2002; Miller et al., 1997; Sanders et al., 1992). While Sanders et al. (1992) collected socioeconomic characteristics of participants in their study, they did not report this information in relation to those who cited forgetting the appointment as their reason for non-attendance. Socioeconomic characteristics of women participating in the other studies were not collected.

While my consideration of socioeconomic variation in barriers to colposcopy is not exhaustive, it is evident that there is limited research available in this area. Minimising missed appointments which increase the risk of the development of cervical cancer (NHS Cancer Screening Programme, 2011) remains important despite the high rates of attendance found in this study overall. The unnecessary financial burden of missed appointments has potentially become of greater significance since the national rollout of HPV Triage in 2012, given the increased volume of colposcopy referrals (Albrow et al., 2012; Health and Social Care Information Centre, 2013; Kelly et al., 2011). Further, in the event of the introduction of HPV self-testing (Racey et al., 2013), the management of cervical abnormalities will still take place at colposcopy. Timely colposcopy attendance, therefore, remains an essential component of a successful cervical screening programme for some time to come.

9.4.1 Strengths and Limitations

This study is novel in its ability to generalise retrospective patient-level colposcopy attendance at first referral following an abnormal screening result within the NHS Cervical Screening Programme in England. The sample included over 27,192 women and spanned colposcopy attendance from 2006 to 2012. Colposcopy attendance data were sourced from

KC65 data via the Cyres Software database to provide individual level colposcopy attendance data, thereby overcoming some of the drawbacks of self-reported attendance data or appointment-level data. Most other studies that examined patient level colposcopy attendance were published before this time period.

While the use of area-level data on income deprivation may be considered a weakness of the study, these data are not routinely collected by the cervical screening programme. Income domain data were matched at the LSOA level, which are small, homogenous geographical areas designed for neighbourhood statistical analyses (ONS, 2007). The income domain of the IMD was chosen as the measure of deprivation, rather than the full IMD score that encompasses all seven domains of the IMD. As previously discussed in Study 1, this may be considered a weakness of the study as this fails to capture to other complex dimensions of socioeconomic deprivation. Sensitivity analyses using the full IMD were conducted to assess potential differences when multiple domains of deprivation are considered. The results were similar to those using the income domain of IMD only and are reported in Appendix 9.

The study used data from the East of England region which has relatively high colposcopy attendance in comparison with other regions (Health and Social Care Information Centre, 2013), but linking the area-level measures to national quintiles may increase the generalisability of these results for other regions in England. Most other studies reported patient level colposcopy attendance source data from one or two colposcopy clinics and, therefore, were not generalisable beyond a small area.

9.5 Conclusion

The findings in this study have potential implications for cervical cancer outcomes and the cervical screening programme. The high attendance rates at colposcopy overall are encouraging since they indicate that once women have accepted an invitation to cervical screening they are likely to accept a referral to colposcopy. Lower attendance among women in the most income-deprived areas is of concern, since this indicates that even when women in more deprived areas attend cervical screening they remain at higher risk of missing out on the benefits of the programme, namely the prevention or earlier diagnosis of cervical cancer.

Chapter 10: Discussion

The research in this thesis was prompted by the ongoing concern about socioeconomic inequalities in health and how to tackle them. Cervical cancer was chosen as a particular area of interest because it is preventable and yet women still die from this disease in the UK every year. Women of lower SES have disproportionally poorer cervical cancer outcomes. While women of lower SES are likely to be exposed to more risk factors for cervical cancer, it should be preventable if attendance at cervical screening, and colposcopy where recommended, is equitable across all SES groups. Understanding socioeconomic inequalities in cervical screening may help inform strategies to prevent poorer outcomes in cervical cancer for women of lower SES.

10.1 Summary of Findings

The principal aim of this thesis was to understand socioeconomic inequalities in cervical cancer screening, and to explore the pathways that link SES and poorer attendance at cervical screening and colposcopy. In Chapter 3, I set out four questions which I sought to address in my thesis. Below I have summarised my findings in relation to these questions.

10.1.1 Are Socioeconomic Inequalities in Cervical Screening Coverage in England Improving? (Study 1)

<u>Study 1 Findings</u>

Study 1 explored if the cervical screening coverage gap, the mean coverage difference between the most and least deprived women, had narrowed in recent years. A cervical screening coverage gap was found across all age groups and all areas, and was greater in younger women than in either older women or all eligible women.

There were significant changes to cervical screening coverage over the time period in England (excluding London) in a pattern that reflected the 'Jade Goody' effect. Unfortunately, the peak levels of cervical screening coverage in 2008 and 2009 were not long-lasting and have since fallen into decline, and no significant difference in screening coverage was found at the end of the period. The patterns of screening coverage over time were similar across all SES groups, and the lack of interaction between deprivation and time confirmed that the association between coverage and deprivation remained stable.

For PCTs in London, there was no significant difference in the screening coverage over the period and, perhaps surprisingly, the 'Jade Goody' effect was not detectable. Patterns of association between deprivation and cervical screening coverage did not significantly differ across the time period, despite the obvious presence of a cervical screening coverage gap.

For younger women in all PCTs in England, there was a significant increase in cervical screening coverage. In this group, there was a distinct 'Jade Goody' effect, and coverage was higher at the end of the period in comparison with the beginning. Unfortunately, however, cervical screening coverage is in steady decline and should the current trend continue, it may fall below the level found prior to Goody's diagnosis and death. The patterns of association between deprivation and cervical screening coverage were similar across the time period, indicating that despite the increase in coverage over the time period, there was no significant difference by SES group.

For older women in all PCTs in England, cervical screening coverage has been in steady decline. This pattern was reflected across all SES groups which indicated that there was no interaction between deprivation and time over the period. While cervical screening coverage in older women has generally been higher than coverage in younger women, the levels are beginning to converge. For example, cervical screening coverage in the most deprived group of older women is now comparable with screening coverage in the least deprived group of younger women.

Despite the differences in the trends in cervical screening coverage over the time period, no evidence was found to suggest that there has been any improvement in socioeconomic inequalities in cervical screening coverage over the years 2007–08 to 2012–13.

Study 2 Findings

Study 2 explored whether the continued socioeconomic inequalities in cervical screening coverage may be explained by programme-specific or population-specific factors by comparing the cervical screening coverage gap in older women (age 50–64 years) with the breast screening coverage gap (women aged 53–70 years) over the same time period.

For breast screening coverage in all PCTs in England, there was a significant interaction between deprivation and time on breast screening coverage, largely driven by the improvement in breast screening coverage in the most deprived areas. This was quite different from the trends found for cervical screening coverage for women of comparable age. However, cervical screening coverage is higher overall than breast screening coverage.

This result indicates that programme-specific factors may affect the different rates of coverage and, potentially, socioeconomic inequalities in screening coverage. It is encouraging that the NHS Breast Screening Programme has seen a significant increase in breast screening coverage over the time period. However, this sits in direct contrast to the decline in cervical coverage found across all SES groups.

10.1.2 Which Factors Support or Hinder Higher Cervical Screening Coverage in PCTs in England? (Study 3 and 4)

Study 3 Findings

Study 3 explored the factors which may hinder or support higher cervical screening coverage by using regression models to fit cervical screening coverage in younger and older women with programme-delivery and population-level factors. Population factors, rather than programme-delivery factors, were found to explain more of the variation in cervical screening coverage in younger and older women. However, both population-level and programme-delivery factors were more strongly associated with cervical screening coverage in younger rather than older women.

Five high-performing and five low-performing PCTs were identified in the analyses. The high-performing PCTs tended to either have relatively high screening coverage despite having population factors associated with lower screening coverage, or were PCTs that did not appear to face these same challenges. Low-performing PCTs for cervical screening coverage in younger women were London based, and had relatively higher ethnic minority population, higher percentage of younger women although were generally more educated. Low-performing PCTs for cervical screening coverage in older women were also urban PCTs but had more women without higher education.

Study 4 Findings

The health professionals interviewed in Study 4 considered higher cervical screening coverage as being supported by local and national health promotion campaigns, requiring the necessary staff to support general practices to deliver the programme, including staff training and assisting with data list cleansing. The efficiency of the NHS Cervical Screening Programme such as the new structure embedded as a result of the NHS reorganisation in 2013 and the longstanding commitment to 14-day turnaround for delivery of results were also considered important. Factors considered to hinder higher cervical screening coverage included emotional and practical barriers to attendance, lower awareness of the cervical screening programme, its benefits and its relevance to different populations, and previous bad experiences at screening. General practice issues such as the implementation of incentives of the Quality Outcomes Framework and exception reporting were considered potentially problematic. There was also concern that the reorganisation of the NHS in 2013 had led to a loss of local knowledge and local area support that may hinder training of general practice staff and assistance with local health promotion campaigns. ‘City effects’, such as population mobility, difficulty for general practices to maintain the volume of patient records and, potentially, a greater propensity for some women to attend cervical screening privately, were also cited as factors that may explain lower coverage in London, and possibly other larger cities too.

10.1.3 Do Perceived benefits of Cervical Screening Mediate the Association between Socioeconomic Status and Cervical Screening Coverage? (Study 5)

Study 5 Findings

Women of lower SES, younger women and those in full-time employment were more likely to be overdue for cervical screening. Women who were up-to-date with their cervical screening invitations and those in higher SES groups were more likely to agree with the statements on perceived benefits of cervical screening, and in mediation analysis, these beliefs were found to explain a significant portion of the association between SES and screening status.

10.1.4 Do Socioeconomic Inequalities in Attendance at Referral to Colposcopy following an Abnormal Cervical Screening Test contribute to Socioeconomic Inequalities in Cervical Cancer? (Study 6)

Study 6 Findings

Attendance at colposcopy at eight weeks and four months post-referral was generally high, however, women living in less deprived areas were more likely to attend colposcopy than women living in more deprived areas, even after accounting for age and area-level ethnicity. Older women, rather than younger women, were more likely to have attended screening at four months post referral.

The cervical screening indicator had a significant effect on colposcopy attendance, such that women with more advanced indicators (moderate/severe and ?invasive/?Glandular) were more likely to attend screening than women with low grade/borderline abnormalities (reference group) within 8 weeks of referral. At four months post referral, women with a moderate/severe cervical screening indicator were still significantly more likely to attend colposcopy than the reference group but this was not the case for women with more the ?invasive/?Glandular indicators. This last finding is encouraging as it suggests that women with indicators of more advanced abnormalities are being supported to attend sooner.

There was also a distinct ethnic gradient in colposcopy attendance at both 8 weeks and 4 months post referral, even after adjustment for the effects of deprivation, age and cervical screening indication.

Socioeconomic inequalities in colposcopy attendance were found at eight weeks post referral but were no longer significant at four months post referral. This indicates that while women of lower SES may be slower to attend colposcopy they may be supported to attend in time. However, attendance at colposcopy is potentially of greatest concern in communities with a lower proportion of white population.

10.2 Overview

Overall, the studies in my thesis have explored different pathways to understand socioeconomic inequalities in cervical cancer screening: my background review of evidence for socioeconomic inequalities in the high-risk HPV status, including exposure to cervical cancer risk factors; socioeconomic inequalities in cervical screening coverage; an exploration of potential individual-level mediators of SES and cervical screening attendance; and evidence of socioeconomic inequalities in colposcopy attendance. It is clear that there is no simple, quick-fix answer to addressing this issue and it is likely to require attention to different levels of engagement and the complex interactions between the various factors.

Women of lower SES do appear to be at greater risk of being high-risk HPV positive, and this was supported by evidence that these women were more often exposed to, or partaking in health behaviours that increased their risk for acquiring and maintaining high-risk HPV infection. However, this is an insufficient explanation for socioeconomic inequalities in cervical cancer outcomes because cervical cancer can be prevented through participation in the NHS Cervical Screening Programme. However, it is clear that equitable access to the NHS Cervical Screening Programme remains problematic despite the long-term availability of the programme and successive policies to promote wider participation.

Variation in cervical screening coverage in areas across England may be more sensitive to population characteristics than programme-delivery characteristics, at least for the factors considered in this thesis. More deprived populations that also had lower levels of education were particularly susceptible to poorer cervical screening coverage. There were also key differences in the associations between cervical screening coverage and deprivation, education and ethnicity in both younger and older age groups. This study was also able to assess the difference in cervical screening coverage across different ethnic minority groups. In particular, higher levels of cervical screening coverage were found in ethnic minority groups with higher levels of education than in other ethnic minority groups. With regards to programme-delivery factors, cervical screening coverage is supported by the greater availability of general practice staff.

Area-level effects, particularly in relation to London, indicate that the association between deprivation and cervical screening coverage is weaker, and the overall picture of what contributes to lower cervical screening coverage in the city remains unclear.

Health professionals expressed concern about lower cervical screening coverage in younger women, ethnic minority women and those of lower SES. They were also concerned about the delivery of the cervical screening programme, citing the need for greater flexibility in screening appointment times, the pros and cons of standardised versus targeted invitation letters to particular populations of women, and the need to ensure all general practice staff are motivated to promote cervical screening attendance. Local health-promotion campaigns were generally acknowledged to be successful when they were co-ordinated across the service, but there was little evidence of any substantive evaluation of the impact of local health-promotion campaigns on cervical screening uptake.

While the perceived benefits of cervical screening are considered as having some mediating effect on the association between SES and cervical screening attendance, the wider consideration of other potential mediators is useful. This may include the wider consideration of socioeconomic variation in cancer fear and cancer fatalism, practical barriers and other psychosocial factors. These may be more modifiable than the wider social constructs of lower income and lower education. This pathway may extend beyond the understanding of socioeconomic inequalities in cervical screening coverage, and therefore also offer potential routes in which to intervene on SES and poorer cervical screening coverage.

Colposcopy attendance is generally high, which is a welcome indication that when women choose to accept their invitation to cervical screening that they are likely to follow further medical advice. Yet, evidence of socioeconomic inequalities in colposcopy non-attendance is of particular importance because it highlights the risk that precancerous changes may go untreated in a population with an abnormal cervical screening test result. Around two-thirds of all women who attend colposcopy following an abnormal screening test result go on to have treatment. This may be higher in women of lower SES who are more likely to be high-risk HPV positive.

The findings from this thesis open up areas for further research. These will be discussed in the relevant section below.

10.2.1 SES Measures and Women

In chapter 2, I discussed the implications for the interpretation of research findings when using different measures of SES in health research which focusses specifically on women. In this section, I will discuss the implications and interpretation of the measures of SES used in each of my studies in the context of their applicability to promoting further understanding of the pathways by which SES is associated with either cervical screening coverage or colposcopy attendance in England.

Studies 1 and 2 associated area-level income (the percentage of households receiving income support) with cervical screening coverage. As mentioned in the previous section, individual-level measures of SES are not available for national cervical screening coverage which enforced the use of an area-level measure. Income may be preferable to other area-level measures of SES for women as it can be valid at both an individual-level and a household-level. For example, for women who live alone, their individual income is equal to their household income, whereas, women whose household income is supplemented by another member of the household may, in some cases, be in a better financial position overall. However, equivalised household income, which adjusts household income for size and composition (ONS, 2012), would need to be used to ascertain if this were indeed the case.

Although the NHS Cervical Screening Programme is free at the point of access, the enduring pattern of lower attendance in more income-deprived areas found in studies 1 and 2 could be interpreted in terms of the relatively greater challenge for women who live in such areas to overcome the logistics of attending screening. This may be due to the financial implications of arranging childcare, as some low-income women may not be able to afford this. The cost of transport may also be more prohibitive for women living in these areas. Or, it may be that attending screening is not a priority for women who may have relatively greater ongoing financial worries.

Cervical screening attendance is more normative in less deprived areas indicating that those in more deprived areas may not have the same access to supportive social networks to facilitate attendance. This may operate in terms of the willingness or availability of others to offer free childcare but may also include other issues, such as encouragement to attend screening or the opportunity to discuss any difficulties, or indeed, reservations about screening with others. However, it cannot be determined that this is the pathway to lower screening attendance given the sole use of income as a measure of SES in studies 1 and 2, as screening attendance is likely to be more socially normative in areas with, for example, higher levels of education.

Study 3 also used area-level income as a measure of SES and found cervical screening to be lower in more deprived areas. Therefore, these results can be interpreted along similar lines to those in studies 1 and 2. However, this study also incorporated area-level education and therefore opened other potential pathways for consideration. The measure was the percentage of the population without any higher education and was not specific to *women's* higher education per se. This was considered to be appropriate because study 3 compared screening coverage across age groups. Comparisons between younger and older women on the basis of education level could be problematic given that younger women generally have greater opportunities to access higher education.

Study 3 found a positive association between the percentage of the population *without* higher education and cervical screening attendance in younger women (in univariate analyses) but this was no longer significant when the results were adjusted for other population factors. There was no association between higher education and cervical screening in older women. These results were surprising as the cervical screening literature suggests that higher education would be positively associated with cervical screening coverage. The potential pathways for the expected outcome may include the higher levels of health literacy in more educated populations that may promote the understanding of the value of screening or in engagement with the screening invitation and associated health information. Women with higher education are more likely to have a professional job, as previously discussed, and are therefore likely to have fewer barriers to attendance due to their employment conditions. However, these potential pathways cannot be inferred from the results of Study 3. It is likely that the particular measure was insensitive to the effects of education on screening attendance, perhaps for the aforementioned limitations of area-level measures and/or to the specific education measure applied across all age groups of women.

Study 5 used data from a cross-sectional population-based survey and aimed to investigate if perceived benefits of cervical screening mediated the association between cervical screening (self-reported cervical screening attendance) and SES (an individual-level index of SES measures). The index comprised housing tenure, car ownership and education and was similar to indices used in other studies of socioeconomic inequalities in cervical screening. While such an index may be an acceptable means of establishing the association between socioeconomic status and health outcomes, unfortunately it can also limit the interpretation of the results in terms of the potential mechanisms through which SES may be operating. This is because the index combines all of the explanatory factors into an overall score. In retrospect, entering the individual measures independently into the model could have been more informative. Had the perceived benefits been found to mediate the association between education and cervical screening attendance but did not mediate the association between home or car ownership and cervical screening, then the findings could have suggested, for example, that health literacy was a pathway to higher attendance.

Study 6 associated area-level income (the percentage of households receiving income support) with colposcopy attendance. Colposcopy attendance was significantly lower in more deprived areas at both eight weeks post referral (in both univariate and adjusted models) and was significantly lower at four months post referral in univariate analyses (but not when adjusted for: age; ethnicity; and cervical screening indication/invitation period). One interpretation of these findings may be that financial issues are an initial, but not insurmountable, barrier to colposcopy attendance. Colposcopy appointments generally take place in dedicated colposcopy clinics within hospitals and may be more expensive or lengthy than the journey to a local GP for the originating cervical screening appointment. Access to childcare may also pose as another financial barrier, either because low-income women may need to align their appointment with a week/month that they have the resources to cover childcare costs or because they may be reliant on the favour and convenience of friends and neighbours to look after their child/children for free. It could be that reminder letters and other mechanisms of the fail-safe process (letter to the GP to inform them of their patient's non-attendance at colposcopy) may support women to prioritise their colposcopy appointment even where financial costs are an initial obstacle. Women in lower paid jobs with less autonomy or flexibility may need longer to negotiate a suitable time to attend a colposcopy appointment and hence may be more susceptible to delay their initial allocated colposcopy appointment.

This thesis has used area-level and individual-level measures of SES covering income, education and an index of socioeconomic status. This has enabled the interpretation of these results to incorporate different pathways or mechanisms to attendance at cervical screening and colposcopy appointments.

10.3 Strengths and Limitations

10.3.1 Sampling

Studies 1, 2, 3 and 6 relied heavily on area-level data, including screening coverage data from the NHS Cancer Screening Programmes website and other population level factors, such as income deprivation and ethnicity from administrative sources. Although screening coverage data were aggregated to area-level, data were based on actual attendance and were not subject to the inherent biases of self-reported data such as recall bias or response bias. Care was taken to moderate the interpretation of the results with respect to the 'ecological fallacy' where area-level population data should not be assumed to represent individuals. Data were collected at the smallest geographic unit possible, Lower

Super Output Area (LSOAs). LSOAs are relatively small, homogenous areas comprising around 1500 residents and 650 households, and are considered to offer as good a representation of their population as can be derived from within the limitations of area-level data (ONS, 2011b). Further, the NHS Cervical Screening Programme does not hold information on a woman's income, ethnicity, and levels of education, therefore these data are just not available. Had I used a population-based survey to gather this information, it would have been expensive and would also have been limited in its ability to answer my questions regarding the area-level variation in cervical screening coverage across England. The benefits of using these data are that I was able to utilise accurate data on cervical screening coverage, rather than the disadvantages of self-reported screening, and that I was able to analyse the association between cervical screening attendance and deprivation across the whole of England. The benefits of this approach are exemplified in the atypical pattern of association between cervical screening coverage and deprivation in London in comparison to other areas of the country.

Study 4 offered an alternative form of data by interviewing health professionals about the factors they felt were important for cervical screening coverage, albeit with a small sample. It would have been interesting if I had also been able to speak with women directly about their reasons for not attending cervical screening but there are already many existing studies in this area (Waller et al., 2011; Logan and McIlfatrick, 2011; Jepson et al., 2007). The women's perspective was limited to the few items used in the population-based survey utilised in Study 5. However, this study did offer the opportunity to investigate an alternative pathway from SES to cervical screening attendance.

10.3.2 Combining Quantitative and Qualitative Methods

The mixed methods approach used in this thesis enabled me to choose the different methods to answer my questions. The quantitative studies allowed me to look at the variety of factors that may affect cervical screening coverage across England, taking into account programme-delivery characteristics and population-level characteristics. The qualitative study with health professionals working in the NHS Cervical Screening Programme allowed for an alternative analysis of these factors and the opportunity to explore these factors in a more holistic manner. However, integrating the findings from such different methodological approaches was not without its challenges. Study 3 produced evidence of the association between cervical screening coverage and a variety of different factors in an effort to address the factors that hinder or support cervical screening. The views of the health professionals were much more holistic, with each professional giving their own perspective in light of their experience of working in the NHS Cervical Screening Programme, although this was limited by the small sample size.

10.4 Implications of findings

10.4.1 Contribution to Literature

Study 1 found that there has been no discernible improvement in the cervical screening coverage gap in recent years. Inequalities in cervical screening coverage are ongoing and did not change significantly over the period 2007 to 2012. This updates the existing literature on socioeconomic inequalities in cervical screening because it focuses on the screening coverage gap and considers potential interactions between deprivation and cervical screening coverage over time (Bang et al., 2012; Moser et al., 2009). This finding renews to the call to continued efforts to improve the cervical screening coverage gap as a means of reducing cancer incidence (Weller and Campbell, 2009). In contrast, the socioeconomic inequalities in colposcopy attendance, found in Study 6, were smaller than those found for cervical screening coverage. Colposcopy attendance was relatively high, and this is perhaps an indication that once women have attended cervical screening they are likely to also attend colposcopy, if advised. However, there is plausible yet anecdotal evidence of the potential for a wider colposcopy attendance gap than found in my study, if some women of higher SES are actually attending colposcopy at private clinics. This may counter the suggestion by some earlier studies of the limited benefit from efforts to improve default rates at colposcopy (Balasubramani et al., 2008; Lester and Wilson, 1999). Socioeconomic variation in colposcopy attendance may be viewed as another missed opportunity in which to improve cervical cancer outcomes in women of lower SES.

Study 2 found evidence of a reduction in the coverage gap for breast cancer screening. Women in a National Statistics Omnibus survey reported higher attendance at breast screening than cervical screening (Moser et al., 2009). However, as far as I am aware, no other study has reported a reduction in the socioeconomic inequalities in breast cancer screening in the UK and therefore these are novel findings. Given the difficulty in effecting any meaningful change to socioeconomic inequalities in screening coverage overall, the improvement in breast screening coverage among the women in the most deprived SES group is worth further exploration. It is recommended that future research seek to explore the specific factors that may have led to this improvement and how they can be further applied within the breast screening programme to support improved attendance in other SES groups also. Further, any lessons that could be learned from further research in this area may offer valuable lessons for the NHS Cervical Screening Programme. There is evidence that socioeconomic inequalities in breast cancer survival have been improving over time (Lyratzopoulos et al., 2011). This may provide some encouragement for improved breast cancer outcomes since survival rates are better when breast cancer is screen-detected, even in more deprived women who have poor prognosis (Morris et al., 2015).

The findings from Study 3 were unique. Other studies have addressed PCT level cervical screening coverage and its association with primary care factors (Bang et al., 2012) but this is the first time that individual areas have been identified as performing relatively well or poorly after consideration of such factors. While national strategies to improve cancer screening uptake continue to require further research and prioritisation (Weller and Campbell, 2009), identifying areas that could be used as exemplars of best practice may fast track improvements elsewhere. Further, and perhaps more importantly, areas identified with poorer cervical screening coverage that also have a range of factors known to hinder cervical screening uptake may be targeted to received additional support. While PCTs have been replaced by Clinical Commissioning Group (CCGs), with the exception of Sefton, all other low performing PCTs identified in this study have the same geographical footprint as their respective CCG. Therefore, there is still relevance to the findings of this study. Further, the research methods used can also be applied to other areas or institutions, including CCGs if desired.

The findings from Study 4 provided a means of reflecting on the different factors that hinder or support cervical screening coverage. The process illuminated ambiguity in the potential effect of some factors. For example, the current standardised invitation to cervical screening was found to be both a support and a hindrance. Most interestingly, the health professionals provided insight into the potential effects of organisational change on cervical screening coverage. It remains to be seen if these changes will ultimately be of benefit to NHS Cervical Screening Programme. However, should significant change in cervical screening coverage be found in future studies addressing the period during and since the reorganisation of the NHS, then this study may offer insight that may support interpretation of their findings.

The findings from Study 5 indicate that perceived benefits of the NHS Cervical Screening Programme explain some of the association between SES and cervical screening attendance. While the study was limited in the number of belief factors able to be included in the study, it did support other findings in the literature that suggest that such factors are important.

Study 6 addressed socioeconomic inequalities in colposcopy attendance. The study was unique in so far as it is the first study to analyse individual level colposcopy attendance at a regional level within the UK. Larger scale studies to date have generally relied upon appointment-level attendance data, which is limited in its capacity to represent patient-level attendance. While other studies that have used patient-level data, they have generally had a smaller sample size, as their data were often derived from individual colposcopy clinics, or were sourced from participants taking part in a wider clinical trial. The contributions to current literature include the findings that women of lower SES are slower to attend colposcopy than other SES groups and therefore may need to be supported to attend sooner. When attendance is prioritised, as is the case in women with indications of more advanced cervical abnormalities, colposcopy attendance is higher. While this may, in part, be due to the encouragement given to these women to attend, it may also be due to the greater urgency from the women themselves when they receive the notification that they have a more advanced cervical abnormality. Ethnic variation in colposcopy attendance was most striking in this study. It is recommended that future research further explores ethnic variation in colposcopy attendance.

10.4.2 Contribution to Policy and Practice

In Study 1, I found that there was no discernible improvement in socioeconomic inequalities in cervical screening coverage since 2007. This is an important finding in the context of policy and practice because it indicates that efforts since 2007 have failed to make a meaningful impact on socioeconomic inequalities in cervical screening coverage, despite best efforts. Recommendations to policy and practice as a consequence of these findings suggest that new policy measures are required. Given the different patterns of association between deprivation and screening coverage in younger and older women, it is likely that action to deal with socioeconomic inequalities should also be mindful of the target age group. The findings of this study suggest that without a change in policy there may be no change in socioeconomic inequalities in cervical cancer coverage in the longer term.

There have been improvements in breast screening coverage over the same period. The improvements in the breast screening programme, with largely the same older population of women invited to cervical screening, indicates that the progress is due to factors within the breast screening programme. The breast screening coverage gap has narrowed due to the improved screening attendances rates in women of lower SES. It is unclear if this may be due to the policies in place to improve socioeconomic inequalities in the NHS Breast Screening Programme, targeted interventions to support lower SES women into breast screening or if changes to the delivery of the programme may have made it more accessible. The improvements noted for the NHS Breast Screening Programme may offer valuable lessons for adaptive policies to reduce screening inequalities in the other screening programmes, potentially with more relevance to the bowel screening programme where current socioeconomic inequalities are greatest.

Prior to the research undertaken in this thesis in Study 3, there had been no literature published on the identification of high- and low-performing PCTs. While PCTs no longer exist, many of the same geographical areas can be mapped to the new Clinical Commissioning Groups (CCGs) and the fundamental variation in cervical screening coverage is likely to remain unchanged. The identification of high-performing areas, that is, areas that have exceptionally high levels of coverage after taking into consideration programme-delivery factors and population factors, offers the opportunity for these areas to be further investigated as potential examples of best practice. The identification of low-performing areas also offers the opportunity for these areas to receive further support to tackle the particular challenges they face.

As mentioned in the previous section, socioeconomic variation in colposcopy attendance indicates a point in the cervical screening programme for further intervention to reduce poorer cervical cancer outcomes. The findings suggest that women with more advanced cervical screening test indicators attend colposcopy sooner. In part, this is due to current policies which target the provision of earlier appointments for advanced cervical abnormalities. This finding may inform strategies to support other women at risk of delayed attendance or non-attendance. While women of lower SES are slower to attend a colposcopy appointment following an abnormal screening test result and may need to be supported to attend sooner, women who live in more ethnically diverse communities are most likely to not to attend. Therefore, it is recommended that policies are amended to seek ways in which women from ethnic minority populations can be supported into attending colposcopy. This may include changes to the priority given to their appointments or to addressing the means by which ethnic minority women are invited to attend colposcopy or are provided information or reassurance about what the appointment may entail. All areas across England are required to have fail-safe policies to support colposcopy attendance. If colposcopy attendance is to be improved, evaluation of these fail-safe policies, including their implementation, should be reviewed to determine their suitability for different SES groups and ethnic-minority populations.

10.5 Future Research

10.5.1 The Screening Coverage Gap – what can be learnt from improvements in the breast screening coverage gap?

Further work could be undertaken to ascertain why the breast screening coverage gap has narrowed, yet the cervical screening coverage gap has not. Potential areas for further exploration include investigating if the narrowing of the breast screening coverage gap was attributable to increased awareness of the benefits of breast cancer screening, adaptive changes to the accessibility in the NHS Breast Screening Programme to lower SES women, or successful reminder interventions.

It is important to note that breast screening coverage had been lower than cervical screening coverage and therefore may have had more improvements to make in the first instance. In this respect, insight from the breast screening programme may offer valuable lessons to the colorectal screening programme which has lower levels of uptake, and a significant coverage gap. Work to compare barriers to screening across the three programmes has highlighted important similarities and distinctions to screening coverage (Lo et al., 2013). Further work to identify key components that may inform future strategies to improve screening coverage is recommended.

10.5.2 Is there a 'London effect' on Cervical Screening Coverage?

Both cervical and breast screening coverage were lower in London. There were distinct patterns of association between screening coverage and deprivation in London too, where the association tended to be much weaker. There were a number of reasons suggested for these findings, not least of which was that the area-level measure of income deprivation (income domain of the IMD) may not be sensitive enough to detect poverty within London. Other issues relating to high population diversity and population mobility may require further investigation. It is unclear, however, if these issues are particular to London, or if they may be generalisable to other large cities – a 'city effect'.

Further work in this area may include investigation of the patterns of screening coverage in London in comparison with other large cities. From my findings in Study 3, I would suggest further analyses of screening coverage and its association with a number of different factors, as follows. Is the association between screening coverage and deprivation also weaker in other inner city/large city areas? What are the patterns of association between screening coverage and distinct ethnic minority groups? My findings suggest that other factors associated with ethnic minority groups, including level of education and specific religious beliefs may be associated with variations in screening coverage. This may be important for cities which, like London, have greater ethnic diversity. Further work may also include a comparison on these factors across screening programmes to determine which factors are common across all three programmes, and, therefore, may be considered a 'city effect', or, alternatively, may be specific to the screening programme in question. Certainly, I found similar patterns of association between deprivation and both cervical and breast screening coverage. Would these patterns still hold for bowel screening uptake where the eligibility extends to both sexes? Finally, further investigation of the workload for general practices and their ability to cope with potentially higher administration of the cervical screening programme, in particular, may be warranted. Could a higher administrative burden be carried for city general practices? The results of such investigations may contribute to a wider understanding of the means to support screening uptake in city locations but also potentially to the support for particular groups of the population and for delivery of the respective programmes.

10.5.3 Cervical Cancer Prevention – targeting socioeconomic inequalities in colposcopy attendance to reduce avoidable deaths from cervical cancer

Socioeconomic inequalities in colposcopy attendance occur despite the provision of fail-safe policies to support attendance. This presents a problem for the NHS Cancer Screening Programme since around two-thirds of all women who present at colposcopy following an abnormal screening test result go on to have some sort of diagnostic procedure and/or treatment. Women of lower SES are more likely to have a high-risk HPV positive status. Further research into the reasons why women, who have already attended cervical screening, choose not to attend colposcopy is needed. Little is known about what these reasons may be, although research is available on the anxiety and stress felt by women who receive an abnormal screening test result, many of whom still go on to attend colposcopy. Other psychosocial or practical barriers may need to be identified. An evaluation of fail-safe policies, and of variations in such policies across areas in England, may indicate ways in which these policies may be more effective.

Ways in which socioeconomic variation colposcopy may be investigated are suggested here. This may be particularly interesting to address in areas that are less affluent than the East of England, where my data were sourced. A study of this type may undertake similar analysis to my study and use logistic regression to regress colposcopy attendance for women against age, deprivation, education and ethnicity. I would also recommend that system-level and individual-level barriers to colposcopy attendance be investigated.

Such a study may use qualitative research methods to explore the professionals' views of the implementation of 'fail-safe' policies to support colposcopy attendance and to explore potential barriers to women's colposcopy attendance. If the professionals were to be recruited from colposcopy clinics in low-/medium-/high-income areas and with low/medium/high mix of ethnic minority populations then further understanding of challenges in different areas may be gathered. I would also recommend that women's views of facilitators and barriers to colposcopy attendance may be investigated, even though this may be a challenging group to recruit for. One suggestion may be to contact women identified as having been referred to colposcopy following an abnormal screening result and who were more than four months overdue to complete a brief questionnaire (by post/online/phone) on reasons for not attending colposcopy. Women who participated in the questionnaire could also be invited to attend a semi-structured interview to discuss in greater detail their reasons for not attending colposcopy (practical/psychosocial/knowledge) and to consider what supports, if any, may have enabled them to attend.

10.6 Final Remarks

Poorer cervical cancer outcomes for women of lower SES remain evident in the UK despite the availability of the NHS Cervical Screening Programme. This thesis argued that targeting efforts to improve cervical screening attendance and colposcopy attendance are important pathways to future intervention on socioeconomic inequalities in cervical cancer. Evidence was found for large discrepancies in cervical screening coverage across England, and areas have been identified for further support or as exemplars of best practice. The population characteristics of some areas may support further targeted interventions to increase cervical screening coverage in groups at-risk of not attending. Evidence was found of socioeconomic variation in colposcopy attendance, and this should be highlighted as an opportunity for improving cervical cancer outcomes in a population already identified as having cervical abnormalities. Work remains to be done to address the socioeconomic inequalities in cervical screening and colposcopy attendance, and this thesis has identified some ways in which continued efforts can be focused.

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Appendix 1: Inequalities in Cervical Screening Coverage (Chapter 4)

A copy of the published paper begins on the following page.

Original Article

Socioeconomic inequalities in breast and cervical screening coverage in England: are we closing the gap?

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Abstract

Objective: Health policy in the UK is committed to tackling inequalities in cancer screening participation. We examined whether socioeconomic inequalities in breast and cervical cancer screening participation in England have reduced over five years.

Methods: Cross-sectional analyses compared cervical and breast screening coverage between 2007/8 and 2012/13 in Primary Care Trusts (PCTs) in England in relation to area-level income deprivation.

Results: At the start and the end of this five year period, there were socioeconomic inequalities in screening coverage for breast and cervical screening. Inequalities were highest for breast screening. Over time, the coverage gap between the highest and lowest quintiles of income deprivation significantly reduced for breast screening (from 12.3 to 8.3 percentage points), but not for cervical screening (5.3 to 4.9 percentage points).

Conclusions: Efforts to reduce screening inequalities appear to have resulted in a significant improvement in equitable delivery of breast screening, although not of cervical screening. More work is needed to understand the differences, and see whether broader lessons can be learned from the reduction of inequalities in breast screening participation.

Keywords

cancer screening, coverage, socioeconomic inequalities

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Introduction

The National Health Service (NHS) Breast and Cervical Screening Programmes were introduced in the UK in 1988. In England, breast screening is offered every three years to women aged 50–70, with an age-extension from 47–73 years currently being rolled out.[1] In the face of recent debate about the value of the breast screening, an independent review was carried out in 2012, which concluded that, on balance, screening is beneficial.[2] Cervical screening is offered to women aged 25–64, every three years for women aged 25–49 and every five years for those aged 50–64.[3] Both programmes use a 'call-recall' system in which women receive invitations, re-invitations, and reminders, as recommended by the World Health Organization (http://www.who.int/cancer/detection/variouscancer/en/).

Coverage (defined as breast screening within the past three years, and cervical screening within the past five years) is high for both programmes: currently 77% for breast screening[4] and 78% for cervical screening,[3] although cervical screening coverage has been declining, particularly in younger women,[3] and has not reached its 80% target since 2005. There is also long-standing concern that coverage across both programmes is lower among women from lower socioeconomic status (SES) backgrounds. Using area-level measures of SES, breast and cervical screening coverage has been found to be lower in more deprived areas.[5–9] Using individual-level measures, women who live in rented accommodation or in households without cars have been shown to be significantly less likely to attend breast screening.[10] Educational level has also been associated with lower cervical screening coverage in a number of national surveys.[10–13] Inequalities in coverage of breast and cervical screening are likely to be contributing to inequalities in cancer outcomes.[14,15]

Successive UK governments have made policy commitments to tackling inequalities in cancer screening participation.[1,16] Building on this commitment, there have been many local activities designed to promote screening coverage in deprived areas. These have adopted a variety of

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strategies, including GP endorsement, addressing programme-specific barriers, and developing socially and culturally appropriate invitation approaches.[17,18] Cumulatively, these may have contributed to a reduction in socioeconomic inequalities in screening coverage over time.

Until 2013, Primary Care Trusts (PCTs) were responsible for screening coverage within their areas. National, quality-assured PCT-level coverage data are available for download from the NHS Health and Social Care Centre and are not subject to self-report bias inherent in individual-level data. The present study therefore examined associations between area-level deprivation and breast and cervical screening coverage in England from 2007 to 2012.

Methods

PCT[1] data on breast and cervical screening coverage for the period 2007–2012 were downloaded from the Health and Social Care Information Centre.[4,19] We included data from all 151 PCTs in England, 31 of which were in London.

Breast screening coverage data were for women aged 53–70. Breast screening coverage is defined as the percentage of eligible women who have had a test with a recorded result in the last three years.[4] Cervical screening data were available for women aged 25–64, but we also subdivided the sample into those aged 25–49 (using 3.5 year coverage) and 50–64 (using five year coverage), for age-matched comparison with breast screening. Cervical screening coverage is defined as the percentage of eligible women who have had a test with a recorded result in the last 3.5 years for those aged 25–49 and in the last five years for those aged 50–64.[4]

We used the income domain score from the Index of Multiple Deprivation (IMD) 2010 as the marker of deprivation. This is an area-level measure based on the number of households on low income, benefits or other welfare support. The score is the proportion of people classed as income deprived, and is calculated using a population-weighted average of Lower Super Output Area income deprivation score, aggregated to PCT level. IMD scores at PCT level were downloaded from the National Gynaecological Hub.[20] IMD scores were categorized into quintiles for the primary analyses.

Statistical analysis

Data were analysed using Stata version 10.1.[21] Descriptive statistics were generated for PCT-level coverage of both screening programmes. To describe the relationship between screening coverage and income deprivation, we fitted a Poisson regression model by quintiles of IMD. We examined changes over time by testing for an interaction between time and income deprivation in their combined effect on coverage in the Poisson regression model. This is equivalent to estimating and testing the effect of the product of year and IMD on coverage.

Table 1. Descriptive statistics for breast and cervical screening coverage within PCTs, England (2007–2012).

	Breast screening coverage (%)			Cervical screening coverage (%)		
Year	Min-Max	Mean	SD	Min-Max	Mean	SD
2007–08	43.9–84.6	74.6	8.1	66.7–85.7	78.1	3.7
2008–09	50.9–84.8	75.1	7.6	65.8–85.8	78.5	3.8
2009–10	56.9–85.0	75.6	6.2	66.4–85.4	78.5	3.6
2010–11	59.8–85.1	75.9	5.3	67.2–84.3	78.3	3.4
2011–12	59.5–84.7	75.6	5.1	65.9–83.8	78.3	3.4
2012–13	58.3–83.3	74.8	5.3	65.5–83.5	78.0	3.4

Results

Screening Coverage

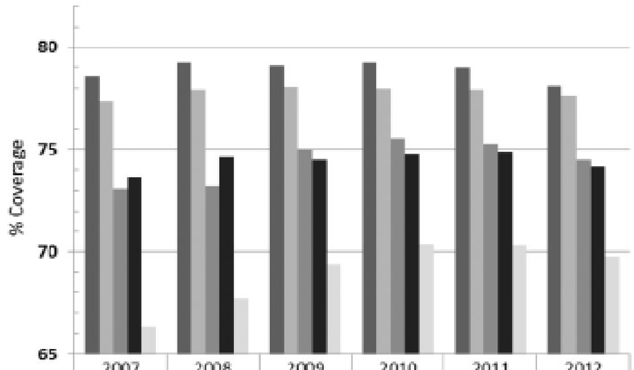
Annual coverage figures for the two programmes from 2007 to 2012 are shown in Table 1. Overall, breast screening coverage was fairly stable at 74–75%, although the range shows that there was an improvement in the worst-performing PCTs, with the minimum coverage increasing from 43.9% in 2007/8 to 58.3% in 2012/13. Overall cervical screening coverage was also stable at around 78%, with little change in the range across PCTs.

Deprivation and Screening Coverage

Figure 1 shows breast screening coverage by PCT-level quintile of income deprivation across the time period of the study. In 2007, the difference in coverage between the least deprived (Q1) and most deprived (Q5) quintile was 12.3 percentage points. Coverage in the less deprived quintiles changed little, but coverage in Q5 increased from 66.3% to 69.8%, suggesting that inequalities improved over time. Table 2 shows the relative rates of coverage from the Poisson regression. Poisson regression models for each year showed that Q3, Q4 and Q5 had significantly lower coverage than Q1 (see Table 2). However, the relative coverage for Q5 was 0.85 (95% CI 0.84–0.86) in 2007/8 and increased to 0.89 (95% CI 0.88–0.90) in 2012/13. There was significant heterogeneity in the association of coverage with income deprivation by year ($p < 0.0001$), with the strength of the negative association declining significantly with successive years.

Figure 2 shows cervical screening coverage for women aged 25–64 by quintile of income deprivation. In 2007, the difference in coverage between Q1 and Q5 was 5.3

[1]Primary Care Trusts (PCTs) were local NHS healthcare organisations which, until March 2013, were responsible for cancer screening in their local area. The median population covered by a PCT was 284,000 http://www.kingsfund.org.uk/blog/2012/07/ccgs-and-pcts-not-so-different-after-all



	2007	2008	2009	2010	2011	2012
1 - Least Deprived	78.6	79.2	79.1	79.2	79.0	78.1
2	77.3	78.0	78.1	78.0	78.0	77.6
3	73.0	73.2	75.0	75.5	75.2	74.5
4	73.7	74.6	74.5	74.8	74.9	74.2
5 - Most Deprived	66.3	67.7	69.4	70.4	70.3	69.8

Figure 1. Breast screening coverage by quintile of area-level deprivation within PCTs, England, age 53–70 (2007–12).

Table 2. Results of Poisson regression of breast screening coverage on quintiles of deprivation by year, England (2007–12).

Year	Deprivation quintile	RR*	95% CIs Lower	95% CIs Upper	Average % coverage	p
2007–08	Q1 (reference)	1.00			79	–
	Q2	0.99	0.98	1.00	77	<.0001
	Q3	0.94	0.93	0.95	73	<.0001
	Q4	0.94	0.93	0.95	74	<.0001
	Q5 (most deprived)	0.85	0.84	0.86	66	<.0001
2008–09	Q1 (reference)	1.00			79	–
	Q2	–.99	0.98	1.00	78	<.0001
	Q3	0.93	0.92	0.94	73	<.0001
	Q4	0.95	0.94	0.96	75	<.0001
	Q5 (most deprived)	0.86	0.85	0.87	68	<.0001
2009–10	Q1 (reference)	1.00			79	–
	Q2	1.00	0.99	1.01	78	.2
	Q3	0.95	0.94	0.96	75	<.0001
	Q4	0.95	0.94	0.96	75	<.0001
	Q5 (most deprived)	0.88	0.87	0.89	70	<.0001
2010–11	Q1 (reference)	1.00			79	–
	Q2	0.99	0.98	1.00	78	<.0001
	Q3	0.96	0.95	0.97	76	<.0001
	Q4	0.95	0.94	0.96	75	<.0001
	Q5 (most deprived)	0.89	0.88	0.90	70	<.0001
2011–12	Q1 (reference)	1.00			79	–
	Q2	0.99	0.98	1.00	78	.01
	Q3	0.95	0.94	0.96	75	<.0001
	Q4	0.95	0.94	0.96	75	<.0001
	Q5 (most deprived)	0.89	0.88	0.90	70	<.0001

(continued)

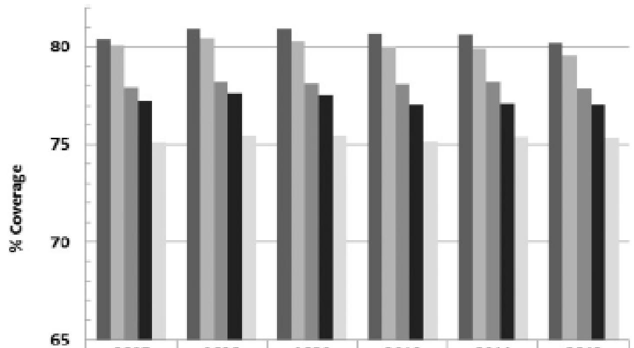
Table 2. Continued

Year	Deprivation quintile	RR*	95% CIs Lower	95% CIs Upper	Average % coverage	p
2012–13	Q1 (reference)	1.00			78	–
	Q2	1.00	0.99	1.01	78	.6
	Q3	0.96	0.95	0.97	75	<.0001
	Q4	0.95	0.94	0.96	74	<.0001
	Q5 (most deprived)	0.89	0.88	0.90	70	<.0001

*Relative rate of coverage.

percentage points, considerably smaller than the breast screening coverage gap. Unlike the pattern for breast screening, coverage was fairly stable across time in all quintiles, with little evidence of a reduction in the socio-economic gradient, although there was a relatively high coverage in the least deprived quintile in 2009–10, yielding a stronger gradient for that year. As with breast screening, Poisson regression analyses showed that Q3, Q4 and Q5 (and in most years Q2) had significantly lower cervical screening coverage than Q1 (Table 3). The coverage gradient ran from 80% (least deprived) to 75% (most deprived) in both 2007–08 and 2012–13. There was significant heterogeneity in the relationship between coverage and income deprivation across years ($p < 0.0001$). This was not due to a decline in the gradient over time, but rather a peak in the gradient in year 2009–10.

We repeated the cervical screening analyses restricted to women aged 50–64 (five year coverage data), to be age-comparable with the breast screening programme.



	2007	2008	2009	2010	2011	2012
1 - Least Deprived	80.4	80.9	80.9	80.7	80.7	80.2
2	80.1	80.4	80.3	80.0	79.9	79.5
3	77.9	78.2	78.1	78.1	78.2	77.9
4	77.2	77.6	77.5	77.1	77.1	77.0
5 - Most Deprived	75.1	75.5	75.5	75.1	75.4	75.3

Figure 2. Cervical screening coverage by quintile of deprivation within PCTs, England, age 25–64 (2007–12).

Table 3. Results of Poisson regression of cervical screening coverage on quintiles of deprivation by year, England (2007–12).

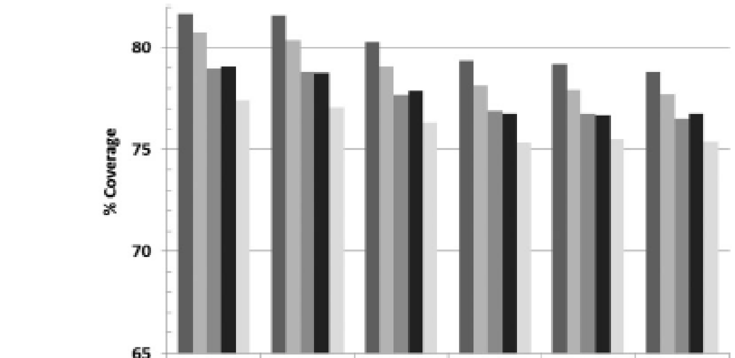
Year	Deprivation quintile	RR*	95% CIs Lower	95% CIs Upper	Average % coverage	p
2007–08	Q1 (reference)	1.00			80	–
	Q2	1.00	0.99	1.01	80	.4
	Q3	0.96	0.95	0.97	78	<.0001
	Q4	0.95	0.94	0.96	77	<.0001
	Q5 (most deprived)	0.93	0.92	0.94	75	<.0001
2008–09	Q1 (reference)	1.00			81	–
	Q2	0.99	0.98	1.00	80	.008
	Q3	0.96	0.95	0.97	78	<.0001
	Q4	0.95	0.94	0.96	78	<.0001
	Q5 (most deprived)	0.93	0.92	0.94	76	<.0001
2009–10	Q1 (reference)	1.00			84	–
	Q2	0.93	0.92	0.94	80	<.0001
	Q3	0.89	0.88	0.90	78	<.0001
	Q4	0.88	0.87	0.89	77	<.0001
	Q5 (most deprived)	0.86	0.85	0.87	76	<.0001
2010–11	Q1 (reference)	1.00			81	–
	Q2	0.99	0.98	1.00	80	<.0001
	Q3	0.96	0.95	0.97	78	<.0001
	Q4	0.95	0.94	0.96	77	<.0001
	Q5 (most deprived)	0.93	0.92	0.94	75	<.0001
2011–12	Q1 (reference)	1.00			81	–
	Q2	0.99	0.98	1.00	80	<.0001
	Q3	0.97	0.96	0.98	78	<.0001
	Q4	0.95	0.94	0.96	77	<.0001
	Q5 (most deprived)	0.93	0.92	0.94	76	<.0001
2012–13	Q1 (reference)	1.00			80	–
	Q2	0.99	0.98	1.00	80	<.0001
	Q3	0.97	0.96	0.98	78	<.0001
	Q4	0.95	0.94	0.96	77	<.0001
	Q5 (most deprived)	0.94	0.93	0.95	75	<.0001

*Relative rate of coverage.

The pattern of findings was very similar to the full age distribution. Figure 3 shows that the pattern of coverage across quintiles is much more similar to the pattern for cervical screening across all ages than the pattern of breast screening. This suggests that programmatic differences underlie the different patterns of association, rather than the age of the women invited.

Discussion

Associations between income deprivation and screening coverage are well documented,[7,12,18] but few studies have examined whether inequalities are changing. We found, as expected, that PCTs with higher levels of income deprivation had lower coverage for both breast and cervical screening. However, for breast screening, the difference in coverage between the most and least deprived PCTs narrowed significantly over the five years from 2007/8 to 2012/13. This was not the case for cervical screening, even



	2007	2008	2009	2010	2011	2012
1 - Least Deprived	81.7	81.6	80.3	79.4	79.2	78.8
2	80.8	80.4	79.1	78.1	77.9	77.7
3	79.0	78.8	77.7	76.9	76.8	76.5
4	79.1	78.8	77.9	76.8	76.7	76.8
5 - Most Deprived	77.4	77.1	76.3	75.4	75.5	75.4

Figure 3. Cervical screening coverage by quintile of deprivation within PCTs, England, in women aged 50–64 (2007–12).

when the analyses were restricted to women of an age comparable with those in the breast screening programme. This suggests that while strategies to increase breast screening coverage in poorer areas of England may have been successful, the low uptake of cervical screening in poorer areas has been more resistant to change, though the coverage gap is still greater for breast than cervical screening. In 2012/13 the difference in coverage between the highest and lowest quintiles of income deprivation was 8.3 percentage points for breast screening and 4.9 percentage points for cervical, so there is still scope for improvement.

Differences in screening coverage across the programmes may be due to the particular characteristics of each screening programme.[22] For example, women invited to cervical screening are asked to arrange an appointment for screening at their own General Practice, whereas women invited to breast screening are provided with a scheduled appointment at a breast screening unit, generally in a local hospital or mobile unit. However, as yet it is unclear whether these factors might have a differential impact on women from different socioeconomic backgrounds and therefore what their contribution to the SES gradients in coverage might be.

There has been a suggestion that lower screening uptake – regardless of the characteristics of the unscreened group – should be respected as the result of an informed choice.[23] The evidence suggests otherwise. At least in the case of colorectal screening, the unscreened group is much less likely to read the information provided with the screening invitation.[24] This suggests that they are more likely to be unengaged than making an informed choice, particularly as their health literacy tends to be lower.[25] In addition, even in countries such as the UK, where medical care is delivered without cost to the individual, many barriers to screening across programmes - social, fear of the test, embarrassment - are more prevalent in more deprived groups.[26] Until we ensure that information and access are socially equitable, it is not appropriate to interpret uptake differences as a consequence of an informed choice.

One unexpected finding was the peak in cervical screening coverage in 2009–10. This may have been related to death from cervical cancer of the television celebrity, Jade Goody,[27] though we are not aware of previous work which suggests that the impact was strongest among less deprived groups.

Strengths and Limitations

This study benefited from complete data on uptake as a result of using routinely collected data, so there were none of the problems associated with differential response rates in more deprived population subgroups. Methods of data collection over time were also the same, making it possible to interpret differences. But there were also limitations. Area-based measures of deprivation do not reflect the granularity of variation between individuals, and may therefore show a different relationship with behaviour.[28] However, this is the only option when using routinely collected data without individual permissions to access screening records. In this study they were based on scores at Lower Super Output Areas, which are relatively small, homogenized geographic units, and then weighted to PCT level, so they should be fairly accurate. In addition, we only used the income domain because the full

IMD includes the health domain and may incur a 'mathematical coupling'.[29]

Conclusion

A reduction in the breast screening coverage gap across English PCTs suggests that efforts to reduce screening inequalities may have had an effect. However, for cervical screening, there has been no discernible improvement in inequalities, although the magnitude of the inequality effect was consistently lower for cervical than breast screening. More work is needed to understand the differences, and to see what lessons can be learned from the reduction of inequalities in breast screening participation to apply to other programmes, such as colorectal screening, which have very high inequalities.

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Appendix 2: Deprivation and Cervical Screening Coverage in England (including sensitivity analyses using Full Index of Multiple Deprivation)

Appendix Table 1. All England Cervical screening coverage – all eligible women by deprivation quintile (Q1 – Low, Q5 – High)

Yr	Dep. Qs	All eligible women - England Using Income Domain					All eligible women – England Using Full IMD				
		B	95% CIs Lower	Upper	SE	p	B	95% CIs Lower	Upper	SE	p
07	Q1	80.39	79.24	81.54	0.58	–	80.13	78.96	81.31	0.60	–
	Q2	-0.31	-1.94	1.32	0.82	0.710	-0.09	-1.75	1.57	0.84	0.915
	Q3	-2.49	-4.11	-0.88	0.82	0.003*	-2.64	-4.29	-0.99	0.83	0.002*
	Q4	-3.15	-4.78	-1.53	0.82	<0.001†	-2.26	-3.93	-0.60	0.84	<0.008*
	Q5	-5.27	-6.90	-3.64	0.82	<0.001†	-4.93	-6.59	-3.27	0.84	<0.001†
08	Q1	80.94	79.77	82.10	0.59	–	80.69	79.51	81.87	0.60	-
	Q2	-0.51	-2.15	1.14	0.83	0.541	-0.26	-1.93	1.41	0.85	0.757
	Q3	-2.74	-4.37	-1.11	0.83	0.001*	-2.92	-4.57	-1.26	0.84	0.001
	Q4	-3.34	-4.99	-1.69	0.83	<0.001†	-2.44	-4.12	-0.77	0.85	0.004
	Q5	-5.48	-7.13	-3.84	0.83	<0.001†	-5.22	-6.89	-3.54	0.85	<0.001†
09	Q1	80.92	79.81	82.03	0.56	–	80.72	79.59	81.85	0.57	-
	Q2	-0.62	-2.20	0.95	0.80	0.44	-0.48	-2.08	1.12	0.81	0.552
	Q3	-2.78	-4.34	-1.22	0.79	0.001*	-3.10	-4.68	-1.51	0.80	<0.001†
	Q4	-3.40	-4.98	-1.83	0.80	<0.001†	-2.39	-3.99	-0.80	0.81	0.004*
	Q5	-5.46	-7.04	-3.89	0.80	<0.001†	-5.27	-6.86	-3.67	0.81	<0.001†
10	Q1	80.70	79.70	81.69	0.50	–	80.50	79.47	81.53	0.52	-
	Q2	-0.71	-2.11	0.70	0.71	0.324	-0.76	-2.22	0.70	0.74	0.307
	Q3	-2.63	-4.03	-1.24	0.71	<0.001†	-2.95	-4.40	-1.51	0.73	<0.001†
	Q4	-3.64	-5.04	-2.23	0.71	<0.001†	-2.50	-3.96	-1.04	0.74	0.001*
	Q5	-5.56	-6.96	-4.15	0.71	<0.001†	-5.33	-6.79	-3.87	0.74	<0.001†
11	Q1	80.67	79.65	81.69	0.52	–	80.48	79.43	81.53	0.53	-
	Q2	-0.77	-2.21	-0.68	0.73	0.307	-0.80	-2.28	0.68	0.75	0.286
	Q3	-2.46	-3.90	-1.03	0.72	0.001*	-2.97	-4.44	-1.50	0.74	<0.001†
	Q4	-3.56	-5.00	-2.12	0.73	<0.001†	-2.21	-3.69	-0.72	0.75	0.001*
	Q5	-5.26	-6.70	-3.81	0.73	<0.001†	-5.11	-6.59	-3.63	0.75	<0.001†
12	Q1	80.21	79.15	81.26	0.53	–	80.04	78.96	81.12	0.55	-
	Q2	-0.67	-2.16	0.84	0.76	0.38	-0.82	-2.35	0.709	0.77	0.291
	Q3	-2.34	-3.82	-0.86	0.75	0.002*	-2.84	-4.36	-1.33	0.76	<0.001†
	Q4	-3.17	-4.66	-1.68	0.75	<0.001†	-1.84	-3.37	-0.32	0.77	0.018*
	Q5	-4.90	-6.39	-3.41	0.75	<0.001†	-4.70	-6.23	-3.18	0.77	<0.001†

Appendix Table 2. All England: cervical screening coverage in younger and older women by deprivation quintiles

Yr	Dep Qs	Cervical screening (25–49 years)					Cervical screening (50–64 years)				
		B	95% CIs		SE	P	B	95% CIs		SE	P
			Lower	Upper				Lower	Upper		
07	Q1	71.29	69.64	72.94	0.84		81.68	80.79	82.56	0.49	
	Q2	0.54	-1.80	2.87	1.18	0.651	-0.88	-2.13	0.37	0.63	0.165
	Q3	-2.50	-4.82	-0.19	1.17	0.034*	-2.67	-3.91	-1.42	0.63	<0.001†
	Q4	-3.29	-5.62	-0.95	1.18	0.006*	-2.58	-3.83	-1.33	0.63	<0.001†
	Q5	-5.58	-7.92	-3.24	1.18	<0.001 †	-4.25	-5.50	-3.00	0.63	<0.001†
08	Q1	75.38	73.96	76.80	0.72		81.59	80.61	82.58	0.50	
	Q2	-0.58	-2.59	1.42	1.01	0.565	-1.19	-2.58	0.20	0.70	0.092
	Q3	-3.50	-5.49	-1.51	1.01	0.001*	-2.78	-4.15	-1.40	0.70	<0.001†
	Q4	-4.69	-6.70	-2.69	1.01	<0.001 †	-2.82	-4.21	-1.43	0.70	<0.001†
	Q5	-6.99	-8.99	-4.98	1.01	<0.001 †	-4.51	-5.90	-3.13	0.70	<0.001†
09	Q1	78.82	75.40	78.25	0.72		80.29	79.41	81.18	0.45	
	Q2	-0.74	-2.76	1.27	1.02	0.467	-1.20	-2.45	0.05	0.63	0.059
	Q3	-3.21	-5.20	-1.21	1.01	0.002*	-2.61	-3.85	-1.37	0.63	<0.001†
	Q4	-4.42	-6.43	-2.40	1.02	<0.001 †	-2.42	-3.68	-1.17	0.63	<0.001†
	Q5	-7.06	-9.07	-5.05	1.02	<0.001 †	-3.94	-5.20	-2.69	0.63	<0.001†
10	Q1	76.64	75.35	77.94	0.66		79.39	78.60	80.19	0.40	
	Q2	-0.84	-2.67	0.99	0.93	0.367	-1.25	-2.37	-0.12	0.57	0.030*
	Q3	-3.11	-4.93	-1.29	0.92	0.001*	-2.49	-3.61	-1.38	0.56	<0.001†
	Q4	-4.62	-6.45	-2.78	0.93	<0.001 †	-2.61	-3.74	-1.38	0.57	<0.001†
	Q5	-7.13	-8.96	-5.29	0.93	<0.001 †	-4.04	-5.16	-2.92	0.57	<0.001†
11	Q1	76.20	74.86	77.54	0.68		79.20	78.40	79.99	0.40	
	Q2	-0.80	-2.69	1.10	0.96	0.408	-1.28	-2.41	-0.16	0.57	0.026*
	Q3	-2.61	-4.48	-0.73	0.95	0.007*	-2.40	-3.52	-1.28	0.57	<0.001†
	Q4	-4.22	-6.12	-2.33	0.96	<0.001 †	-2.48	-3.61	-1.35	0.57	<0.001†
	Q5	-6.56	-8.45	-4.67	0.96	<0.001 †	-3.69	-4.82	-2.56	0.57	<0.001†
12	Q1	74.10	72.73	75.48	0.70		78.80	78.05	79.56	0.38	
	Q2	-0.76	-2.70	1.19	0.98	0.443	-1.07	-2.14	0.01	0.54	0.051
	Q3	-2.61	-4.53	-0.68	0.98	0.008*	-2.28	-3.34	-1.22	0.54	<0.001†
	Q4	-3.93	-5.87	-1.97	0.98	<0.001 †	-2.04	-3.11	-0.97	0.54	<0.001†
	Q5	-6.20	-8.14	-4.25	0.98	<0.001 †	-3.42	-4.49	-2.35	0.54	<0.001†

* p < 0.01, † p < 0.001

Appendix 3: Socioeconomic Inequalities in Cervical Screening Coverage Over Time

In the Appendix, the results of the mixed ANOVA for all PCTs in England are presented below.

England

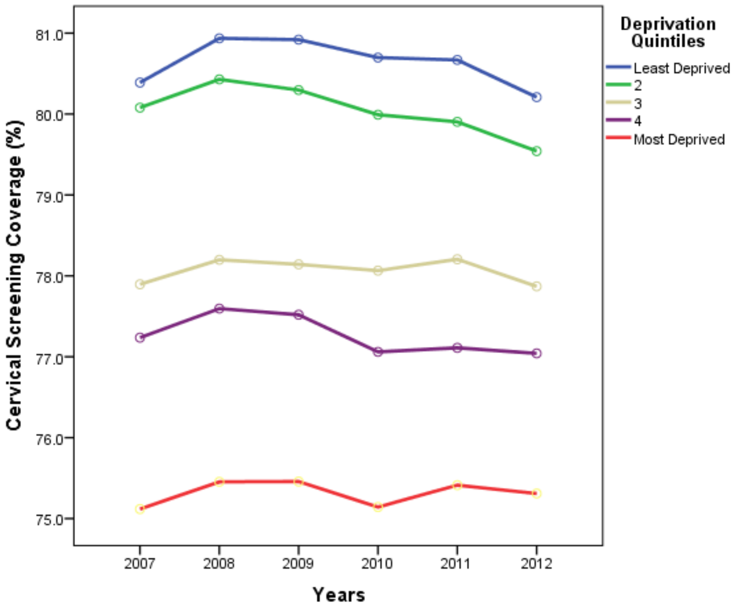
A mixed ANOVA was conducted to determine whether there were statistically significant differences in cervical screening coverage from 2007 to 2012 and to test if there was an interaction between deprivation and time on cervical screening coverage. The assumption of sphericity was violated, as assessed by Mauchley's test of sphericity, χ^2 (14) = 576.22, p < 0.001, therefore a Greenhouse-Geisser correction was applied.

The main effect of deprivation showed there was a statistically significant difference in cervical screening coverage between deprivation quintiles F (4, 46) = 16.34, p < 0.001, partial η^2 = 0.309. Cervical screening coverage in the most deprived quintile (Q5) was notable lower than cervical screening coverage in other quintiles, particularly the least deprived (Q1 and Q2), see Figure 26.

The main effect of time showed a statistically significant difference in cervical screening coverage across the years, F (1.77, 259.21) = 9.424, p < 0.001, η^2 = 0.061. This is likely to be due to an increase in cervical screening coverage in 2008, followed by a subsequent fall in coverage in 2010, see Figure 26.

There was no significant interaction between deprivation and time on cervical screening coverage for all women aged 25-64 years, F(7.10, 259.21) = 0.990, p = 0.440, partial η^2 = 0.026.

Figure 26. Cervical Screening Coverage by Deprivation Quintile - England



Appendix 4: Inequalities in Breast Screening Coverage (Chapter 5)

Appendix Table 3. Quintiles of Deprivation and Breast Screening Coverage –England (including sensitivity analyses)

Yr	Dep. Qs	All eligible women - England Using Income Domain					All eligible women – England Using Full IMD				
		B	95% CIs Lower	Upper	SE	p		95% CIs Lower	Upper	SE	p
07	Q1	78.61	76.07	81.14	1.28	-	78.21	75.55	80.87	1.35	-
	Q2	-1.27	-4.86	2.31	1.81	-0.06	-1.43	-5.19	2.34	1.90	0.455
	Q3	-5.56	-9.12	-2.01	1.80	-0.28*	-4.94	-8.68	-1.21	1.89	0.010*
	Q4	-4.94	-8.53	-1.36	1.81	-0.24*	-5.07	-8.83	-1.31	1.90	0.009*
	Q5	-12.28	-15.86	-8.69	1.81	-0.60**	-10.63	-14.39	-6.87	1.90	<0.001 **
08	Q1	79.24	76.89	81.60	1.19	-	79.07	76.59	81.56	1.26	-
	Q2	-1.28	-4.61	2.05	1.69	-0.07	-2.27	-5.79	1.25	1.78	0.204
	Q3	-6.05	-9.36	-2.75	1.67	-0.32**	-4.63	-8.12	-1.14	1.77	0.010*
	Q4	-4.62	-7.95	-1.26	1.68	-0.24*	-5.66	-9.18	-2.14	1.78	0.002*
	Q5	-11.51	-14.84	-8.18	1.69	-0.61**	-10.10	-13.62	-6.59	1.78	<0.001 **
09	Q1	79.06	77.14	80.99	0.97	-	79.09	77.11	81.06	1.00	-
	Q2	-0.99	-3.71	1.73	1.38	-0.06	-1.64	-4.43	1.16	1.41	0.248
	Q3	-4.10	-6.79	-1.40	1.37	-0.27*	-4.32	-7.09	-1.54	1.40	0.002*
	Q4	-4.55	-7.27	-1.83	1.38	-0.29*	-4.18	-6.97	-1.38	1.41	0.004*
	Q5	-9.70	-12.42	-6.98	1.38	-0.62**	-9.32	-12.12	-6.53	1.41	<0.001 **
10	Q1	79.22	77.61	80.83	0.82	-	78.90	77.26	80.53	0.83	-
	Q2	-1.21	-3.49	1.07	1.15	-0.09	-0.48	-2.80	1.83	1.17	0.680
	Q3	-3.68	-5.94	-1.42	1.14	-0.28*	-4.11	-6.40	-1.82	1.16	0.001*
	Q4	-4.45	-6.73	-2.17	1.15	-0.33**	-3.74	-6.05	-1.43	1.17	0.002*
	Q5	-8.84	-11.12	-6.56	1.15	-0.66**	-8.22	-10.53	-5.91	1.17	<0.001 **
11	Q1	78.99	77.45	80.54	0.78	-	78.51	76.95	80.06	0.79	-
	Q2	-1.03	-3.22	1.16	1.11	-0.08	0.02	-2.18	2.23	1.12	0.983
	Q3	-3.75	-5.93	-1.58	1.10	-0.29*	-3.77	-5.96	-1.59	1.11	0.001*
	Q4	-4.12	-6.31	-1.93	1.11	-0.32**	-3.29	-5.49	-1.08	1.12	0.004*
	Q5	-8.70	-10.89	-6.51	1.11	-0.70**	-8.10	-10.30	-5.90	1.12	<0.001 **
12	Q1	78.11	76.51	79.71	0.81	-	77.70	76.09	79.30	0.81	-
	Q2	-0.51	-2.78	1.75	1.15	-0.04	0.38	-1.89	2.65	1.15	0.741
	Q3	-3.62	-5.87	-1.38	1.14	-0.28*	-3.79	-6.04	-1.54	1.14	0.001*
	Q4	-3.93	-6.20	-1.67	1.15	-0.30*	-3.08	-5.35	-0.81	1.15	0.008*
	Q5	-8.34	-10.60	-6.07	1.15	0.63**	-7.82	-10.09	-5.55	1.15	<0.001 **

Appendix 5: Variation in cervical and breast screening coverage in England (published paper)

Open Access Research

BMJ Open

Variation in cervical and breast cancer screening coverage in England: a cross-sectional analysis to characterise districts with atypical behaviour

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ABSTRACT

Objectives: Reducing cancer screening inequalities in England is a major focus of the 2011 Department of Health cancer outcome strategy. Screening coverage requires regular monitoring in order to implement targeted interventions where coverage is low. This study aimed to characterise districts with atypical coverage levels for cervical or breast screening.

Design: Observational study of district-level coverage in the English Cervical and Breast screening programmes in 2012.

Setting: England, UK.

Participants: All English women invited to participate in the cervical (age group 25–49 and 50–64) and breast (age group 50–64) screening programmes.

Outcomes: Risk adjustment models for coverage were developed based on district-level characteristics. Funnel plots of adjusted coverage were constructed, and atypical districts examined by correlation analysis.

Results: Variability in coverage was primarily explained by population factors, whereas general practice characteristics had little independent effect. Deprivation and ethnicity other than white, Asian, black or mixed were independently associated with poorer coverage in both screening programmes, with ethnicity having the strongest effect; by comparison, the influence of Asian, black or mixed ethnic minority was limited. Deprivation, ethnicity and urbanisation largely accounted for the lower cervical screening coverage in London. However, for breast screening, being located in London remained a strong negative predictor. A subset of districts was identified as having atypical coverage across programmes. Correlates of deprivation in districts with relatively low adjusted coverage were substantially different from overall correlates of deprivation.

Discussion: These results inform the continuing drive to reduce avoidable cancer deaths in England, and encourage implementation of targeted interventions in communities residing in districts identified as having atypically low coverage. Sequential implementation to monitor the impact of local interventions would help accrue evidence on 'what works'.

Strengths and limitations of this study

- This study reports on an analysis of breast and cervical screening coverage rates to identify district-level factors associated with high and low coverage.
- This is the first study to characterise English districts with atypically high or low cervical or breast screening coverage using a risk adjustment approach.
- At district level, high rates of deprivation, urbanisation and ethnic minority groups other than Asian, black or mixed remain independent predictors of lower coverage for both programmes, and explain most of the lower cervical screening coverage seen in London.
- Districts with atypically low screening coverage displayed distinct correlation patterns between their population characteristics, in particular with regard to deprivation: these districts may benefit from the development of new approaches to target the low-attending communities living within their boundaries.
- This study deals only with area-level rather than individual-level factors. However, this is often the only data available on participation in public health interventions; the method used is fairly simple and could easily be applied to other settings.

INTRODUCTION

The English National Cervical and Breast Screening Programmes aim to either prevent cancer by treating precancerous changes or diagnose cancer at earlier stages when treatment outcomes are more successful.[1 2] Their success is dependent on high levels of participation.[3]

Reducing cancer screening inequalities in England is a major focus of the 2011 Department of Health cancer outcome strategy to promote early diagnosis and save lives.[4 5] There is a need to characterise districts that require most support in reducing inequalities, or those which could be used as leading examples.

Funnel plots overlapped with control limits have been shown to be a useful tool for comparing proportional outcomes between centres or districts.[6–8] The outcome is plotted against a measure of precision for each district, and control limits are set around the target value. Districts lying outside the limits are subject to 'special-cause variation' and may benefit from further investigation. Control limits can be adjusted to incorporate sources of variation, such as demographic and socioeconomic factors, in order to identify districts with atypically high or low outcomes, given their known characteristics.[8 9]

Identification of atypical districts might be expected to be a simple matter. It is, however, challenging due to the necessarily incomplete nature of aggregate data, the possible collinearities in such data, and the multiplicity of model choices even with the relatively small numbers of potential risk factors.

Factors associated with variation in screening coverage in England have previously been identified: deprivation, non-Caucasian ethnicity and poorer levels of primary care service have been found linked with lower attendance at both cervical[10 11] and breast[12 13] screening. In addition, coverage in London has generally been observed to be lower than the national average.[1 2]

We constructed funnel plots to display the scatter of cervical and breast screening coverage around the national average in areas defined by former English Primary Care Trusts (PCTs), which were the commissioning groups for GPs at the time of data collection. We developed risk adjustment models based on demographic, socioeconomic and primary care characteristics, and control limits were adjusted accordingly. Districts with atypically high or low coverage were identified, and associations among district characteristics were investigated in an attempt to highlight those districts where further investigation may be beneficial in informing policy to improve coverage.

METHODS

Data source

Coverage data were available in 151 PCTs (referred to in this paper as districts) defined by the commissioning groups of GPs at the time the data were collected, that is, from the English PCTs. Data from April 2011 to March 2012 were sourced from the Health & Social Care Information Centre (HSCIC).[1 2] *Cervical screening coverage* was defined as the percentage of eligible women registered with a general practice who had an adequate screening test performed within the last 3.5 years for patients aged 25–49 years, and within the last 5 years for patients aged 50–64 years. District-level data were obtained for the two age groups separately. *Breast screening coverage* was defined as the percentage of eligible women registered with a general practice, who had an adequate screening mammogram within the last 3 years. Data for women aged 50–64 years were obtained to match the older cervical screening group.

The percentage of urbanisation within each PCT was derived from the urban-rural classification.[14] For two PCTs with missing data (Stockton-on-Tees, Isle of Wight), the local authority urbanisation score was used instead.

The income deprivation domain score from the English Indices of Multiple Deprivation 2010 was obtained and the percentage deprivation calculated as a population-weighted average of Lower Super Output Area income deprivation score.[15]

Ethnicity data and the percentage of the total population without any higher education were sourced from the Office of National Statistics 2011 Census.[16 17] For ethnicity, two explanatory variables were derived: the percentage of Asian, black, or mixed ethnic minority groups, and the percentage of 'other' ethnic minority groups, which includes Asian and African Arabs, and any other ethnic minority groups (eg, Polynesians, Melanesians and Micronesians).

Data relating to general practice characteristics were sourced from the HSCIC[18] and included average list size, percentage of single-handed practices (only 1 working provider or salaried/other general practitioner (GP) with possible additional GP registrar/retainer), practitioner headcount (excluding retainers and registrars) per 10^5 population, practice staff (excluding GPs and registrars) full-time equivalent (FTE), and percentage of GPs who attained their primary medical qualification outside the UK.

Statistical analysis

Grouped logistic regression was applied to coverage data aggregated at district level.[19] A generalised linear model with quasi-binomial error distribution was used to account for within-district extra-binomial variation.[20] For the purpose of the analysis, variables were classified as 'population' and 'general practice' risk factors (table 1). Continuous covariates were mean-centred. Covariates found to be significant at the 1% level using Wald tests in univariate analyses[21] were considered for inclusion in two multiple regression submodels, the first including population factors only, and the second including general practice factors only. Correlation and collinearity were evaluated based on Pearson correlation coefficients (see online supplementary file table A1), and generalised variance-inflation factors for covariate coefficients, respectively.[22] Differences in correlation coefficients between independent groups were assessed for significance by applying Fisher's z test on z-transformed correlations.[23]

The full regression model was built by including both population and general practice factors that were significant at the 5% level in the submodels. Per cent of deviance (−2 log-likelihood statistic) explained by the adjusted model compared with the null (unadjusted) model was used as a descriptive measure of attribution of variation.[19]

Table 1 District-level summary of population factors, general practice factors, and screening coverage in England in 2012 (n=151)

	Minimum–Maximum	Mean (SD)	Median (IQR)
Population factors, %			
Urbanisation	31.0–100.0	81.2 (21.5)	91.0 (35.03)
Deprivation	6.8–33.8	16.2 (5.8)	15.3 (8.4)
Asian, black or mixed ethnicity	1.3–67.6	15.1 (15.4)	8.9 (20.5)
'Other' ethnicity	0.1–11.1	1.2 (1.6)	0.6 (1.3)
No higher education	10.1–35.2	23.0 (5.1)	23.0 (6.8)
Registered women aged 25–29	12.2–32.2	19.5 (4.2)	18.3 (5.2)
General practice factors			
Average practice list size	4026.4–9566.2	6656.2 (1371.2)	6537.1 (2236.0)
Single-handed practices, %	0.0–41.0	13.45 (10.2)	11.0 (16.0)
Practitioner headcount per 10^5 population	50.9–95.3	68.7 (8.3)	67.7 (10.8)
Practice staff FTE	146.3–1884.2	513.7 (296.7)	424.0 (283.7)
Practitioners qualified outside UK, %	3.0–70.0	26.4 (14.7)	25.0 (19.2)
Screening coverage (%)			
Cervical group aged 25–49 years			
Overall	58.7–80.4	73.4 (4.4)	74.6 (5.9)
London SHA (Q36)	58.7–77.7	67.8 (4.6)	67.8 (5.7)
Rest of England	67.4–80.4	74.8 (3.0)	75.4 (3.8)
Cervical group aged 50–64 years			
Overall	69.1–82.0	77.2 (2.5)	77.5 (3.5)
London SHA (Q36)	69.1–80.9	75.7 (2.8)	75.6 (3.1)
Rest of England	70.1–82.0	77.6 (2.3)	77.9 (2.8)
Breast group aged 50–64 years			
Overall	59.5–84.7	75.6 (5.1)	76.9 (6.5)
London SHA (Q36)	59.5–78.8	69.0 (4.9)	68.8 (8.6)
Rest of England	64.6–84.7	77.3 (3.6)	78.1 (5.5)

FTE, full-time equivalent; SHA, strategic health authority.

Funnel plots of coverage against eligible population in each district were constructed.[9] The covariate-adjusted coverage proportion for each district was calculated as the product of the national average by the ratio of observed to expected values from the full regression model. The national average for coverage was used as a target value, and the 95% and 99.8% control limits were plotted around it using the asymptotic normal approximation, with a variance inflation factor for extra-binomial variation (details available from NJM).[24] All statistical analyses were performed in R version 3.0.2 (2013-09-25).

RESULTS

Data description

District-level data on cervical (age groups 25–49 and 50–64) and breast (age group 50–64) screening coverage are summarised in table 1, overall, and separately for London and the rest of England. Between-district variability was more pronounced for the breast screening group (median 76.9, IQR 6.5) and the cervical screening age group 25–49 (median 74.6, IQR 5.9) than for the cervical screening age group 50–64 (median 77.5, IQR 3.5, table 1). The difference in coverage level between London and the rest of England was also larger for the breast and younger cervical screenings groups, with median coverage 7–8% lower in London.

Relationships between population, general practice factors, and coverage

Tables 2–4 show the unadjusted and adjusted ORs of the associations between population and general practice risk factors, and coverage. Each factor was found to be univariately associated with coverage in all screening groups, except for the percentage of population with no higher education and the practitioner headcount, which were only significant for the cervical screening group aged 25–49 years.

Variability in coverage was primarily explained by population factors, with general practice characteristics only accounting for a small fraction of the residual variability (<2% of total deviance after adjustment for population factors). Population covariates explained a lesser percentage of the total deviance among the cervical screening group aged 50–64 years (45%, table 3) than the cervical screening group aged 25–49 years (78%, table 2) or the breast screening group (72%, table 4); overall variability was also lowest among the former group (IQR 3.5 vs IQR 5.9 and 6.5, respectively, table 1).

With regard to general practice factors, only staff FTE remained positively associated with cervical screening coverage after accounting for population factors (table 3).

After adjusting for deprivation, ethnicity and education, residing in London and urbanisation were no longer significantly associated with lower cervical

Table 2 Regression modelling for cervical screening coverage among women aged 25–49 years

Model	Univariate			Population		General practice		Population and general practice	
Deviance explained by model	–			78.2%		46.4%		79.1%	
	OR (95% CI)	p Value (Wald, χ^2)	Deviance explained, %	OR (95% CI)	p Value (Wald, χ^2)	OR (95% CI)	p Value (Wald, χ^2)	OR (95% CI)	p Value (Wald, χ^2)
Population factors									
Urbanisation, %	0.993 (0.992 to 0.995)	<0.001	41.9	0.999 (0.998 to 1.000)	0.03	–		0.999 (0.998 to 1.000)	0.3
London SHA (Q36)	0.696 (0.653 to 0.741)	<0.001	46.2	1.011 (0.939 to 1.088)	NS (0.8)	–		–	
Deprivation, %	0.977 (0.973 to 0.981)	<0.001	41.1	0.987 (0.981 to 0.993)	<0.001	–		0.989 (0.981 to 0.996)	0.004*
Asian, black or mixed ethnicity, %	0.989 (0.988 to 0.990)	<0.001	63.3	0.997 (0.995 to 0.999)	0.005	–		0.997 (0.995 to 0.999)	0.005
'Other' ethnicity, %	0.901 (0.889 to 0.912)	<0.001	62.4	0.958 (0.941 to 0.975)	<0.001	–		0.963 (0.946 to 0.980)	<0.001
No higher education, %	1.012 (1.005 to 1.020)	0.001	7.3	1.011 (1.004 to 1.017)	0.001	–		1.011 (1.004 to 1.018)	0.003
General practice factors									
Average practice list size	1.00008 (1.00005 to 1.00010)	<0.001	23.3	–		0.99999 (0.99996 to 1.00002)	NS (0.6)	–	
Single-handed practices, %	0.990 (0.987 to 0.993)	<0.001	20.6	–		0.990 (0.985 to 0.995)	<0.001	0.998 (0.996 to 1.000)	0.1
Practitioners headcount per 10^5 population	0.993 (0.989 to 0.997)	=0.001	6.5	–		0.989 (0.985 to 0.992)	<0.001	0.9993 (0.9963 to 1.0022)	0.6
Practice staff FTE	1.0003 (1.0002 to 1.0004)	<0.001	22.8	–		1.0002 (1.0001 to 1.0003)	<0.001	1.00005 (0.99999 to 1.00011)	0.06
Practitioners qualified outside UK, %	0.994 (0.992 to 0.997)	<0.001	13.7	–		0.998 (0.996 to 1.001)	NS (0.2)	–	

*The variance of the coefficient estimate is being inflated by multicollinearity with other factors (GVIF=2.7).
FTE, full-time equivalent; NS, considered non-significant (see Methods section for details); SHA, strategic health authority.

Table 3 Regression modelling for cervical screening coverage among women aged 50–64 years

Model	Univariate			Population		General practice		Population and general practice	
Deviance explained	–			44.6%		26.7%		45.3%	
	OR (95% CI)	p Value (Wald, χ^2)	Deviance explained, %	OR (95% CI)	p Value (Wald, χ^2)	OR (95% CI)	p Value (Wald, χ^2)	OR (95% CI)	p Value (Wald, χ^2)
Population factors									
Urbanisation, %	0.997 (0.996 to 0.998)	<0.001	25.5	0.999 (0.998 to 0.999)	0.004	–		0.999 (0.998 to 0.999)	0.02
London SHA (Q36)	0.886 (0.837 to 0.937)	<0.001	10.6	0.940 (0.875 to 1.010)	NS (0.09)	–		–	
Deprivation, %	0.987 (0.984 to 0.990)	<0.001	31.1	0.989 (0.985 to 0.992)	<0.001	–		0.990 (0.985 to 0.994)	<0.001
Asian, black or mixed ethnicity, %	0.997 (0.996 to 0.998)	<0.001	9.9	1.005 (1.003 to 1.007)	<0.001	–		1.004 (1.002 to 1.006)	<0.001
'Other' ethnicity, %	0.959 (0.947 to 0.972)	<0.001	19.6	0.970 (0.952 to 0.988)	0.001	–		0.963 (0.946 to 0.980)	<0.001
No higher education, %	0.997 (0.993 to 1.002)	NS (0.3)	0.9	–		–		–	
General practice factors									
Average practice list size	1.00004 (1.00003 to 1.00006)	<0.001	20.2	–		1.000025 (1.000003 to 1.000047)	0.02	0.999996 (0.999979 to 1.000012)	0.6
Single-handed practices, %	0.995 (0.993 to 0.997)	<0.001	13.1	–		0.999 (0.995 to 1.002)	NS (0.4)	–	
Practitioner headcount per 10^5 population	0.998 (0.996 to 1.001)	NS (0.2)	1.2	–		–		–	
Practice staff FTE	1.00015 (1.00010 to 1.00020)	<0.001	19.5	–		1.00010 (1.00005 to 1.00016)	<0.001	1.000058 (1.000007 to 1.000109)	0.03
Practitioners qualified outside UK, %	0.997 (0.996 to 0.999)	<0.001	7.8	–		1.001 (0.998 to 1.002)	NS (0.5)	–	

FTE, full-time equivalent; NS, considered non-significant (see Methods section for details); SHA, strategic health authority.

Table 4 Regression modelling for breast screening coverage among women aged 50–64 years

Model	Univariate			Population		General practice		Population and general practice	
Deviance explained by model	–			70.7%		31.0%		70.6%	
	OR (95% CI)	p Value (Wald, χ^2)	Deviance explained, %	OR (95% CI)	p Value (Wald, χ^2)	OR (95% CI)	p Value (Wald, χ^2)	OR (95% CI)	p Value (Wald, χ^2)
Population factors									
Urbanisation, %	0.992 (0.991 to 0.993)	<0.001	50.5	0.996 (0.995 to 0.998)	<0.001	–		0.996 (0.995 to 0.998)	<0.001
London SHA (Q36)	0.642 (0.587 to 0.703)	<0.001	37.7	0.896 (0.811 to 0.990)	0.03	–		0.885 (0.806 to 0.970)	0.009
Deprivation, %	0.972 (0.967 to 0.978)	<0.001	38.8	0.991 (0.986 to 0.997)	0.002	–		0.991 (0.985 to 0.997)	0.004
Asian, black or mixed ethnicity, %	0.987 (0.985 to 0.989)	<0.001	49.1	0.999 (0.996 to 1.002)	NS (0.5)	–		–	
'Other' ethnicity, %	0.880 (0.863 to 0.898)	<0.001	50.8	0.948 (0.923 to 0.973)	<0.001	–		0.945 (0.922 to 0.969)	<0.001
No higher education, %	1.010 (1.001 to 1.019)	NS (0.03)	3.1	–		–		–	
General practice factors									
Average practice list size	1.00 010 (1.00 007 to 1.00 012)	<0.001	26.5	–		1.000 046 (1.000 006 to 1.000 087)	0.03	1.00 001 (0.99 998 to 1.00 003)	0.6
Single-handed practices, %	0.988 (0.984 to 0.991)	<0.001	24.2	–		0.9945 (0.9886 to 1.0004)	NS (0.07)	–	
Practitioner headcount per 10^5 population	0.996 (0.991 to 1.001)	NS (0.1)	1.7	–		–		–	
Practice staff FTE	1.00 025 (1.00 015 to 1.00 035)	<0.001	14.1	–		1.000 099 0.999 990 to 1.000 209)	NS (0.07)	–	
Practitioners qualified outside UK, %	0.993 (0.990 to 0.996)	<0.001	16.0	–		0.9992 (0.9957 to 1.0027)	NS (0.6)	–	

FTE, full-time equivalent; NS, considered non-significant (see Methods section for details); SHA, strategic health authority.

screening coverage, but both remained associated with lower breast screening coverage.

Deprivation remained inversely associated with coverage in all screening groups, but displayed some collinearity with other factors for the cervical screening group aged 25–49 years (table 2).

Absence of higher education remained associated with higher coverage in the cervical screening group aged 25–49 years after adjusting for other population factors (table 2). In this latter group, the effect of deprivation and education were no longer significant when the model accounted for the percentage of registered women aged 25–29 years (see online supplementary file table A2.1).

After adjusting for other population factors, the percentage of 'other' ethnic minority groups remained negatively correlated with coverage in all screening groups, whereas the percentage of Asian, black or mixed ethnic minority groups was no longer associated with lower breast screening coverage (tables 3 and 4).

Identification of districts with atypical coverage

Figure 1 illustrates the districts with coverage estimates lying outside the control limits prior to (figure 1A–C) and after (figure 1A′–C′) full covariate adjustment. The geographical location of districts with atypical coverage is shown in figure 2.

Over two-thirds of the districts initially lying below limits for cervical screening—for most, located within London—no longer lay *below* limits after adjustment. For the breast screening group, only one out of the four initial outliers (Kensington & Chelsea in London—data not shown) was found to lie within limits after adjustment, while a new London district was uncovered as atypically low (Wandsworth, London). For two London districts, the adjusted coverage remained below the 99.8% lower limit for the cervical screening group aged 25–49 years, and ranked among the 15 lowest districts for the other two screening groups (Hammersmith and Fulham, and Camden, figure 2).

By contrast with what was observed for the districts lying below limits, the districts lying above the 95% upper limits *after* adjustment were mostly different from those identified prior to adjustment: only 1 in 2 districts for the cervical screening group aged 25–49 years, 1 in 5 for the cervical screening group aged 50–64 years, and 2 in 5 for the breast screening group would have been identified as atypically high performers without adjustment (figure 2 and data not shown). Two districts displayed atypically high coverage of all screening groups irrespective of age (Enfield, London and Nottinghamshire County Teaching, East Midlands).

Characteristics of districts with relatively high and low adjusted coverage

Districts were ranked according to their adjusted coverage values (see online supplementary file tables A3.1 and A3.2). Associations between population factors were

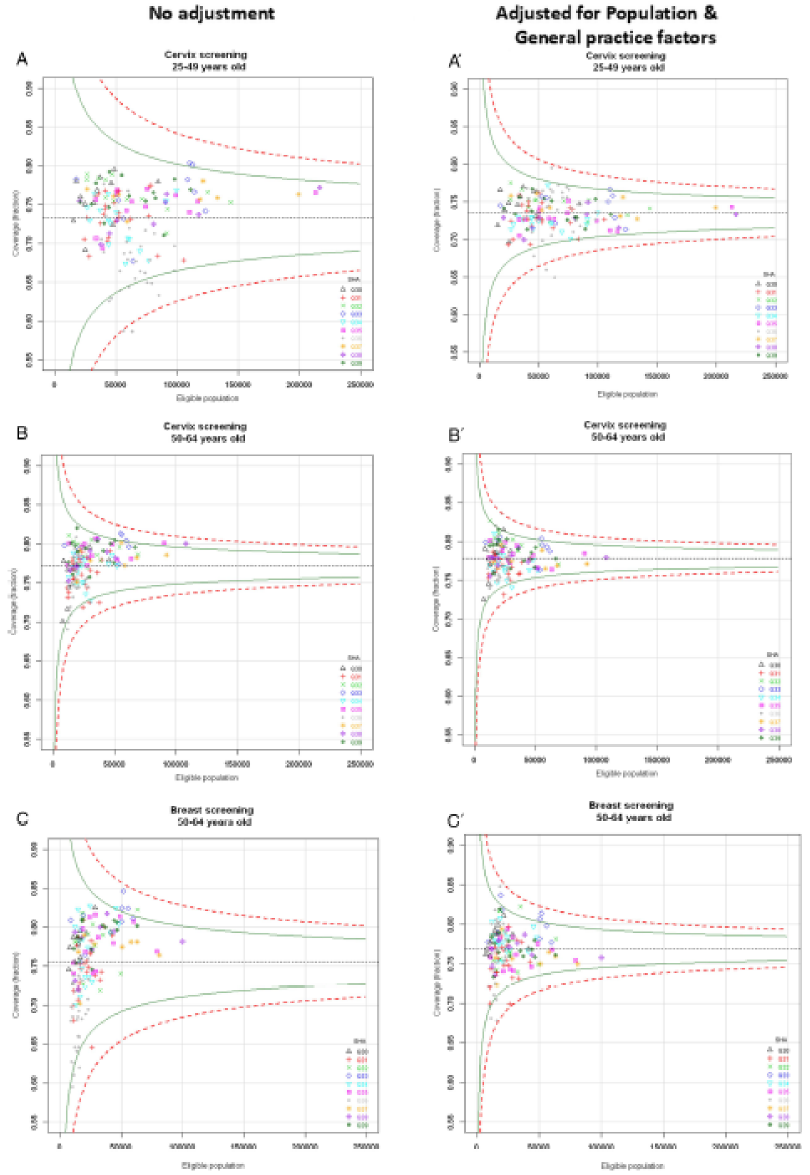


Figure 1 Funnel plots of screening coverage and list of districts lying outside the 95% control limits prior to and after risk adjustment. Top left panel: funnel plots of screening coverage prior to any adjustment. (A) Cervical screening in women aged 25–49 years. (B) Cervical screening in women aged 50–64 years. (C) Breast screening in women aged 50–64 years. Top right panel: funnel plots of screening coverage after adjustment for population and general practice factors. (A′) Cervical screening in women aged 25–49 years. (B′) Cervical screening in women aged 50–64 years. (C′) Breast screening in women aged 50–64 years. Green line shows 95.0% control limits; Red dotted line shows 99.8% control limits. SHA, strategic health authority; Q30, North East; Q31, North West ;Q33, East Midlands; Q34, West Midlands; Q35, East of England; Q36, London; Q37, South East Coast; Q38, South Central; Q39, South West. Table: number of districts lying outside the 95% control limits prior to and after risk adjustment. The number of districts within London SHA (Q36) is shown in brackets.

Figure 1 Continued

Screening group		Control limit	No adjustment	Adjusted for Population & General practice factors
Cervical age group 25-49	Above	Upper 99.8%	0 (0)	0 (0)
		Upper 95%	2 (0)	2 (1)
	Below	Lower 95%	9 (9)	3 (3)
		Lower 99.8%	2 (2)	2 (2)
Cervical age group 50-64	Above	Upper 99.8%	0 (0)	0 (0)
		Upper 95%	5 (0)	5 (2)
	Below	Lower 95%	7 (3)	2 (0)
		Lower 99.8%	0 (0)	0 (0)
Breast age group 50-64	Above	Upper 99.8%	0 (0)	0 (0)
		Upper 95%	5 (0)	5 (1)
	Below	Lower 95%	4 (3)	4 (3)
		Lower 99.8%	0 (0)	0 (0)

investigated among the 15 lowest (figure 3B) and the 15 highest ranking districts (figure 3C).

For all screening groups, we noted strong positive associations between deprivation and non-white ethnicities among the highest ranking districts, which differed significantly from the associations seen among lowest ranking districts (Fisher's z test $p<0.05$ for cervical screening and $p=0.05$ for breast screening group among ethnic minorities groups only, figure 3D).

For cervical screening, a strong positive correlation between deprivation and absence of higher education was observed among the lowest ranking districts ($\rho=0.77$ and 0.68 for age group 25–49 and 50–64, respectively), which tended to not be as strong overall, or among highest ranking districts, in particular for the younger age group (Fisher's z test $p=0.04$).

Lowest ranking districts tended to have populations of ethnicity other than Asian, black or mixed with a higher level of education ($\rho=-0.88$, -0.77 and -0.70 for cervical age groups 25–49 and 50–64, and breast age group 50–64, respectively) compared with overall or highest ranking districts, in particular for cervical screening (Fisher's z test $p=0.1$ for both cervical age groups).

DISCUSSION

The aim of this analysis was to identify and characterise districts that displayed atypically high or low cervical or breast screening coverage given population and general practice risk factors at district level. We found that a subset of districts with atypical coverage levels was common to both programmes, while other sets were more specific to the programme or age group.

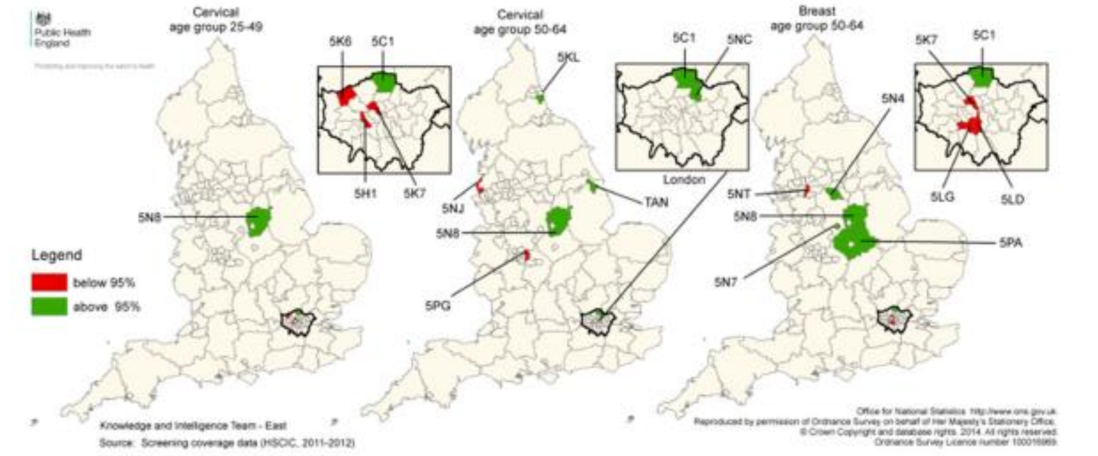
Our risk adjustment results confirm the importance of demographic and socioeconomic characteristics for coverage levels, and highlight the comparatively minor impact of various aspects of primary care. This suggests that strategies targeted at raising awareness or addressing barriers among socially diverse and culturally diverse populations are likely to be the most effective at increasing coverage.

The number of practice staff FTE remained positively associated with cervical screening coverage, but not with breast screening coverage after adjusting for population factors. The finding that cervical screening coverage is more likely to be influenced by general practice factors is unsurprising since many women are screened at their local practice,[25] and previous studies have shown the number of nurses per practice to be associated with cervical screening coverage in deprived areas.[10]

Coverage in London has generally been observed to be lower than the national average,[1 2] in spite of some other public health features (eg, obesity rates) being better in London.[26] We found that urbanisation, ethnicity and deprivation, largely accounted for the lower cervical screening uptake in London. For breast screening, however, being located in London, remained a strong independent negative risk factor, which warrants further investigation.

Deprivation was an independent negative risk factor for all screening groups, as also found for cervical screening by Bang *et al*.[27] In the cervical screening group aged 25–49 years, this effect was, in part, explained by the numbers of women under 30 years old, as was the positive impact of lack of higher education on coverage. Cervical screening coverage has been reported to be lower in younger women;[28] however, younger women of lower socioeconomic status or with fewer educational qualifications, regardless of ethnicity, have also been shown to be positively influenced by the 2009 Jade Goody's story with respect to cervical screening behaviour,[29] giving hints for potential strategies for improving the uptake.

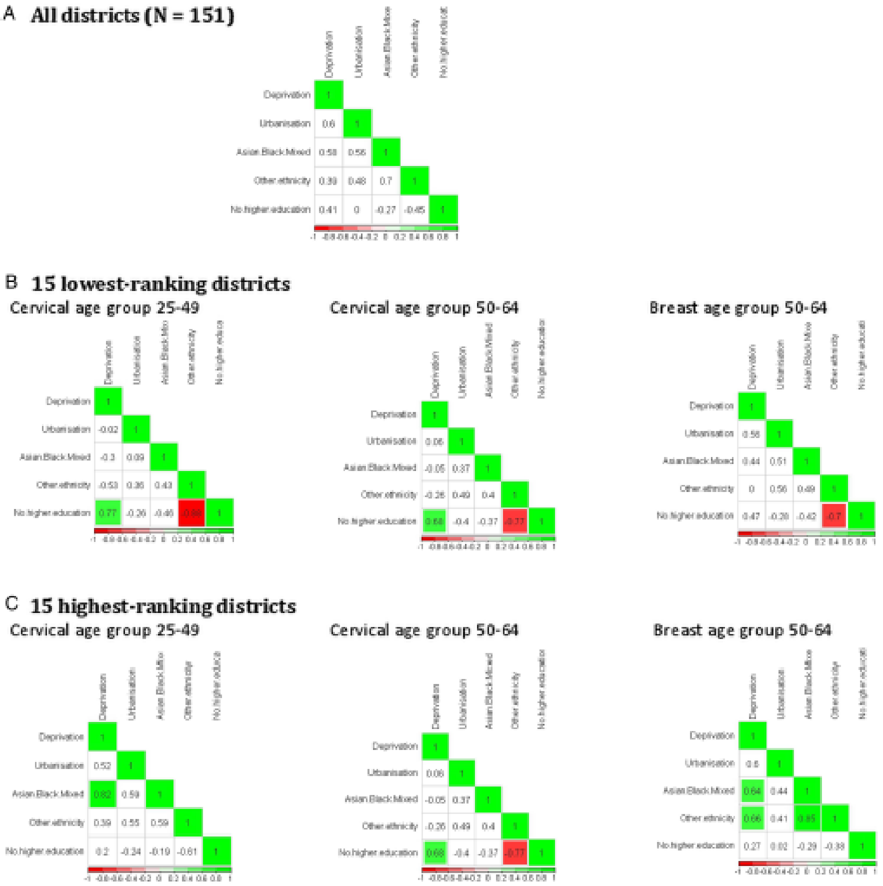
The impact of Asian, black or mixed ethnic minority groups on coverage differed between programmes after controlling for other population factors. For breast screening, it was no longer significant. For cervical screening, we found it negatively influenced coverage in the age group 25–49, but was associated with greater coverage in the age group 50–64. Previously, only an overall negative association after adjustment for other population factors had been reported for cervical screening in women aged 25–64 years.[27]



PCT name	SHA	Screening group Cervical age group 25–49	 Cervical age group 50–64	 Breast age group 50–64
Below lower 95% control limit				
5H1 / Hammersmith and Fulham	Q36	**Below 99.8%** (0.01%)	Rank≥137	Rank≥137
5K6 / Harrow	Q36	**Below 95%** (0.2%)	Rank≥137	–
5K7 / Camden	Q36	**Below 99.8%** (0.001%)	Rank≥137	**Below 95%** (0.02%)
5NJ / Sefton	Q31	Rank≥137	**Below 95%** (0.3%)	–
5PG / Birmingham East & North	Q34	Rank≥137	**Below 95%** (1.2%)	–
5LD / Lambeth	Q36	–	Rank≥137	**Below 95%** (0.01%)
5LG / Wandsworth	Q36	–	Rank≥137	**Below 95%** (0.4%)
5NT / Manchester	Q31	–	Rank≥137	**Below 95%** (0.2%)
Above upper 95% control limit				
5C1 / Enfield	Q36	**Above 95%** (99.8%)	**Above 95%** (99.9%)	**Above 95%** (99.9%)
5N8 / Nottinghamshire County Teaching	Q33	**Above 95%** (93.9%)	**Above 95%** (93.9%)	**Above 95%** (93.5%)
5KL / Sunderland Teaching	Q30	Rank≤15	**Above 95%** (98.6%)	Rank≤15
5NC / Waltham Forest	Q36	–	**Above 95%** (99.3%)	Rank≤15
TAN / North East Lincolnshire Care Trust Plus	Q32	Rank≤15	**Above 95%** (99.8%)	–
5N4 / Sheffield	Q32	–	–	**Above 95%** (98.5%)
5N7 / Derby City	Q33	–	Rank≤15	**Above 95%** (99.7%)
5PA / Leicestershire County & Rutland	Q33	–	–	**Above 95%** (96.5%)

Figure 2 Geographical location of atypical districts. Map: map of Primary Care Trust 2006 boundaries with districts lying below the 95% lower control limits after risk adjustment coloured in red and districts lying above the 95% upper control limits after risk adjustment coloured in green. Table: districts lying outside the control limits are listed with corresponding percentiles given in brackets. Districts with coverage ranking among the 15 lowest (rank ≤15) or 15 highest (rank ≥137) are specified. All districts lying outside the control limits had relative coverage rankings ≤15 for lower 95% limit and ≥137 for upper 95% limit. SHA, strategic health authority; Q30, North East; Q31, North West; Q33, East Midlands; Q34, West Midlands; Q35, East of England; Q36, London; Q37, South East Coast; Q38, South Central; Q39, South West.

For both programmes, and regardless of age, 'other' ethnic minority groups were still associated with poorer coverage after accounting for deprivation and urbanisation, with a particularly strong effect in breast screening. In addition, our results suggest that women of 'other' ethnic minority background, who may be well educated and living in areas with smaller Asian, black or mixed ethnic minority populations, are less likely to go for screening. Arab communities account for a moderately large subset of the 'other' ethnic minority groups (40%), and uptake of cervical and breast screening has been shown to be low in these populations for a number of reasons, including religious beliefs, emotional barriers (embarrassment/fear), language barriers or taboos



D Differences in correlates between the 15 lowest- and the 15 highest-ranking districts

Cervical age group 25-49

1				
0.14	2			
<0.001	*0.15*	3		
0.02	*0.54*	*0.59*	4	
0.04	*0.95*	*0.46*	0.10	5

Cervical age group 50-64

1				
0.17	2			
0.01	*0.65*	3		
0.02	*0.73*	0.07	4	
0.12	*0.70*	*0.72*	0.10	5

Breast age group 50-64

1				
0.87	2			
0.48	*0.82*	3		
0.05	*0.64*	0.08	4	
0.56	*0.45*	*0.70*	*0.25*	5

Figure 3 Correlations between population factors, overall, and among the 15 highest and 15 lowest ranking districts after risk adjustment. Correlation coefficients are displayed in each cell: (A) all districts; (B) 15 lowest ranking districts and (C) 15 highest ranking districts. For the 15 lowest and 15 highest ranking districts, correlation coefficients which are significantly different from zero at the 1% level are highlighted in green for positive correlations, and in red for negative correlations. (D). Fisher's z test for significant differences in correlation coefficients between two independent groups. Bold represents p values < 0.05. Italic represents p values not significant at the 10% level. 1, % deprivation; 2, % urbanisation; 3, % Asian, black or mixed ethnic minority groups; 4, % 'other' ethnic minority groups; 5, % no higher education.

surrounding sexual activity (for cervical screening).[30–32] These communities may, therefore, require newly targeted interventions to promote screening.

Our correlation analyses suggest that districts with atypical coverage levels differ from one another not only in respect of a number of population-level and general practice-level characteristics, but also in how these characteristics relate to each other. Correlates of deprivation in districts with relatively low adjusted coverage were substantially different from the general results, and even more so for cervical screening. In particular, the nature of the relationship between deprivation and non-white ethnicity differed, with an inverse relationship between deprivation and non-white ethnic groups among lowest ranking districts.

Using funnel plots based on crude performance data to assess quality of care at area level may overestimate the number of 'underperforming' districts, and overdispersion needs to be addressed a priori. We chose a risk adjustment approach to uncover districts with atypical coverage given particular population and general practice characteristics. Districts with adjusted coverage values lying outside control limits display a behaviour which cannot solely be explained by the area-level risk factors investigated (ie, they present with special cause-variation).

Districts with atypically high coverage were singled out and could be investigated to identify any local health interventions and policies that might help improve coverage in districts with similar characteristics but lower performance. Unfortunately, there is a general lack of reporting in the research literature across districts on the impact of local interventions that have been implemented to improve screening uptake (ED, unpublished PhD thesis), so identifying 'what works' is challenging.

Simultaneously, districts with atypically low coverage were distinguished from those lying within bounds after accounting for urbanisation, deprivation and ethnicity, in particular, for the London region. These districts may benefit from further investigation to uncover the features driving their atypically low coverage and help design population-specific strategies. Additional risk factors that may explain low coverage, as well as differences in district performance between programmes, include the percentage of women who are disabled,[33] incarcerated,[34] have greater difficulty in accessing services as indexed by time-to-screening centre,[13] and differential utilisation behaviour as a result of sociocultural factors, such as marital status,[35] occupation,[36] sexual orientation,[37] and overseas birthplace or religious beliefs,[11 38] that might apply to particular programmes.

Our results are limited by the aggregated nature of the data, which may conceal ecological associations within districts. This could account for the weak association seen between coverage and general practice characteristics after adjustment for population factors. However, similar trends were observed when analysing general practice-level data for cervical screening coverage.[27]

The district boundaries used in this study (151 PCTs) are no longer in place; however, the findings may be applied to the newly defined boundaries (210 Clinical Commissioning Groups) by 1:1 mapping for the most part.[39]

The strength of the approach of combining risk adjustment modelling with funnel plots was to allow us to identify districts with an unusual level of screening coverage after accounting for some of the important demographic and socioeconomic characteristics of their population and their primary care settings known to affect coverage level. Such an approach could be implemented sequentially to monitor the impact of local interventions in a centralised fashion. This method could also be adapted for use with other health indicators.

Our results demonstrate that population factors largely explain the lower coverage in London. In addition, districts in London and other urban centres with specific population characteristics, such as non-deprived ethnic minority groups, were identified as requiring targeted intervention to improve coverage levels. Bilingual outreach and community-based advocacy, such as support from family and community leaders including GPs, has been found to be valuable in increasing uptake of cancer screening in ethnic minorities.[40]

We hope these results will inform the continued drive to reduce inequalities in cancer screening and avoidable deaths, and encourage implementation of targeted interventions in communities residing within districts identified as having atypically low coverage.

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Contributors NJM performed the statistical analysis, interpreted the results and wrote the manuscript. ED carried out the data informatics and data checks, and co-wrote the manuscript. JoW and JaW provided general expert guidance. SWD provided general statistical guidance. All authors reviewed and approved the final manuscript.

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Data sharing statement Data are freely available from the HSCIC: Cervical screening: http://www.hscic.gov.uk/catalogue/PUB10339/bres-scre-prog-eng-2011–12-tab.xls. Breast screening: http://www.hscic.gov.uk/catalogue/PUB07990/cerv-scre-prog-eng-2011–12-tab.xls

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Appendix 6: Characteristics of High- and Low-Performing PCTs

Characteristics of High-Performing PCTs

There were five high-performing PCTs, of which Enfield PCT and Nottinghamshire County PCT performed well for cervical screening coverage in both younger and older women, and North and East Lincolnshire Care Trust, Waltham Forest PCT and Sunderland PCT performed well for older women only. The descriptive characteristics of these PCTs are presented alongside the mean descriptive statistics for all 151 PCTs in Table 15.

Enfield PCT

Enfield, a London PCT, performed well for cervical screening coverage in younger and older women. Coverage for older woman was 80% and therefore slightly higher than the mean coverage of 77% for older women in all PCTs. However, its coverage for younger women at 72% was slightly below the mean coverage of 73% for younger women in all PCTs, indicating that its relatively good performance was held despite other more challenging factors. For population factors, the percentage deprivation (24% vs 16%), Asian, Black or Mixed Ethnic population (34% vs 15%), 'other ethnic' population (5% vs 1%) and urbanisation (99% vs 81%) were all higher in Enfield than the respective mean in all PCTs in England. The percentage of women without higher education (23%) and GP registered women aged 25-29 years (20%) in the PCT were similar to the mean of all PCTs. For programme-delivery factors, the average practice list size, practitioner headcount per 100,000 and the number of practice staff working full-time were below the respective mean of all PCTs in England. However, the number of single-handed practices and percentage of practitioners qualified outside the UK were higher than the national mean.

Nottinghamshire County PCT

Nottinghamshire County, an East Midlands PCT, performed well for cervical screening coverage in younger and older women. Its actual coverage for both younger (80% vs 73%) and older women (81% vs 77%) were higher than the mean for all PCTs in England. For population factors, the percentage deprivation (12% vs 16%), Asian, Black or Mixed Ethnic population (5% vs 15%), 'other ethnic' population (0.3% vs 1.2%), urbanisation (69% vs 81%) and GP registered women 25-29 years (17% vs 20%) were all lower than the respective mean in all PCTs in England. The percentage of those without higher education was slightly higher than the mean of all PCTs (25% vs 23%). For programme-delivery factors, the percentage of single-handed general practices (7.0 vs 14%) and practitioners qualified outside the UK (20.0 vs 26%) and practitioner headcount per 100,000 population (65% vs 69%) were lower than the respective mean of all England PCTs. The average practice list size (6,905 vs 6,656) was broadly comparable with the mean of all PCTs in England. The average number of Practice staff working full-time (1,103 vs 513) was much higher in Nottinghamshire County PCT than the mean for all PCTs in England.

<u>North East Lincolnshire PCT</u>

North East Lincolnshire, a Yorkshire and Humber PCT, performed well for cervical screening coverage in older women only. Its cervical screening coverage was higher than the mean for all PCTs in England for younger (79% vs 73%) and older women (81% vs77%). For population factors, the percentage deprivation (19% vs 16%) and women without higher education (30% vs 23%) were higher than the respective mean in all PCTs in England. The percentage Asian, Black or Mixed Ethnic population (2% vs 15%) was lower than the mean for all PCTs. The percentage of 'other ethnic' population, urbanisation and GP registered women aged 25-29 years were broadly comparable with the respective mean for all PCTs in England. For programme-delivery factors, the average practice list size (4,698 vs 6,652) and the number of practice staff working full-time (333 vs 513) were lower than the respective mean for all PCTs in England. The practitioner headcount per 100,000 population was broadly comparable with the mean in all PCTs, and the percentage of single-handed practices (29% vs 14%) and percentage of practitioners qualified outside the UK (57.0% vs 26%) were higher than the national mean.

<u>Waltham Forest PCT</u>

Waltham Forest, a London PCT, performed well for cervical screening coverage in older women only. Cervical screening coverage for younger women (69% vs 73%) was below the mean for all PCTs in England, and higher for older women (79% vs 77%). For population factors, the percentage of deprivation (24% vs 16%), Asian, Black or Mixed Ethnic population (43% vs 15%), 'other ethnic' population (4% vs 1%) and urbanisation (100% vs 81%) were higher than the respective mean for all PCTs in England. The percentage of women without further education was slightly lower (21% vs 23%) than the mean for all England PCTs. For programme-delivery factors, the average number of practice staff working full-time (397 vs 514) was lower than the respective mean for all PCTs in England. The average practice list size (6,156 vs 6,656) was broadly comparable and the practitioner headcount per 100,000 (72% vs 69%) population was a little higher than the mean for all PCTs in England. However, the percentage of single-handed practices (21.0 vs 14%) and the percentage of practitioners qualified outside the UK (53.0 vs 26%) were both higher than the national mean.

Sunderland PCT

Sunderland, a PCT in the North East of England, performed well for cervical screening coverage in older women only. Cervical screening coverage for younger women (78% vs 73%) and older women (80% vs 77%) was higher than the mean for all PCTs in England. For programme delivery factors, this PCT had higher levels of deprivation (20% vs 16%), women without higher education (29% vs 23%) and urbanisation (99% vs 81%) than the mean for all PCTs in England, but had lower levels of Asian, Black or Mixed Ethnic populations (4% vs 15%). The percentage of 'other ethnic' populations (0.3 vs 1.2%) and percentage of GP registered women aged 25-29 years (both 20%) were comparable to the mean for all PCTs in England. For programme-delivery factors in Sunderland PCT, the average practice list size (5,170 vs 6,652) and the number of practice staff working full-time (416 vs 513) were below the respective mean of all PCTs in England. The percentage of single-handed practices (15% vs 14%) and the practitioner headcount per 100,000 population (67% vs 69%) were broadly comparable with the mean for all PCTs. Finally, the percentage of practitioners qualified outside the UK (36% vs 26%) was higher than the mean for all PCTs.

Summary of characteristics for all high-performing PCTs

All high-performing PCTs had relatively high cervical screening coverage for older women, of which two, Enfield and Nottinghamshire County, also performed exceptionally well for cervical screening coverage in younger women. Deprivation, the percentage of women without higher education, urbanisation, the percentage of single-handed practices and percentage of practitioners qualified outside the UK tended to be higher than the national mean and the number of practice full-time practice staff, with one notable exception, tended to be below the national mean. Other characteristics either had no distinct pattern of association across the high-performing PCTs (the percentage of ethnic minority populations and the average practice list size) or were broadly comparable to the mean for all England PCTs (the percentage of GP registered women aged 25-29 years and the practitioner headcount per 100,000 population).

Appendix Table 4. Descriptive statistics for PCT-level characteristics of High Performing PCTs (Younger Women and Older Women)

	All PCTs	Younger & Older Women		Older Women Only		
	(n=151)	Enfield	Nottinghamshire County	North East Lincolnshire	Waltham Forest	Sunderland
	Mean (SD)	Actual	Actual	Actual	Actual	Actual
Cervical Coverage (%)						
Younger women	73.4 (4.4)	72.0	80.4	78.9	68.9	77.8
Older women	77.2 (2.5)	79.5	81.4	81.1	79.4	79.6
Population factors						
% Deprivation	16.2 (5.8)	23.7	11.9	19.1	24.0	20.0
% Without higher education	23.0 (5.1)	23.0	25.0	29.5	20.8	29.1
% Asian, Black or Mixed ethnicity	15.1 (15.4)	33.9	4.5	2.3	43.7	3.8
% 'Other ethnic' minority	1.2 (1.6)	5.1	0.3	0.3	4.1	0.3
% Urbanisation	81.2 (21.5)	99.3	68.7	83.9	100	98.9
% GP Registered women aged 25-29 years	19.5 (4.2)	20.2	16.9	18.3	19.7	20.1
Programme-delivery factors						
Average practice list size	6656.2 (1371.2)	4903.6	6905.6	4698.7	6156.4	5170.1
% Single-handed practices	13.5 (10.2)	26.0	7.0	29.0	21.0	15.0
Practitioner headcount per 10^5 population	68.7 (8.3)	58.3	65.1	66.2	71.8	67.4
Practice staff FTE	513.7 (296.7)	278.6	1103.6	333.7	397.1	416.0
% Practitioners qualified outside UK	26.4 (14.7)	47.0	20.0	57.0	53.0	36.0

FTE, Full-Time Equivalent; SD, Standard Deviation

Characteristics of Low-Performing PCTs

There were five low-performing PCTs, of which Camden PCT, Hammersmith & Fulham PCT and Harrow PCT performed poorly for cervical screening coverage in younger women and Birmingham East & North PCT and Sefton PCT performed poorly for cervical screening coverage in older women. The descriptive characteristics of these PCTs are presented alongside the mean descriptive statistics for all 151 PCTs in Table 16.

Camden PCT

Camden, a London PCT, performed poorly for cervical screening coverage in younger women only. Cervical screening coverage for younger women was 59%, the lowest coverage among all PCTs in England, and also returned lower screening coverage in older women (72% vs 77%) than the mean for all PCTs in England. Camden had a higher percentage of deprivation (19% vs 16%), Asian, Black & Mixed populations (30% vs 15%), 'other ethnic' populations (4% vs 1%), urbanisation (100% vs 81%) and GP registered women aged 25-29 years (31% vs 20%) than the respective mean for all PCTs, however, it had fewer women without higher education (13% vs 23%). With the exception of the practitioner headcount per 100,000 population, all programme-delivery factors were lower than the respective mean for all PCTs in England, and this was notably so for the percentage of single-hand practices (0.2% vs 14%) and practitioners qualified outside the UK (0.1% vs 26%).

Hammersmith & Fulham PCT

Hammersmith & Fulham, a London PCT, was a poor performing PCT for cervical screening coverage in younger women only. It joined Fulham PCT as the joint lowest for cervical screening coverage in younger women (59%) out of all PCTs in England, and also had low cervical screening coverage in older women (69% vs 77%). It's population factors are also broadly comparable with Fulham PCT in so far as it has higher levels of deprivation (19% vs 16%), Asian, Black or Mixed Ethnic populations (26% vs 15%), 'other ethnic' populations (6% vs 1%), urbanisation (100% vs 81%) and % GP registered women aged 25-29 years (27% vs 20%) but had fewer women without higher education (13% vs 23%) than the respective mean for all PCTs in England. Similarly, the pattern for programme-delivery factors were comparable with Fulham PCT. With the exception of the practitioner headcount per 100,000 population, all programme-delivery factors were lower than the respective mean for all PCTs in England, and this was notably so for the percentage of single-hand practices (0.2% vs 14%), average number of practice staff working full-time (216 vs 514) and practitioners qualified outside the UK (0.3% vs 26%).

Harrow PCT

Harrow, a London PCT, was the third and final PCT identified as a poor performing PCT for cervical screening coverage in younger women (63% vs 73%). Cervical screening coverage for older women was just below the mean for all PCTs in England (76% vs 77%). Harrow had a much higher percentage of Asian, Black or Mixed Ethnic population (55% vs 15%) and also had higher levels of 'other ethnic' population (3% vs 1%) and urbanisation (100% vs 81%). However, it had comparable levels of deprivation (15% vs 16%) and GP registered women aged 25-29 years (both 20%) with the mean for all PCTs in England, and had fewer women without higher education (17% vs 23%). Harrow followed a similar pattern for programme-delivery factors to Camden and Hammersmith & Fulham PCTs. That is, all programme-delivery factors were lower than the respective mean for all PCTs in England with the exception of the practitioner headcount per 100,000 population.

Birmingham North & East PCT

Birmingham North & East, a West Midlands PCT, performed poorly for cervical screening coverage in older women. Cervical screening coverage was lower than the mean for all PCTs in England for both younger (68% vs 73%) and older women (73% vs 77%). The percentage of deprivation (26% vs 16%), women without higher education (31% vs 23%), Asian, Black or Mixed population (35% vs 15%) and urbanisation (99% vs 81%) were higher than the respective mean in all PCTs in England. The percentage 'other ethnic' minority population (both 1%) and GP registered women aged 25-29 years (22% vs 20%) were similar to the respective mean for all PCTs in England. For programme-delivery factors, all were lower than the respective mean for all PCTs in England, particularly the percentage of single-handed practices (0.3 vs 14%) and the practitioners qualified outside the UK (0.3 vs 26%).

Sefton PCT

Sefton, a North West PCT, performed poorly for cervical screening in older women (72% vs 77%), and also had lower cervical screening coverage for younger women (70% vs 73%) than the mean for all PCTs in England. In comparison with the mean values for all PCTs in England, the percentage deprivation (17% vs 16%), women without higher education (25% vs 23%) and GP registered women (17% vs 20%) were broadly comparable. Sefton had lower levels of Asian, Black or Mixed Ethnic population (2% vs 15%) and 'other ethnic' population (0.3 vs 1%) and higher levels of urbanisation (97% vs 81%). All programme-delivery factors were lower than the respective mean of all PCTs in England: average practice list sizes (5,017 vs 6,652), practitioner headcount per 100,000 population (63% vs 69%), percentage of single-handed practices (0.2 vs 14%), practice staff working full-time (360 vs 513), percentage of practitioners qualified outside the UK (0.2 vs 26%).

Summary of characteristics of low-performing PCTs

All low-performing PCTs for cervical screening coverage in younger women were in London and had fewer women without higher education, more women from ethnic minority populations and a higher percentage of younger women aged 25-29 years. Their average practice lists size were broadly comparable with the national mean and they tended to have a higher percentage of practitioner headcount per 100,000 population but the number of full-time practice staff was consistently below the national mean for all PCTs in England. The PCTs identified with low cervical screening coverage in older women also had a high percentage of urbanisation. They had higher percentages of women without higher education and from Asian, Black and Mixed ethnic populations. They had below average practice lists sizes but had more single-handed practices, fewer practitioners per 100,000 population and fewer full-time practice staff.

Appendix Table 5. Descriptive statistics for PCT-level characteristics of Low Performing PCTs (Younger Women and Older Women)

	All PCTs	Younger Women			Older Women	
	(n=151)	Camden	Hammersmith & Fulham	Harrow	Birmingham East & North	Sefton
	Mean (SD)	Actual	Actual	Actual	Actual	Actual
Cervical Coverage (%)						
Younger women	73.4 (4.4)	58.7	58.7	62.9	67.8	70.4
Older women	77.2 (2.5)	72.0	69.1	75.6	72.8	71.8
Population factors						
% Deprivation	16.2 (5.8)	19.1	19.3	14.9	26.2	16.9
% Without higher education	23.0 (5.1)	12.7	12.8	16.8	31.4	25.1
% Asian, Black or Mixed ethnicity	15.1 (15.4)	29.9	26.4	54.8	34.9	2.3
% 'Other ethnic' minority	1.2 (1.6)	3.8	5.5	2.9	1.2	0.3
% Urbanisation	81.2 (21.5)	100	100	99.7	99.4	97.1
% GP Registered women aged 25-29 years	19.5 (4.2)	30.5	27.0	20.0	21.9	16.5
Programme-delivery factors						
Average practice list size	6656.2 (1371.2)	6123.2	6287.5	6364.5	5760.6	5017.6
% Single-handed practices	13.5 (10.2)	22.0	16.0	11.0	28.0	21.0
Practitioner headcount per 10^5 population	68.7 (8.3)	79.0	74.8	70.0	64.2	62.7
Practice staff FTE	513.7 (296.7)	256.1	215.5	305.4	482.2	360.1
% Practitioners qualified outside UK	26.4 (14.7)	13.0	27.0	34.0	31.0	17.0

FTE, Full-Time Equivalent; SD, Standard Deviation

Appendix 7: Factors Associated with Cervical Screening Coverage (chapter 7)

Appendix 7: Ethics Letter Page 1

UCL RESEARCH ETHICS COMMITTEE
GRADUATE SCHOOL OFFICE

Dr Jo Waller
HBRC
Department of Epidemiology and Public Health
UCL

13 March 2013

Dear Dr Waller

Notification of Ethical Approval
Project ID: 4594/001: Exploring cervical screening coverage at PCT level

I am pleased to confirm that in my capacity as Chair of the UCL Research Ethics Committee I have approved your study for the duration of the project i.e. until March 2014.

Approval is subject to the following conditions:

1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form'.

The form identified above can be accessed by logging on to the ethics website homepage: http://www.grad.ucl.ac.uk/ethics/ and clicking on the button marked 'Key Responsibilities of the Researcher Following Approval'.

2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported.

Reporting Non-Serious Adverse Events
For non-serious adverse events you will need to inform Helen Dougal, Ethics Committee Administrator (ethics@ucl.ac.uk), within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

Reporting Serious Adverse Events
The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.

Appendix 7: Ethics Letter Page 2

On completion of the research you must submit a brief report (a maximum of two sides of A4) of your findings/concluding comments to the Committee, which includes in particular issues relating to the ethical implications of the research.

With best wishes for the research.

Yours sincerely

Professor John Foreman
Chair of the UCL Research Ethics Committee

Cc:
Elaine Douglas, Applicant
Professor Richard Watt, Head of Department

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Appendix 7: Demographic Questionnaire

DEMOGRAPHIC QUESTIONNAIRE	
What is your age?	☐☐

Gender	Male ☐ Female ☐

What is your ethnic group?				
White	Mixed	Asian / Asian British	Black / Black British	Chinese/other
White British ☐	White & Black Caribbean ☐	Indian ☐	Black Caribbean ☐	Chinese ☐
White Irish ☐	White & Black African ☐	Pakistani ☐	Black African ☐	Other ☐ …………………
Any other White background ☐	White & Asian ☐	Bangladeshi ☐	Any other Black background ☐	Prefer not to say ☐
	Any other Mixed background ☐	Any other Asian background ☐		

What is your job title?	
Lead for Cervical Screening ☐	Public Health Screening Co-ordinator ☐
Screening Programme Co-ordinator ☐	Screening Programmes Manager ☐
Other (please specify) ______________________________	
How long have your worked in this role?	☐☐ yrs ☐☐ months
How long have you worked in roles relating to the NHS Cervical Screening Programme	☐☐ yrs ☐☐ months

How does your role and its responsibilities relate to the NHS Cervical Screening Programme

Appendix 8: Potential Mediators of SES and Screening Attendance (chapter 8)

Potential Mediators of SES and Screening Attendance: Using Social Grade as the measure of SES

This appendix details the methods and results for Study 5 when Social Grade is used as the measure of SES

Methods

Recruitment

Recruitment methods were as outlined in Chapter 8.

Measures

The measures used in this alternative analysis of Study 5 were as outlined in Chapter 8, with the exception of the measure of SES. In this example, occupational social grade was used as the marker of SES. The occupational social grade, was collected as part of the TNS BMRB survey described earlier. Social Grade relates to the main household earner and therefore may not necessarily reflect the occupational status of the individual woman. It is based on the occupation, type of organisation worked for, job title and whether self-employed (Ipsos MediaCT, 2009). Social Grade consists of the following categories: A – high managerial, administrative or professional; B – Intermediate managerial, administrative or professional; C1 – Supervisory, clerical and junior managerial, administrative or professional; C2 – Skilled manual workers; D – Semi and unskilled manual workers; and E – State pensioners, casual or lowest grade workers, unemployed with state benefits only. Of the population, 4% are allocated social grade A so this category is often grouped with category B. Similarly, 8% of the population fall within social grade E, so this category is often grouped with category D. This produces four social grades: AB, C1, C2 and DE.

Results

Sociodemographic Characteristics

Appendix Table 5 details the sample characteristics using unweighted data, grouped by Social Grade. Analyses reported here use the unweighted data. Participants were aged 26–64 years (M = 42.0). Lower Social Grade groups were more likely to be younger (χ^2 = 13.25, df = 6, p = 0.04), from non-white ethnic backgrounds (χ^2 = 12.28, df = 3, p = 0.006), single (χ^2 = 74.19, df = 6, p < 0.001), and not working (χ^2 = 153.35, df = 9, p < 0.001).

Appendix Table 6. Demographics and Social Grade

	Social Grade				
	AB (n = 190) High SES	C1 (n = 241)	C2 (n = 163)	DE (n = 248) Low SES	Stat. test of group difference
Age %					
26–35yrs	30.5	28.6	33.7	41.5	χ^2 = 13.25, df = 6, p = 0.039
36–49yrs	43.2	44.4	42.3	31.9	
50–64yrs	26.3	27.0	23.9	26.6	
Ethnicity %					
White	89.5	87.4	91.4	80.6	χ^2 = 12.28, df = 3, p = 0.006
Non-white	10.5	12.6	8.6	19.4	
Marital Status %					
Married	77.9	72.1	80.4	48.4	χ^2 = 74.19, df = 6, p < 0.001
Single	12.1	12.5	11.7	33.5	
Other	10.0	15.4	8.0	18.1	
Work Status %					
Full-time	37.4	40.7	27.6	9.3	
Part-time	28.4	29.5	44.2	18.5	χ^2 = 153.35, df = 9, p < 0.001
Not working/ unemployed	25.3	23.7	21.5	63.3	
Retired	8.9	6.2	6.7	8.9	

Screening Status, Social Grade and Demographic Variables

There was a significant association between Social Grade and screening status (see Appendix Table 7). Women in lower social grade groups were more likely to be overdue for screening than women in higher social grade groups (26% in social grade DE vs 16% in social grade AB). Younger women were more likely to be overdue than older women (25% of 26–35 year-olds vs 16% of 50–64 year-olds). Single women were more likely to be overdue than other marital status groups (29% single vs 20% of married and 21% of Other). Ethnicity and Work Status were not significantly associated with screening status. Age and marital status were associated with social grade and screening status and were controlled for in the multivariate analyses.

Appendix Table 7. Screening Status, social grade and Demographic Factors ł

	Screening Status		
	Overdue % (n = 181)	Up-to-date % (n = 661)	Test for linear association
Social Grade			
AB – Highest SES Group	15.8 (30)	84.2 (160)	$\chi2 = 6.76$, df = 1, p = 0.009
C1	20.3 (49)	79.7 (192)	
C2	23.3 (38)	76.7 (125)	
DE – Lowest SES Group	25.8 (64)	74.2 (184)	
Age			
26–35 years	24.9 (71)	75.1 (214)	$\chi2 = 6.95$, df = 2, p = 0.031
36–49 years	22.6 (76)	77.4 (261)	
50–64 years	15.5 (34)	84.5 (186)	
Ethnicity			
White	20.6 (150)	79.4 (577)	$\chi2 = 2.85$, df = 1, p = 0.092
Non-white	27.7 (31)	72.3 (81)	
Marital Status			
Married	19.6 (112)	80.4 (460)	$\chi2 = 6.49$, df = 2, p = 0.039
Single	29.0 (45)	71.0 (110)	
Other	21.1 (24)	78.9 (90)	
Work Status			
Full-time	23.2 (55)	76.8 (182)	$\chi2 = 7.21$, df = 3, p = 0.065
Part-time	15.6 (38)	84.4 (205)	
Not working/unemployed	23.9 (71)	76.1 (226)	
Retired	26.2 (17)	73.8 (48)	

ł May not add to 100% (797) due to rounding or missing values

Screening Status and Perceived Benefits of Cervical Screening

The next set of analyses examined the association between screening status and the perceived benefit variables (see Appendix Table 8). The three perceived benefits of cervical screening showed significant associations with screening status. Women who were up-to-date were more likely to agree that the 'chances of curing cervical cancer are better when the disease is discovered at an early stage' than those who were overdue (94% vs 87%). They were more likely to agree that 'cervical screening can pick up cell changes that can go on to become cervical cancer' (92% vs 82%). They were also more likely to agree that cervical screening is effective in preventing cervical cancer (82% vs 74%).

Appendix Table 8. Perceived benefits of cervical screening by screening status ł

	Overdue (n = 181)	Up-to-date (n = 661)	Test for association
The chances of curing cervical cancer are better When the disease is discovered at an early stage			
Agree	86.7 (156)	94.1 (621)	$\chi2 = 11.24$, df = 1, $p < 0.001$
Disagree/Neither	13.3 (24)	5.9 (39)	
Cervical screening can pick up cell changes that can go on to become cervical cancer			
Agree	82.1 (147)	91.5 (603)	$\chi2 = 13.18$, df = 1, $p < 0.001$
Disagree/Neither	17.9 (32)	8.5 (56)	
Cervical screening is effective in preventing cervical cancer			
Agree	74.4 (134)	81.7 (539)	$\chi2 = 4.63$, df = 1, $p = 0.031$
Disagree/Neither	25.6 (46)	18.3 (121)	

ł Numbers may not agree with total due to rounding or missing values

Social Grade Differences in Perceived Benefits about Cervical Screening

Associations between social grade and the perceived benefits variables are shown in Appendix Table 9. Of the highest social grade group (AB), 98% agreed the 'chances of curing cervical cancer are better when the disease is discovered at an early stage' compared with 90% of the lowest social grade group (DE), and 95% vs 83% agreed that 'cervical screening can pick up cell changes that can go on to become cervical cancer'. Agreeing that 'cervical screening is effective in preventing cervical cancer' was not significantly associated with social grade.

Appendix Table 9. Perceived benefits of cervical screening by SES ƚ

	% (n)				
	AB (n = 190) High SES	**C1 (n = 241)**	**C2 (n = 163)**	**DE (n = 248) Low SES**	**Test for association**
The chances of curing cervical cancer are better when the disease is discovered at an early stage					
Agree	98.4 (186)	92.9 (224)	88.3 (144)	90.3 (223)	$\chi2 = 15.40$, df = 3, $p = 0.002$
Disagree/Neither	1.6 (3)	7.1 (17)	11.7 (19)	9.7 (24)	
Cervical screening can pick up cell changes that can go on to become cervical cancer					
Agree	95.2 (179)	92.1 (222)	89.6 (146)	82.5 (203)	$\chi2 = 21.04$, df = 3, $p < 0.001$
Disagree/Neither	4.8 (9)	7.9 (19)	10.4 (17)	17.5 (43)	
Cervical screening is effective in preventing cervical cancer					
Agree	79.9 (151)	79.3 (191)	82.2 (134)	79.8 (197)	$\chi2 = 0.587$, df = 3, $p = 0.899$
Disagree/Neither	20.1 (38)	20.7 (50)	17.8 (29)	20.2 (50)	

ƚ Numbers may not agree with total due to rounding or missing values

Mediational Analyses of the Relationship between SES and Screening Status

Four logistic regression models with screening status (overdue/up-to-date) as the dependent variable tested mediation. Odds ratios (OR) for being overdue are shown in Appendix Table 10.

Model 1 included SES and the control variables age and marital status. The lowest social grade group (DE) was significantly more likely to be overdue for screening than the highest SES group (reference category), OR = 1.71, 95% CI: 1.05–2.81.

Model 2 included SES, the control variables, and the perceived benefit variable 'the chances of curing cervical cancer are better when the disease is discovered at an early stage'. This perceived benefit had an independent association with screening attendance, where the OR for being overdue for screening was statistically significant for those who disagreed with the statement (OR = 2.07, 95% CI: 1.20–3.60). This model showed a small reduction in the odds ratios associated with being overdue across social grade groups in comparison with Model 1, and there was no longer a statistically significant difference between the highest (reference category, AB) and the lowest social grade group (DE). This indicates that it slightly mediated the association between social grade and screening status. Freedman's estimate for the percentage of the association between social grade and screening status mediated by this belief variable is 2.5%.

Model 3 included SES, the control variables, and the perceived benefit 'Cervical screening can pick up cell changes that can go on to become cervical cancer'. This perceived benefit had an independent association with screening attendance, where the OR for being overdue for screening for screening was statistically significant for those who disagreed with the statement (OR = 2.03, 95% CI: 1.25–3.30). Freedman's estimate for the percentage of association between SES and screening status mediated by this belief variable is 4.2%.

Model 4 included SES, the control variables, and both perceived benefit variables. This model showed a small reduction in the odds ratios associated with being overdue across social grade groups in comparison with Model 1, and there was no longer a statistically significant difference between the highest (reference category, AB) and the lowest social grade group (DE). This indicates that it slightly mediated the association between social grade and screening status. Freedman's estimate for the percentage of association between SES and screening status mediated by both belief variables is 5.1%.

Appendix Table 10. SES and belief predictors for being overdue for screening: regression models controlling for age and marital status

	Overdue % (n)	Model 1 SES [2]	Model 2 SES & Chances of Cure Better at Early Stage	Model 3 SES & Screening Picks Up Cell Changes	Model 4 SES & Both Variables [2]
Social Grade					
DE (low SES, n = 248)	25.8 (64)	1.71 [1.05–2.81]	1.57 [0.95–2.56]	1.48 [0.89–2.44]	1.44 [0.89–2.38]
C2 (n = 163)	23.3 (38)	1.61 [0.94–2.75]	1.47 [0.86–2.53]	1.53 [0.89–2.62]	1.46 [0.85–2.51]
C1 (n = 241)	20.3 (49)	1.36 [0.82–2.25]	1.28 [0.77–2.13]	1.31 [0.79–4.72]	1.27 [0.76–2.11]
AB (high SES, n = 190)	15.8 (30)	1.00	1.00	1.00	1.00
Social Grade (Continuous)‡		1.18 [1.02-1.37]	1.15 [0.99-1.34]	1.13 [0.97-1.31]	1.12 [0.96-1.30]
The chances of curing cervical cancer are better when the disease is discovered at an early stage					
Disagree/Neither Agree Nor Disagree	13.3 (24)		2.07 [1.20–3.60]		1.66 [0.90–3.08]
Agree	86.7 (156)		1.00		1.00
Cervical screening (the smear or Pap test) can pick up cell changes that can go on to become cervical cancer					
Disagree/Neither Agree Nor Disagree	17.9 (32)			2.03 [1.25–3.30]	1.62 [0.94–2.81]
Agree	82.1 (147)			1.00	1.00

2. Reference Category (Overdue) n = 181, Up To Date n = 661. 3. Numbers are Odds Ratios with confidence intervals in parentheses, ‡ Used to determine Freedman's estimate of mediation

Appendix 9: Socioeconomic Variation in Colposcopy Attendance (chapter 9)

Sensitivity Analyses using Full IMD

Descriptive Statistics

Appendix Table 11. Descriptive Statistics for Income Domain and Full IMD Quintiles

	% (n)	Min–Max	Mean	Std Dev
Income domain (IMD) Quintiles				
Q1 – Least Income	8.5 (2305)	0.236–0.538	0.306	0.064
Q2	22.3 (6064)	0.142–0.235	0.182	0.026
Q3	26.7 (7255)	0.088–0.142	0.114	0.016
Q4	22.5 (6115)	0.056–0.088	0.070	0.009
Q5 – Most Income	20.1 (5454)	0.005–0.055	0.039	0.012
Full IMD Quintiles				
Q1 – Most Deprived	7.1 (1943)	34.150–87.805	44.510	9.544
Q2	21.2 (5762)	21.342–33.943	26.383	3.528
Q3	23.0 (6245)	13.776–21.313	17.269	2.177
Q4	23.6 (6427)	8.482–13.765	10.973	1.509
Q5 – Least Deprived	25.1 (6816)	1.011–8.456	5.535	1.832

Linear associations

Appendix Table 12. Variables associated with colposcopy attendance

	Attendance at eight weeks, row % (n) 89.3 (24,294)	**Test of linear association**	**Attendance at four months, row % (n) 94.1 (25, 594)**	**Test of linear association**
IMD quintiles				
Q1 – Low income	86.6 (1996)		92.5 (2131)	
Q2	89.6 (5434)	χ^2=23.98,	94.5 (5731)	χ^2=13.97,
Q3	89.4 (6486)	df=4,	94.1 (6828)	df=4,
Q4	90.2 (5517)	p<0.001	94.4 (5771)	p=0.007
Q5 – High income	89.1 (4861)		94.1 (5133)	
Full IMD Quintiles				
Q1 – Most Deprived	87.0 (1690)		92.6 (1799)	
Q2	89.5 (5158)	χ^2=26.32,	94.3 (5436)	χ^2=12.60,
Q3	89.3 (5576)	df=4,	94.1 (5876)	df=4,
Q4	90.6 (5826)	p<0.001	94.6 (6083)	p=0.013
Q5 – Least Deprived	88.7 (6044)		93.9 (6400)	

Appendix Table 13. Variables associated with colposcopy attendance within eight weeks of referral, * p <0.05

	Sample column % (n) 100 (27,193)	Attendance at eight weeks row % (n), 89.3 (24,294)	Unadjusted models OR (95% CI)	p-value	Adjusted model OR (95% CI)	p-value
Full IMD Quintiles						
Q1 – Most Deprived	7.1 (1943)	87.0 (1690)	0.85 (0.73-0.99)	0.041*	0.84 (0.72-0.99)	0.040*
Q2	21.2 (5762)	89.5 (5158)	1.09 (0.97-1.22)	0.131	1.07 (0.94-1.21)	0.308
Q3	23.0 (6245)	89.3 (5576)	1.07 (0.95-1.19)	0.263	0.95 (0.84-1.07)	0.379
Q4	23.6 (6427)	90.6 (5826)	1.24 (1.11-1.39)	<0.001**	1.12 (0.99-1.27)	0.066
Q5 – Least Deprived	25.1 (6816)	88.7 (6044)	1.00	–	1.00	–
Ethnicity						
Q1 – Lowest % White	5.6 (1529)	85.0 (1299)	0.45 (0.37-0.53)	<0.001*	0.51 (0.42-0.62)	<0.001*
Q2	26.9 (7304)	87.5 (6391)	0.55 (0.49-0.63)	<0.001*	0.62 (0.54-0.71)	<0.001*
Q3	29.3 (7965)	89.0 (7085)	0.63 (0.56-0.72)	<0.001*	0.67 (0.58-0.76)	<0.001*
Q4	20.2 (5502)	90.6 (4983)	0.76 (0.66-0.87)	<0.001*	0.74 (0.64-0.86)	<0.001*
Q5 – Highest % White	18.0 (4893)	92.7 (4536)	1.00	-	1.00	-
Cervical Screening Indicator (invitation period)						
Low-grade/borderline (8 wks)	55.2 (15,004)	88.1 (13,220)	1.00	-	1.00	-
Moderate/severe (4 wks)	38.2 (10,380)	92.7 (9625)	1.72 (1.57-1.88)	<0.001*	1.71 (1.57-1.87)	<0.001*
?invasive/?Glandular (2 wks)	1.9 (514)	94.9 (488)	2.53 (1.70-3.77)	<0.001*	2.51 (1.69-3.74)	<0.001*

Appendix Table 14. Variables associated with colposcopy attendance within four months of referral, * p <0.05

	Sample column	Attendance at four months	Unadjusted models		Adjusted model‡	
	% (n), 100 (27,193)	**row % (n),** 94.1 (25, 594)	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Full IMD Quintiles						
Q1 – Low Income	7.1 (1943)	87.0 (1690)	0.81 (0.67-0.99)	0.038*	0.92 (0.75-1.13)	0.432
Q2	21.2 (5762)	89.5 (5158)	1.08 (0.93-1.26)	0.291	1.16 (0.99-1.35)	0.069
Q3	23.0 (6245)	89.3 (5576)	1.04 (0.90-1.20)	0.640	1.02 (0.88-1.19)	0.765
Q4	23.6 (6427)	90.6 (5826)	1.15 (0.99-1.33)	0.064	1.15 (0.99-1.34)	0.071
Q5 – High Income	25.1 (6816)	88.7 (6044)	1.00	–	1.00	-
Age at referral						
25–34 years	55.0 (14949)	93.9 (14038)	1.00	–	1.00	–
35–44 years	27.7 (7539)	94.0 (7083)	1.01 (0.90–1.13)	0.893	1.04 (0.92-1.17)	0.516
45–64 years	17.3 (4705)	95.1 (4473)	1.25 (1.08–1.45)	0.003*	1.26 (1.07-1.47)	0.004*
Ethnicity						
Q1 – Lowest % White	5.6 (1529)	91.8 (1403)	0.46 (0.37-0.58)	<0.001*	0.48 (0.38-0.62)	<0.001*
Q2	26.9 (7304)	93.5 (6826)	0.59 (0.50-0.70)	<0.001*	0.61 (0.52-0.74)	<0.001*
Q3	29.3 (7965)	93.9 (7476)	0.64 (0.54-0.75)	<0.001*	0.65 (0.55-0.78)	<0.001*
Q4	20.2 (5502)	94.3 (5191)	0.69 (0.58-0.83)	<0.001*	0.69 (0.58-0.84)	<0.001*
Q5 – Highest % White	18.0 (4893)	96.0 (4698)	1.00	-	1.00	-
Cervical Screening Indicator (invitation period)						
Low-grade/borderline (8 wks)	55.2 (15,004)	93.9 (14,082)	1.00	-	1.00	-
Moderate/severe (4 wks)	38.2 (10,380)	94.7 (9829)	1.17 (1.05-1.30)	0.005*	1.18 (1.06-1.32)	0.003*
?invasive/?Glandular (2 wks)	1.9 (514)	95.3 (490)	1.34 (0.88-2.03)	0.171	1.32 (0.87-1.99)	0.196

Appendix 10: Paper published in BJC

Please see paper on next page.

BJC

Colposcopy attendance and deprivation: A retrospective analysis of 27193 women in the NHS Cervical Screening Programme

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Background: Attendance for cervical screening is socially graded, but little is known about patterns of attendance for colposcopy following an abnormal screening result.

Methods: Logistic regression was used to regress colposcopy attendance status for 27 193 women against age and area-level deprivation, adjusting for ethnicity.

Results: Colposcopy attendance was high at 8 weeks (89%) and 4 months post-referral (94%) but women living in the most deprived areas were significantly less likely to attend.

Conclusions: The high overall attendance rates at colposcopy are encouraging but lower attendance among women in the most income-deprived areas indicates that even when these women attend primary cervical screening, they remain at higher risk of missing out on the benefits of the programme.

Introduction of an organised cervical screening programme in the UK in 1988 dramatically reduced cervical cancer incidence and mortality (Quinn et al, 1999; Peto et al, 2004), and protected the population against rises in incidence that would probably have occurred because of changes in sexual behaviour (Mercer et al, 2013). The cervical screening programme offers 3–5 yearly testing for cytological abnormalities (Health and Social Care Information Centre, 2013), with referral to colposcopy for further investigation and treatment if abnormalities are detected. The success of the programme depends on high attendance at both primary screening and colposcopy.

Screening attendance has consistently been found to be lower in women who live in more deprived areas (Baker and Middleton, 2003; Webb et al, 2004; Bang et al, 2012), have lower levels of education (Sabates and Feinstein, 2006) or lower socioeconomic status (SES) (Moser et al, 2009). Other factors such as younger age (Lancucki et al, 2010; Albrow et al, 2012) and non-white ethnicity (Webb et al, 2004; Moser et al, 2009) are strong predictors of lower attendance although ethnicity may be confounded with SES. Much less is known about patterns of attendance at colposcopy follow up. In the TOMBOLA trial, colposcopy attendance was very high (around 93%) (Sharp et al, 2012). However, attendance was lower in women who were younger and less educated. Late attendance for colposcopy (more than 6 months after the original appointment) was also associated with having less education, and it predicted non-attendance for subsequent colposcopy appointments (Sharp et al, 2012).

We know of no analyses of socioeconomic patterns of attendance at colposcopy using individual-level attendance data from the national screening programme. National appointment level data for England showed attendance of 77% in 2012–2013; but this underestimates attendance at the individual level, because it fails to account for women who miss or cancel one appointment but attend a second one soon afterwards (Health and Social Care Information Centre, 2013). Appointment-level data may mask demographic patterns of attendance if certain groups are disproportionately likely to rearrange but subsequently attend appointments.

We used patient-level data, which is now available in some areas in England (NHS Cancer Screening Programme, 2011), to explore demographic differences in colposcopy attendance. We hypothesised that patterns of attendance would mirror those in primary screening, with women of lower SES less likely to attend.

MATERIALS AND METHODS

Data and variables. The source of data were the East of England Cyres Colposcopy database, covering a screening eligible population of B1.5 million women (ONS, 2014a). Anonymised data were extracted for all women referred to colposcopy following an abnormal screening result from 2006–2013. Referral date is defined as the date at which cytology is reported. Colposcopy attendance was ascertained by tracking patients from referral to appointment status 8 weeks later, allowing them to re-book their initial appointment within that time period. Women were categorised as ‘attenders’ or ‘non-attenders’ at 8 weeks. This time interval was chosen because 98% of women referred to colposcopy are offered an appointment within 8 weeks (Health and Social Care Information Centre, 2013). A secondary analysis examined attendance at 4 months. This interval was chosen because cervical cancer detected o4 months after a screening referral is considered to be ‘screen-detected’ (NHS Cancer Screening Programme, 2011).

For each individual, data were downloaded on age and Lower Super Output Area (LSOA) for the postcode of their home address at the time of referral. We used LSOA to access local area-level values for deprivation (the income domain of the Index of Multiple Deprivation) (Department for Communities and Local Government, 2011) and ethnic diversity (percentage of the population from white ethnic backgrounds) (ONS, 2014b). The income domain was chosen because it is likely to be relatively homogeneous within LSOAs and so is more likely to reflect individual-level income (ONS, 2007).

Categorical variables were constructed for age (25–34, 35–44 and 45–64 years) and deprivation (quintiles based on national data (Knowledge & Information Team, Public Health England, 2011)). Ethnic diversity was used as a continuous variable.

The study was exempt from the need for ethical approval under the UCL Ethics Committee guidelines.

Analysis. Multiple logistic regression (Hosmer and Lemeshow, 2004) was used to regress colposcopy attendance status (using 8week and 4-month cut-offs) against age and deprivation, prior to and after adjusting for ethnicity.

RESULTS

Characteristics of the sample. During 2006–2013, 27 193 women were referred for colposcopy. Where an individual woman had more than one colposcopy referral, we only included the first. Women had a mean age of 35 years (standard deviation ¼ 9.1), mostly lived in areas within the upper four quintiles of deprivation, reflecting the relative affluence of the East of England in comparison with the country as a whole, and came from areas of predominantly white ethnicity.

Colposcopy attendance and socio-demographic variables. Overall, 89.3% of women attended for colposcopy within 8 weeks (Table 1). In unadjusted analyses, women in the lowest quintile of income had significantly lower odds of attendance compared with the highest income quintile (86.6% compared with 89.1%, odds ratio (OR) ¼ 0.79, 95% CI: 0.68–0.91). There was no significant association between age and attendance within 8 weeks. In the model adjusted for area-level ethnic diversity, the OR for the lowest income group was slightly attenuated but remained significant (OR ¼ 0.83, 95% CI: 0.72–0.97).

When we examined attendance within 4 months, mean attendance was 94% (Table 2). In the unadjusted analysis, women living in the lowest income area were significantly less likely to attend (92.5% vs 94.1%; OR¼ 0.76, 95% CI: 0.63–0.93). In the adjusted model, women living in the lowest quintile remained significantly less likely to attend, though as before, the association was slightly attenuated after adjustment for area-level ethnicity (OR ¼ 0.81, 95% CI: 0.67–0.98). Women aged 45–64 years were significantly more likely to attend colposcopy in unadjusted (OR¼ 1.25, 95% CI: 1.08–1.45) and adjusted models (OR¼ 1.23, 95% CI: 1.06–1.43), than women in the 25–34 year reference category.

DISCUSSION

This is the first study of individual-level colposcopy attendance following an abnormal screening result in the organised cervical screening programme in England. We investigated attendance within 8 weeks, which is the value used in appointment-level statistics, and attendance within 4 months to include ‘late attenders’ who may still attend within the time frame in which cervical cancer, if diagnosed, is considered to be ‘screen-detected’ (NHS Cancer Screening Programme, 2011).

Attendance within 8 weeks of referral was lower than attendance in the multi-centre population-based randomised controlled trial nested in the NHS Cervical Screening Programme (TOMBOLA) (Sharp et al, 2012) (89% compared with 93%) but our 4-month attendance was similar (94%). There is a fail-safe process in place in England to manage women who do not attend colposcopy to minimise loss to follow-up. This includes sending reminder letters and informing the GP of non-attendance, but may vary between colposcopy clinics (NHS Cancer Screening Programme, 2010). The higher attendance at 4 months may be in part due to efforts to encourage women to attend over the extended period; efforts that appear to be effective across all quintiles of deprivation.

High levels of attendance (88%) have also been reported for referral to colonoscopy following a positive faecal occult blood test in the colorectal cancer screening programme (Morris et al, 2012). These findings suggest that once a cancer screening invitation is accepted, compliance with recommended follow-up and treatment is likely to be high. That said, minimising missed appointments, which increase the risk of delayed diagnosis of cervical cancer (NHS Cancer Screening Programme, 2011) and are costly to the NHS (Bech, 2005), remains important despite overall high rates of attendance.

Women from the most income-deprived areas had lower colposcopy attendance at both time points, even after adjusting for area-level ethnicity, but the dose–response association often observed between screening uptake and SES was not seen. This suggests that barriers to colposcopy attendance may be concentrated in the most deprived groups, although this requires further exploration. The association between deprivation and low uptake is consistent with findings from two retrospective studies of colposcopy clinic data in England (Sanders et al, 1992; Orbell et al, 2006). The TOMBOLA study also found that attendance was lower in women with no post-school education (Sharp et al, 2012).

Older women (aged 45–64 years) were significantly more likely to attend colposcopy within 4 months than younger women, consistent with the TOMBOLA study (Sharp et al, 2012). The significant association between age and colposcopy attendance was, however, not found at 8 weeks. This suggests that of the women who have not attended at 8 weeks, older women are more likely to have delayed attendance but attended within 4 months. Analyses of age differences in primary cervical screening attendance suggest that older women are less likely to cite difficulties in either making an appointment or finding time to attend screening, but may have a lower perceived risk of cervical cancer (Waller et al, 2011), which may lead to delayed attendance. ‘Late attenders’ at first referral to colposcopy have been found to be more likely to not attend subsequent follow-up colposcopy appointments (Sharp et al, 2012), therefore gaining further understanding of this issue is an important avenue for future research.

Explanations for non-attendance at colposcopy include physical (Marteau et al, 1990), psychological (Marteau et al, 1990; Wardle et al, 1995; McCaffery et al, 2006; Gray et al, 2006), educational (Lindau et al, 2006) and practical factors (Orbell et al, 2006; Balasubramani et al, 2008; Linsell et al, 2010). One study found evidence that history of domestic violence is a strong predictor of colposcopy default and loss to follow-up (Collier and Quinlivan, 2014), but there is limited research on socio-demographic variation in barriers to colposcopy. Further research in this area is warranted.

This study benefited from the use of a very large sample of women from the NHS screening programme. However, using area level variables for SES and ethnicity is a potential weakness of the study. Socioeconomic status and ethnicity data are not routinely collected by the cervical screening programme, but we were able to match to LSOA level. Lower Super Output Areas are small, homogenous geographical areas designed for neighbourhood statistical analyses (ONS, 2007). The East of England region has relatively high colposcopy attendance in comparison with other regions (Health and Social Care Information Centre, 2013), but linking the area-level measures to national quintiles may increase the relevance of these results for other regions in England. We were not able to look at mediators of the demographic patterns observed, and future work might usefully investigate the relationship between deprivation and other factors such as practical barriers and psychological well-being.

CONCLUSION

The high attendance rate at colposcopy is encouraging because it indicates that, in this area of England at least, women who accept an invitation to cervical screening are likely to accept a referral to colposcopy. However, lower attendance among women in the most income-deprived areas is of concern because this suggests that even when they attend cervical screening, they are at increased risk of missing out on the benefits of the programme. There is a need for research designed to understand the mechanisms through which deprivation is linked to lower colposcopy attendance to inform future intervention development.

Table 1. Analyses of variables associated with colposcopy attendance within 8 weeks of referral

	Sample column % (n)	8 week attenders row % (n)	OR (95% CI)	P-value	OR (95% CI)	P-value
	100 (27193)	89.3 (24294)				
Income quintile						
Q1—Low income	8.5 (2305)	86.6 (1996)	0.79 (0.68–0.91)	0.001*	0.83 (0.72–0.97)	0.016*
Q2	22.3 (6064)	89.6 (5434)	1.05 (0.94–1.19)	0.400	1.12 (0.99–1.26)	0.075
Q3	26.7 (7255)	89.4 (6486)	1.03 (0.92–1.15)	0.622	1.04 (0.93–1.16)	0.514
Q4	22.5 (6115)	90.2 (5517)	1.13 (1.00–1.27)	0.053	1.12 (0.99–1.26)	0.075
Q5—High income	20.1 (5454)	89.1 (4861)	1.00	—	1.00	—
Age						
25–34 years	55.0 (14949)	89.5 (13372)	1.00	—	1.00	—
35–44 years	27.7 (7539)	88.8 (6691)	0.93 (0.85–1.02)	0.111	0.92 (0.84–1.00)	0.053
45–64 years	17.3 (4705)	89.9 (4231)	1.05 (0.95–1.17)	0.353	1.03 (0.92–1.15)	0.607

Abbreviations: CI¼ confidence interval; OR¼ odds ratio.
*Po0.05. a
Adjusted for area-level ethnic diversity (as a continuous variable).

Table 2. Analyses of variables associated with colposcopy attendance within 4 months of referral

	Sample column % (n)	4 month attenders row % (n)	OR (95% CI)	P-value	OR (95% CI)	P-value
	100 (27 193)	94.1 (25594)				
Income quintile						
Q1—Low income	8.5 (2305)	92.5 (2131)	0.76 (0.63–0.93)	0.006*	0.81 (0.67–0.98)	0.031*
Q2	22.3 (6064)	94.5 (5731)	1.08 (0.92–1.26)	0.362	1.13 (0.97–1.33)	0.122
Q3	26.7 (7255)	94.1 (6828)	1.00 (0.86–1.16)	1.000	1.01 (0.87–1.18)	0.875
Q4	22.5 (6115)	94.4 (5771)	1.05 (0.89–1.23)	0.549	1.04 (0.89–1.22)	0.593
Q5—High income	20.1 (5454)	94.1 (5133)	1.00	—	1.00	—
Age						
25–34 years	55.0 (14949)	93.9 (14038)	1.00	—	1.00	—
35–44 years	27.7 (7539)	94.0 (7083)	1.01 (0.90–1.13)	0.893	1.00 (0.89–1.12)	0.941
45–64 years	17.3 (4705)	95.1 (4473)	1.25 (1.08–1.45)	0.003*	1.23 (1.06–1.43)	0.006*

Abbreviations: CI¼ confidence interval; OR¼ odds ratio.
*Po0.05. a
Adjusted area-level ethnic diversity (as continuous variables).

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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