HIV/AIDS in older adults: a biopsychosocial perspective in the era of effective ART

PhD report

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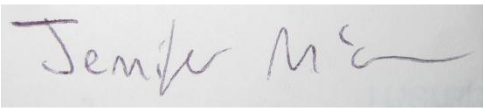
Declaration of freedom from plagiarism

‘I, Jennifer Alice McGowan, 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

The average age of the HIV population is increasing, due primarily to advances in antiretroviral treatment. Adults over the age of 50 will soon make up the majority of adults with HIV in resource rich settings. However, research into their well-being is lagging behind. An initial systematic review into the well-being of older persons with HIV (PWH), conducted as part of this thesis, revealed little comprehensive research. Even fewer studies were identified exploring the effects of 'time diagnosed with HIV' on well-being, which is increasingly a significant variable in HIV care. This makes designing effective health-care interventions for older adults with HIV in the UK problematic.

This thesis aims to identify differences in physical, social, and mental well-being in PWH in relation to age, and time diagnosed with HIV. Using one multi-centre UK study (the ASTRA study; N=3,258), one smaller study (the Resilience study, N=327) and two systematic reviews. It reveals that physical symptom frequency and distress did not differ in prevalence with age, although the symptoms of concern did. Social support decreased with age and problems with activities of daily living increased, but mental health (assessed by depression and anxiety symptoms) improved. Time with diagnosed HIV, however, was found to be strongly related to worse physical, mental, and social well-being. This is novel data and would benefit from further research to identify the extent of its effect on well-being. A second study was designed and utilised to explore these conflicting findings, and 'resilience' (assessed via the RS-14 scale) was found to relate to the increase in mental health with age, as well as the reduction in well-being identified in adults with long-term HIV. This data is the first of its kind. The results are used to suggest appropriate intervention content for adults ageing with HIV.

List of commonly used abbreviations and terms

- **ADLs** - Activities of Daily Living (e.g. washing, getting dressed)
- **Autonomy** - freedom from external control or influence; independence
- **Biopsychosocial health** - physical, mental and social wellbeing
- **cART** - Combination AntiRetroviral Therapy
- **CET** - Coping Effectiveness Therapy
- **Frailty** - a condition characterized by increased vulnerability to stressors and identified through decreased muscle mass, energy, weight, physical strength, and physical activity
- **GAD** - Generalised Anxiety Disorder
- **HrQoL/QoL** - Health-related/ Quality of Life
- **OPWH** - Older Persons With HIV
- **PHE** - Public Health England
- **PWH** - Persons with HIV
- **Resilience** - the ability to maintain wellbeing in the face of stressors
- **SEGT** - Supportive-Expressive Group Therapy
- **Self-efficacy** - an individual's belief in their own ability to complete tasks and achieve goals
- **Stressor** - a biological, chemical, environmental or external event which causes physiological and/or psychological stress
- **Well-being** – The level of happiness, comfort and satisfaction with an individual’s personal state

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1 Introduction

1.1 Age, ageing and HIV infection in the UK

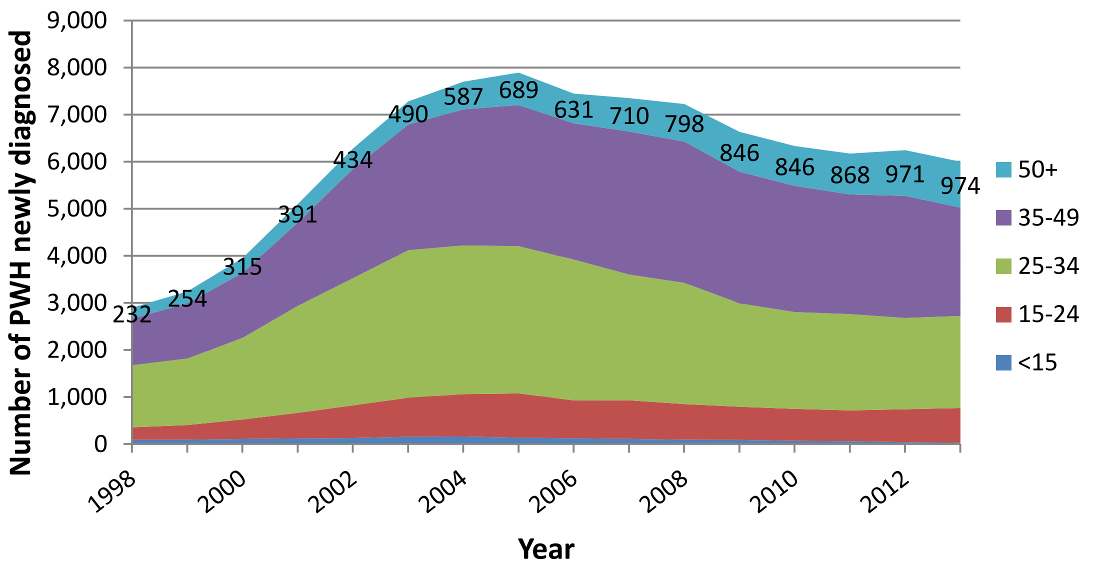
Human immunodeficiency virus (HIV) is a virus which attacks the immune system, resulting in a progressive depletion of CD4 cells (T cells)[1;2]. The CD4 cell count is, therefore, considered an important marker of the progression of HIV. If left untreated, the immune system becomes compromised to the point where the individual can no longer fight infection or disease and illnesses becomes more common and severe[2;3]. These 'opportunistic' infections can signal the transition to AIDS (Acquired Immune Deficiency Syndrome): the last stage of HIV infection.

HIV is primarily spread through unprotected sex, but also through infected needle stick and blood transfusion[4;5]. HIV/AIDS is considered a pandemic—a disease outbreak which is present over a large area and is actively spreading[6;7]. HIV/AIDS was first identified in the early 1980s[6;8;9] and the HIV pandemic has changed markedly over its 35-year history. What was once a terminal illness is now considered to be a chronic, life-long condition which, with regular medication and care, can be controlled[6;9;10].

The medicine used to treat HIV is known as antiretroviral therapy (ART). It controls the replication of the virus and therefore the number of HIV copies present (the viral load)[11]. If adhered to appropriately, ART suppresses viral replication to undetectable levels and maintains this suppression, allowing recovery of CD4 count and normalisation of immune function[12;13]. This can prolong the lives of People With HIV[14] (PWH), reduce the likelihood of opportunistic infections, and greatly lower their chance of transmitting the virus to others[3;9]. As such, an individual diagnosed with HIV in resource rich settings can now expect a life expectancy approaching that of the general population[10;15-18].

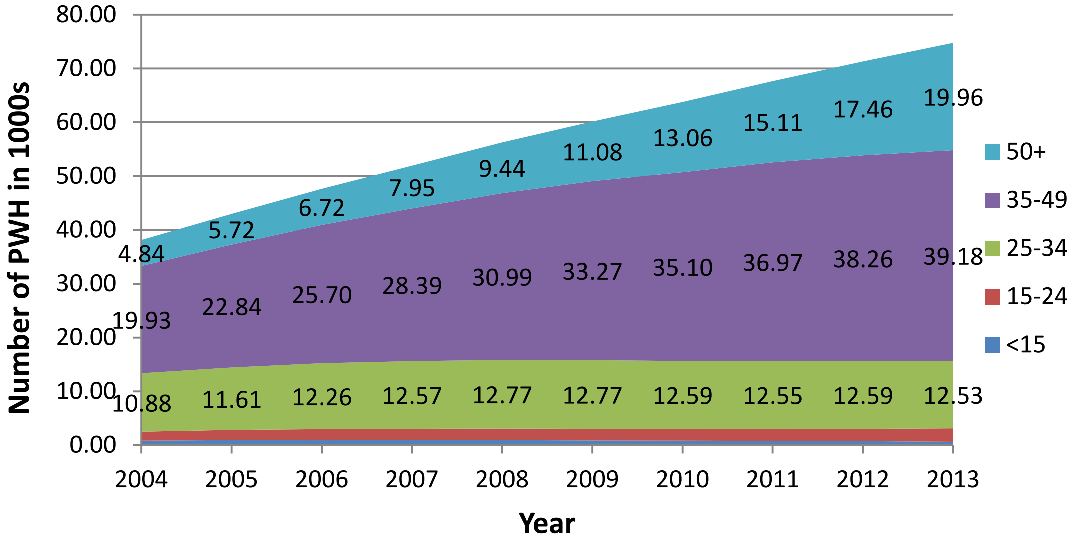
An estimated 103,700 people are living with HIV in the UK[19]. Over the past two decades combination antiretroviral therapy (cART) has become more effective, simpler, and easier to tolerate in terms of side-effects[14]. Due to these advances in treatment, PWH have a greatly improved life expectancy[16;20], with recent reports suggesting that more than 50% of PWH on cART in high-income countries will live beyond the age of 60. UNAIDS surmise that worldwide 3.6 million HIV-diagnosed people (10.2%) are over 50 years old*[1] and that in high income countries this proportion could be nearer 33.3%[22]. In the UK specifically the number of older adults with HIV has tripled in the past decade[23], with newly diagnosed infections in older adults doubling in this population in the same time period[24]. Indeed, according to Public Health England (PHE)[19], there were 6000 new diagnoses of HIV in the UK in 2013, of which 974 (16%) were in people over the age of fifty. The age at HIV diagnosis of PWH from the UK, along with the age distribution of the HIV population itself for the past ten years is shown in *figure 1* and *figure 2* respectively (adapted from PHE statistical reports[19]).

***Figure 1*. Age at HIV diagnosis in PWH from the UK across time[19].**



*The standardised definition of an 'older adult' in HIV research

Figure 2. **The number of people with HIV in the UK by age group[19].**



As can be seen from *figure 1*, while the number of new HIV diagnoses has been declining since 2005, the number of new diagnoses over the age of 50 has been increasing: from 689 in 2005 to 974 in 2013[19]. *Figure 2* shows that the number of people with HIV in the UK has also increased over time, specifically in relation to the 35-49 years and 50+ years age groups (from 19,932 and 4,837 in 2004 respectively to 39,180 and 19,959 in 2013[19]). In the same year there were only 530 reported deaths in the HIV-positive population: a decline in mortality rate from 11 per 1,000 people in 2004 to 4.3 per 1,000 in 2013 (vs. 1.8 per 1,000 people in the general population)[19]. Taken together, this suggests that adults are increasingly being diagnosed with HIV at an older age, and HIV-positive adults are reaching older ages and living with HIV for longer. This creates two distinct, growing, groups in need of care: 1) older adults with HIV and 2) adults who have lived with HIV for a long time (adults growing older with HIV).

Although the number of older adults being diagnosed with HIV is increasing, many older people with HIV (OPWH) are still diagnosed at later stages of infection than younger adults[23;25-30]. Indeed, the 2014 PHE report[19]shows that 58% of older PWH are likely to be diagnosed with a CD4 count lower than 350 cell/mm^3 - the UK clinician guidelines for initiation of cART at the time[24] (this guideline has since been altered to include all persons with HIV of any CD4 count[11]). This delay in diagnosis may in part be affected by health care worker's beliefs that older adults are not sexually active (and are therefore not at risk), their discomfort in exploring sexuality with older patients, and a misattribution of older adult’s symptoms (e.g., fatigue, weight loss, memory loss) to illnesses commonly associated with old age (e.g. Alzheimer's disease, Parkinson's disease, cancer, chronic obstructive pulmonary disease, and non-AIDS-related pneumonia)[31-36]. This delay in diagnosis and treatment, in turn, is related to higher rates of mortality[37-40], faster CD4 cell loss, and faster progression to AIDS[25;41;42]. This makes newly diagnosed OPWH a population at high risk of ill health, and of specific concern for the health-care system.

Despite the increase in numbers of OPWH, there has been a lack of focused research into the interactions between HIV and ageing on physical, mental, and social ‘well-being’. That is, much is left unclear about the impact of ageing with HIV on older adult's 'level of happiness, comfort, and satisfaction with their current personal state’[43]. This has left much of the literature on ageing with HIV to extrapolate information from gerontological and general HIV-based evidence[44]. For example, a literature review (section 1.3) on HIV and ageing was only able to identify five published UK papers conducted in the past ten years which examined the patient-reported experiences of physical health amongst older adults with HIV[25;40;45-47], of which only one was a study, rather than a summary paper[40].

This burgeoning population represents a challenge for researchers and healthcare systems. Specifically, evidence-based planning must be undertaken to meet the health-care needs of OPWH. For this to occur, we need to be aware of their needs - in terms of physical, mental, and social health - as well as to identify any ‘positive’ effects of ageing which could be utilised as a coping resource. In 2012 the National Institute of Health's office of AIDS specified studies into mental health, social networks, and the possibility of 'successful ageing' in OPWH as priority research areas[48]. In order to meet this priority it is important to understand general age-specific issues in well-being, as well as those faced by adults ageing with HIV specifically.

In this thesis I discuss these issues in relation to the Biopsychosocial model of health[49]: a well-established model developed in health psychology that depicts health as a result of interacting physical, mental, and social factors.

In the following introductory sections, general age-related issues with well-being are discussed, followed by those specific to ageing with HIV.

1.1.1 **Ageing**

According to some researchers, ageing is 'a natural process that culminates in physical decline, morbidity, and mortality'[50;51]. Certainly, ageing does bring challenges in relation to health, but also life roles, and social participation. Older adulthood marks a time of change in relation to friends and family, physical functioning, financial productivity, physical appearance, and identity: all of which must be addressed and adapted to.

With age comes an increase in morbidity and mortality rates due to cell death and reductions in the body's ability to maintain a balanced internal environment[8] and to protect against illness[25;52;53]. This also results in greater fatigue, physical frailty, and problems with activities of daily living (ADLs), which in turn reduce the autonomy, physical activity, and social mobility of older adults[26;54;55]. However, should older adults remain free of chronic illness, good physical function appears to be possible[54].

Possibly in relation to these health-related limitations in activity, depression has been found to be high in older adults[56-58]. It is also possible that depression may be high in older adults due to disengagement with social roles and increased economic strain caused by retirement and bereavement[57;59;60]. For example, many adults define themselves by their occupation, hobbies, or ability to care for their spouse and children[61;62]. In these cases retiring, ill health, and/or children growing up and moving away could cause older adults to feel obsolete, or anxious, or feel a need to adapt their identity to reflect these situational changes. As such, where chronic illness prevents these personality-defining activities, it is likely that disengagement with life may occur at an earlier age[63].

For the same reasons, social support is thought to decline with age[64-66]. It has been observed, for example, that many older adults maintain small, highly valued social groups in order to maximise emotional and physical resources while limiting the energy and mobility required to participate in social interactions[64;67;68]. Despite the tendency for smaller size of these social groups, the importance of social support is not diminished with age. Indeed, social support has been repeatedly found to be related to physical and mental well-being in older adults, including the promotion of health-preserving activities such as exercise and healthy diet[69-74]. As such, it is possible that spousal support becomes more salient[75], in relation to overall well-being, with age.

It appears that older adults face challenges to physical, mental, and social health which are not present in younger adults. This strongly implies that their care needs must be explored and addressed separately from those of younger adults.

1.1.2 **Ageing with HIV**

As in the general population, it is likely that older PWH experience age-related co-morbidities and lead more sedentary life-styles than younger PWH. It is also likely that they experience fear and uncertainty in relation to both age-related illness and their ability to recover their health after acute illness[76]. While the improvements in treatment mean that achievement of a satisfactory CD4 count is possible across all age groups[77-79], higher rates of illness and mortality are still reported in OPWH[3;19;21] in comparison to younger PWH and to the general population. There is a recent train of thought, even, that HIV debilitates the immune system in adults in ways which are similar to- and even exacerbate- the ageing process[80;81]. In other words, physical decline in OPWH may be associated with primary ageing (biological ageing), secondary ageing (lifestyle, e.g. high smoking rates[82], sedentary behaviour[83]), and tertiary ageing (disease) causing cumulative detriments to health[37].

Compared to physical health, mental health is under-researched in OPWH, particularly among people with HIV in the UK and Europe. Information on anxiety and positive mental well-being is especially absent in the literature. However, studies from the US have shown that levels of depression are higher in PWH than the general population[84;85] and depression has been related to several factors salient in older age groups, such as bereavement[86], poorer physical function[85;87;88], health-induced anxiety[84;89;90], and social isolation[85;91;92]. As such it is not unreasonable to conclude that OPWH may be at an increased risk of mental distress when compared to younger PWH and the general population.

In relation to social health, OPWH have been identified as showing low levels of disclosure of their HIV status to family and friends[93-96]. Indeed, some report feeling that their adult children are a source of HIV-related stress and stigma[97]. This may result in lower levels of social support and less inclusion in social activities. Furthermore, fear of HIV-related stigma may prevent OPWH from populating their social circles with people of a similar age[96;98;99]. This is likely to result in greater reliance upon a HIV-positive network for support[94-96] which, in turn, may increase the burden of stress on other OPWH. It also increases the likelihood of a diminishing social circle through bereavement at a faster rate than experienced in older adults within the general population.

Therefore it is possible that OPWH face unique physical, mental, and social health needs based on an accumulation of age- and HIV- related limitations. As informal physical and mental support diminishes and age-related ill health increases, OPWH may develop an increasing reliance on formal health-care[100], which places a burden on the health-care system. In order to enable high levels of well-being in this population and ease the burden on health-care, these care needs need to be identified and addressed.

1.1.3 **Time with diagnosed HIV**

An important factor related to the well-being of OPWH is the amount of time they have been diagnosed with HIV. Living with HIV for a long period of time may cause HIV-specific stressors (causes of stress) in older adults. For example, those who were diagnosed before the availability of effective cART - when HIV was a terminal illness - are likely to have experienced many of their friends and partners dying from AIDS. They may also have lived with the fear of their own potentially imminent death, and through the era of early and ineffective treatments (such as monotherapy), severe medication side-effects, and the fear of progression to AIDS. Indeed, these experiences may be unique enough that recently diagnosed- and 'previously-diagnosed'- older PWH should be treated as separate treatment groups with separate histories, experiences, and well-being needs[101;102].

However, this sub-group has not been well-researched. A search of the key-words 'time', 'length', 'long', 'long-term', 'diagnosis' and 'HIV' revealed six papers centring on the needs or issues faced by PWH who had been diagnosed for a long time. One Italian study (N=2,424) initiated in 2004 compared OPWH (over 45 years of age) to adults ageing with HIV (diagnosed for more than 20 years) and HIV negative adults[101]. They found higher morbidity rates (lipodystrophy, cardiovascular disease, hypertension, diabetes, chronic kidney disease) in both HIV positive populations when compared to HIV negative adults. Within the HIV positive group, worse comorbidities were found in relation to older age than longer time diagnosed with HIV[101]. An American study (N=4631) reported worse physical health (assessed via the Physical Health Component Summary) in adults with longer duration of HIV[103]. Another small qualitative study of 24 PWH diagnosed for ten or more years, reported that the primary concerns were in relation to interpersonal relationships, coping with stress, health-care issues, and a fear of progression to AIDS[104]. A second qualitative analysis also reported the importance of social support to long-term survivors, as well as supportive health-care services[105].

Finally one qualitative study published in 2014 revealed that many adults with long-term HIV faced financial concerns, having been unable to work at a younger age due to HIV and not feeling the need to plan effectively for retirement[106]. The participants also identified that they were aware of the lack of information available to their doctors on 'normal' levels of health at prolonged survival, this being the longest any adult has lived with HIV[106]. They voiced concerns of feeling like 'guinea-pigs' for medication efficacy, being hyper-aware of changes in their bodies and that, with time, HIV medication may become less effective and options may run out[106]. As such adults ageing with HIV may face many similar concerns to newly-diagnosed OPWH in relation to ageing and health, as well as time-specific care needs.

Longitudinal data can also be utilised to explore time-related changes, as it can show changes in well-being within individuals over time, and as such can be used to explore 'ageing with HIV'. Following this logic, six studies were identified which involved a longitudinal follow-up of longer than a year carried out between 1998 and 2010. The results showed an increase in CD4 count[30;77;107;108], frailty[109;110], and mortality[77;108;110], and a decrease in viral rebound[77] in individuals across time. No quantitative results were found in relation to depression, anxiety, social support or positive well-being. The information available suggests that ageing with HIV creates unique issues in relation to well-being.

1.1.4 **The possibility for 'successful ageing'**

It would be narrow-minded to assume that ageing has a negative, blanketing effect on well-being in PWH and so the possibility of 'successful ageing' in PWH must be addressed. Recognising the possibility of 'successful ageing' could also allow for the exploration of behaviours which could be encouraged in age-specific interventions.

For example, it is also possible that, with age and/or time, PWH learn to cope with the stress of ill health and are become better equipped to protect their mental health. For example, recent 'resilience' research has begun to focus on the coping behaviours of older adults. Resilience is a multidimensional concept which seeks to explain how some individuals attain, maintain, or regain well-being in the face of hardship[111]. While research is still lacking, current results suggest that resilience may be higher in older- than younger- adults[112-114] due to life-long experience of coping effectively with hardship[115]. This would suggest that OPWH may be more equipped to cope with age-related declines in health and social support and may even show better overall well-being than younger adults. This has yet to be applied to PWH, however.

In general, models of 'successful ageing' - ageing with positive well-being - involve maximising active engagement with life, good physical function, and the prevention of disease and/or disability[116]. For obvious reasons this model is not suitable for older adults with chronic illness, such as HIV. However, Baltes and Baltes' selective optimization with compensation theory[117] suggests that, with age, adults learn to choose activities and behaviours which best maintain well-being, while reducing high-energy or physically unavailable activities. In this way, it is possible for older adults to maintain well-being despite reduced physical and social mobility. Similarly, Kahana and Kahana have developed a model of successful ageing for PWH[67] which states that through planning, health promotion, social and financial support, and adaptation to limitations OPWH can mediate the effects of HIV on well-being[67]. While this model is reliant upon a large number of assumptions about physical, social, and mental ability, it does acknowledge the possibility of an optimistic response to HIV.

In summary, older PWH are a rapidly increasing population both in the UK and globally, with specific care needs. This population is lacking focus in the literature, especially in relation to the UK population, and a better understanding of their well-being is needed in order to effectively address these needs. More specifically, the differences in well-being between chronologically older OPWH and adults 'ageing with HIV', or diagnosed for a longer time, need to be explored. This thesis intends to address the limitations of the literature and explore the biopsychosocial well-being of older PWH in relation to their younger counterparts. In doing so, I hope to identify care needs specific to older age, or longer time since HIV diagnosis, which can be utilised by future health care interventions.

1.2 Thesis Aims and Objectives

1.2.1 **Aims**

This thesis aims to assess biopsychosocial factors among older PWH in the UK. It will utilise evidence from literature reviews and two studies undertaken as part of this thesis to suggest an age-appropriate intervention.

The research presented here will address several gaps identified in the literature. Foremost, it will explore the biopsychosocial wellbeing of adults with HIV across the age spectrum; assessing trends by age in symptom prevalence and distress, depression, anxiety, and social support. The effects of growing older with HIV will also be assessed, in terms of time living with diagnosed HIV, in relation to the above biopsychosocial variables. This will allow us to differentiate between the effects of chronological ageing and long-term HIV infection on well-being. Part of the research will also utilise HIV-negative individuals, allowing us to explore factors associated with older age both among HIV-positive and HIV-negative populations, which is lacking in the research so far. In doing so it will contribute to the available UK studies on the psychosocial health of older PWH and add a large, multi-centre evidence base to a literature which mainly consists of small American studies.

Resilience will also be explored in relation to mental and physical health. Specifically, among PWH, the prevalence of higher resilience by age and time with diagnosed HIV will be assessed, as well as whether resilience differs between adults with and without HIV, and whether resilience relates to depression, anxiety, difficulties with ADLs, and/or physical function. This will produce entirely new information within the field of ageing HIV research. The results will be used, along with the above research, to discuss the potential development of a theoretical, focused intervention to improve quality of life in OPWH.

1.2.2 **Objectives**

To achieve these aims, two separate studies will be used:

Study 1: The first study compares symptom prevalence, symptom distress, depression, anxiety, and social support in people with HIV by age and time diagnosed with HIV as well as the associations between these variables. It utilises data from the ASTRA study[118]- a large multi-centre UK study conducted in 2011-12 - to identify symptoms specifically distressing to older adults. The results will provide an overview of the effects of age and time with diagnosed HIV on the well-being of the HIV-positive population. Due to the large sample size and inclusion of a number of UK clinics, these results are likely to be representative of PWH in the UK as a whole.

Study 2: I then developed and conducted a new smaller study of resilience, mental, and physical in relation to age, among PWH and age-matched HIV-negative counterparts. This will allow for identification of mental and physical health symptoms associated with HIV and/or ageing. 'Resilience' is included in this analysis to allow for the possibility of a form of 'positive' ageing and its effect on mental and physical health. While this is a smaller study, it will give us some insight into how health measures differ with age in the HIV-negative population, allowing differentiation between the effects of HIV and ageing. It also allows for identification of possible positive effects of ageing which can be drawn upon in interventions.

A summary of the specific research questions and chapters by study are given on the next page.

1.2.3 **Research Questions**

Study 1:

i. What physical symptoms are most prevalent and/or distressing in adults with HIV and do they change with age and/or time with diagnosed HIV? **(Chapter 3)**

ii. What problems with Activities of Daily Living (ADLs) are most prevalent in adults with HIV and do they change with age and/or time with diagnosed HIV? **(Chapter 3)**

iii. What psychological symptoms are most prevalent in adults with HIV, do they change with age and/or time with diagnosed HIV and what are their relationships to physical well-being (symptoms and problems with ADLs)? **(Chapter 4)**

iv. Does social support or disclosure of HIV status differ by age and/or time with diagnosed HIV in adults with HIV and what is the relationship to mental and physical well-being? **(Chapter 5)**

v. Does financial stability differ by age and/or time with diagnosed HIV in adults with HIV? Is financial stability and employment status associated with mental or physical well-being of older adults with HIV? **(Chapter 5)**

vi. What relationships are apparent between physical, mental and social factors of well-being and do they change by age or time diagnosed with HIV? **(Chapters 4 and 5)**

Study 2:

a. Is resilience affected by age, time with diagnosed HIV and/or HIV status? **(Chapter 7)**

b. Does depression, anxiety, problems with activities of daily living, or prevalence of regular physical activity differ by age or HIV status? **(Chapter 7)**

c. Is resilience related to depression, anxiety, activities of daily living and/or physical activity? **(Chapter 7)**

To answer these questions I began by exploring the literature, in the form of a systematic review. This identified currently recognised physical, mental, and social issues affecting OPWH.

1.3 A systematic review of the biopsychosocial evidence

This systematic review was conducted to explore current research into the biopsychosocial health of older adults with HIV. 'Biological health' was defined as any physical illness, laboratory measures, or symptoms measurable through standardised means; including comorbidities and the possible biological effects of HIV and cART. This included CD4 count, viral load, mortality rates, and medical conditions (e.g. cardiovascular diseases). Comparisons of the efficacy and/or effects of HIV drugs and cognitive impairments were not included as they were considered to be beyond the scope of this thesis. 'Psychological health' included quality of life, depression, anxiety, distress, mood states, coping mechanisms, and measures of affect (expressed emotion). 'Social health' included reports of disclosure of HIV status, social support, stigma, and isolation. In line with previous work, an 'older adult' was defined as an adult over the age of 50.

A key-word search was conducted using the online databases of: AIDS, Cochrane Database of Systematic Reviews (CDSR), database of systematic and non-systematic reviews of public health interventions (DoPHER), Medline/Pubmed, JAIDS, SAGE, JSTOR, LILACS, Mary Ann Liebert, METALIB, Psychnet, sciencedirect, Springerlink, Taylor and Francis, Wiley and EBSCO in July-August 2014. This was then updated in September 2015.

1.3.1 **Inclusion and exclusion criteria**

The search terms included were; 'HIV' OR 'AIDS' AND '50', 'age', 'aging', 'elder', 'fifty', 'mature', 'old' and 'senior'. This keyword search generated 748 studies potentially relevant to this thesis, which were then examined for inclusion in this review according to inclusion criteria specified in advance (*Table 1*).

Table 1. **Inclusion criteria in order of use.**

No.	**Inclusion Criteria**	**Status of paper and response**		
		Yes	**Unclear**	**No**
0	Is the study clearly outside the scope of the review?	**Exclude**	*Go to question 1*	*Go to question 1*
1.	Are at least one group of participants HIV positive?	*Go to question 2*		**Exclude**
Type of study				
2.	Was the data collected solely after 1999?	*Go to question 4*		*Go to question 3*
3.	If collection date is unclear, was the data published after 2000?	*Go to question 4*		**Exclude**
4.	Is the study quantitative?	*Go to question 5*		**Exclude**
Participants in study				
5.	Is at least one comparison group made up of participants over the age of 50 years?	*Go to question 7*		*Go to question 6*
6.	If some of the participants in the older group are under the age of 50, can the data be disaggregated to show that 80% of the group is over the age of 50 or, if indeterminate, is the mean age over 50?	*Go to question 7*		**Exclude**
7.	Are participants studied in comparison to a control group of HIV negative adults over 50, HIV positive adults under 50 or HIV positive adults over 50 of a different demographic?	*Go to question 8*		**Exclude**
Focus of study				
8.	Does the study explore physical, psychological or social factors for OPWH either as a primary or secondary aim?	*Go to question 8b*		**Exclude**
8b.	In the case of physical outcomes; does the study explore the effects of specific medications only?	**Exclude**		*Go to question 9*
Outcomes				
9.	Does the study measure physical, psychological or social factors measured by validated instruments?	*Include subject to clarification of 'unclear' points*		*Go to question 8*
10.	In the case of social outcomes, is the data quantitatively measured?	*Include subject to clarification of 'unclear' points*		**Exclude**
N.	**Final Decision**	**Include**	**Unclear (more information)**	**Exclude**

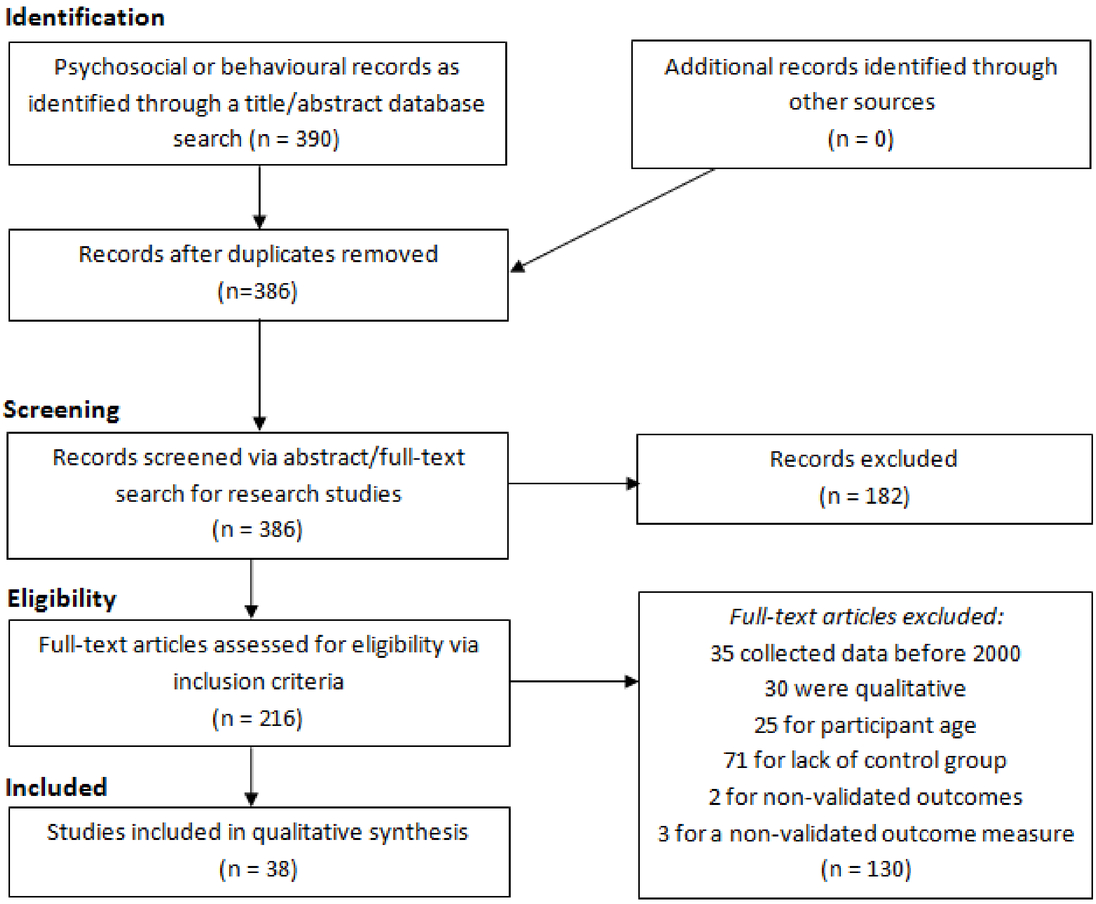
Papers were included if they provided quantitative data on biological, psychological, or social factors in older adults with HIV in comparison to a control group, with data collected from the year 2000 onwards. This date exclusion was incorporated in order to restrict attention to studies carried out in the current era of successful antiretroviral therapy. The control groups could involve younger people with HIV, HIV-negative older adults, or demographically differentiated older adults with HIV. Studies in all geographical regions were included. Outcome measures needed to be gathered according to validated scales or inventories where appropriate. Only 'full text' articles were included. Qualitative studies, non-primary data, review articles and opinion pieces were excluded. Articles focused on older adults as caregivers for others with HIV were excluded, as were studies of older adults where the majority of participants in the older group were under the age of 50 years.

After the search, papers were read independently for confirmation of inclusion by myself and two undergraduate psychology students who were given details of the study inclusion criteria. As the lead author, I took responsibility for adjudication in case of non-agreement (84.5% inter-rater agreement). The review was conducted following PRISMA standards[119]. Juxtaposition of author names, study groups, and population sizes were utilised to identify duplicate publications. All reports of a single study were considered, as long as the outcomes differed. For all included papers, detailed extraction of findings was recorded listing the reference, date and country of study, population details, aims, measure, and results (see *Table 2, Appendix A*).

1.3.2 **Results**

The below criteria (see *figure 3*) generated 390 papers relevant to this review. After excluding duplicates, 386 remained which underwent a more detailed exploration of the full title and abstract. One hundred and eighty two papers were excluded due to non-relevance, leaving 216 full-text articles for assessment via an in-depth search of the full text using the inclusion criteria. Of these, 130 were then excluded: 35 for data collection date, 30 for not reaching the standards in terms of methodology, 25 for participant age, 71 for lack of a control group, 2 for non relevant outcome and 3 for non-validated measures. Thirty eight published studies met the eligibility criteria for inclusion and were subjected to detailed data abstraction.

Figure 3. **Preferred Reporting Items for Systematic Reviews diagram summarizing selection procedure for studies on physical, psychological, social or behavioural outcomes for OPWH.**



One paper was published in 2015, four in 2014, six in 2013, seven in 2012, ten in 2011, four in 2010 and six between 2004-2009. On average, papers were published 3.3 years after data collection (median of 2), with a range of 1-9 years (see *figure 4a*). Five papers originated from the HIV Neurobehavioral Research Program (HNRP) Group[79;120-123]. All other studies had independent results. Overall, 197,313 (Range = 30-90,071) participants were included in analysis in total, 17,190 (8.7%) of whom were older PWH (aged 50 and over). America was the country of origin for 21 (55%) of studies, six occurred in Africa[77;78;124-127], five in Europe (excluding the UK)[107;128-131], two in Brazil[132;133], two from Canada[134;135], one from Singapore[136] and one in the UK[137] (*figure 4b*).

Figure 4a. **Data collection date differentiated by year of publication; the number of studies (n=38).**

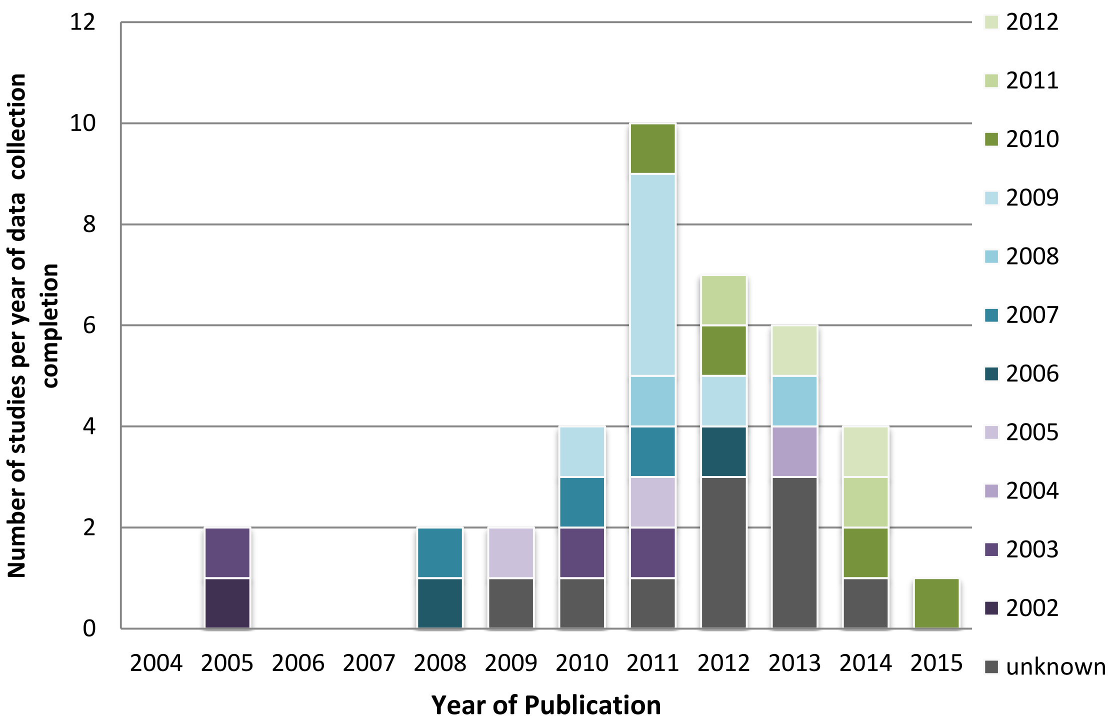
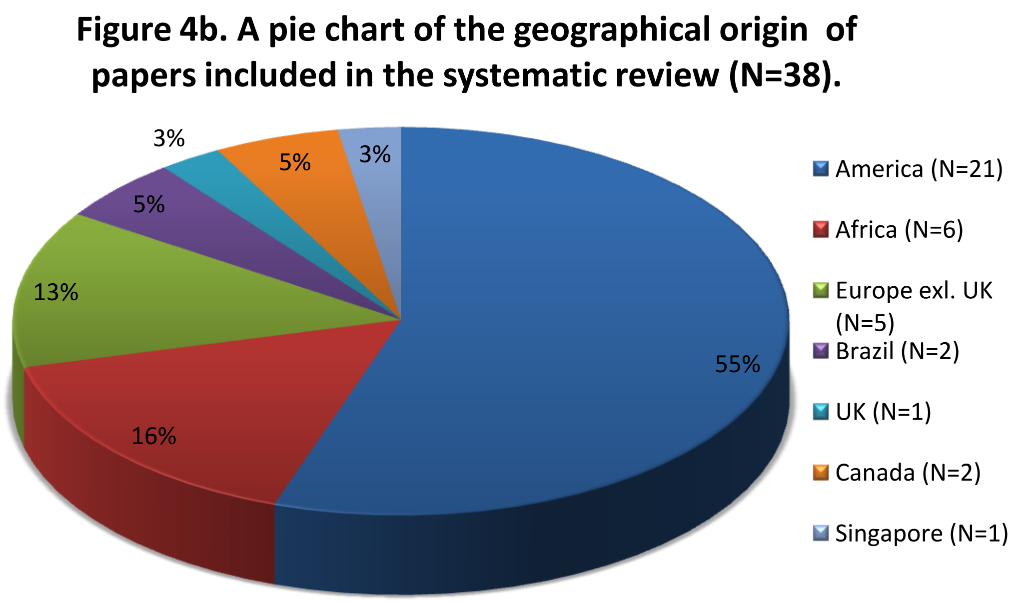


Figure 4b. **A pie chart of the geographical origin of papers included in the systematic review (N=38).**



All but four (89%) studies were not focused on sub-populations of PWH. Of those that were, one looked at rural and urban male PWH[138], one focused on men who have sex with men

(MSM)[55], one on bisexual men[139] and one on men[109]. The control groups included younger PWH in 25 studies, HIV-negative older adults in four[109;140-142], both in six[55;79;121-123;130] (four from the HNRP group) and demographically different older PWH in three[139;143;144].

1.3.2.1 Assessment of study design and risk of bias

Due to selection criteria, the methodology of all studies was considered to be of a 'fair' standard: valid, standardised outcome measures were required of all studies included, except in the case of health-related risk behaviours where no such measure is available. Participation in each design was limited only by the individual's ability to understand the questionnaire and give consent. However, by design, all psychological outcomes were self-reported and all participants were self-selected meaning that the results may be at risk of bias. No studies reported whether their samples were representative of the HIV population, but participant data was collected predominantly through AIDS service organisations (ASOs), which increases the likelihood that the data gives a representative picture of HIV service users. No power calculations were reported for study sample sizes. No conflicts of interest were reported.

1.3.2.2 Biological Outcomes

Twenty of the included papers focused on changes in biological health with age. Of these, twelve papers looked at differences in ART efficacy with age; eleven at CD4 count[64;77-79;107;125-128;132;133], six at viral load[64;77;78;107;131;133] and one at T-cell frequency[132]. Mortality rates were assessed in seven studies[64;107;124;126;127;131;136] and co-morbidities in eleven[55;64;78;79;109;128;130;131;133;141-143].

Data was primarily identified through the most recent medical records available. Of the studies utilising this method, the majority found no difference in CD4 count between older and younger PWH on ART. The individual results are described below.

The Swiss HIV Cohort Study (N=1497)[128] found no significant difference in CD4 count between PWH aged under and over 50 years (median count of 513 (IQR=361-702) vs. 493 (355-68) respectively, p=0.126). Similarly, no difference was found in CD4 count by age in 1,478 PWH aged 18+ from Alabama (p>.05)[64], three studies from Africa (Ns=90,071, 17,561, 3,316, ps>.05)[77;78;126], the HIV Neurobehavioral Research Program (HNRP) Group's study[79] of 302 American PWH (mean count = 568(IQR = 402-806.5) in ≤40s vs. 507(381.3-759.5) in ≥50s, p=0.672) or a Brazilian sample of 30 PWH aged <40 or >55 (Mean count of 614(IQR=401-1007) and 603.8(371-976) respectively, p>.05)[132].

However a second, larger, Brazilian study[133] (N=2,307) found no linear trend in CD4 count with age (mean count of 447(SD= 378) in PWH aged 18-39 vs. 497(309) in ≥60s, p=0.490) but a significantly lower CD4 count in participants aged ≥50 (p<.02) compared to younger groups. This result corresponded to studies identifying changes in CD4 cell count over time: Blanco et al.'s study of 2,726 Spanish PWH[107] and Balestre et al.'s[125] study of 24,107 PWH from West Africa. Blanco et al. identified increases of more than 100 cell/ml in CD4 count with increasing age, and a decrease in immunological response to ART with age (range of 32%-43% less likely to experience immunological response in ages 50-54 to ≥70 in comparison to participants aged <25, ps<.05)[107]. Similarly, Balestre et al.[125] measured CD4 count gain after 12 months of ART and found a smaller increase in CD4 count with increasing age (p<.00001). Maskew's[127] population of 9,139 PWH from Johannesburg aged 18 and over also showed a decrease in CD4 count improvement 6-12 months after ART initiation with age (p<.05). In contrast, Greig et al.'s study of several African countries found a higher median gain in CD4 cell count at 6 and 12 months in adults over the age of 50 compared to those aged 15-49 (Hazard Ratio (HR) = 1.59, N=17,561, p<0.001).

It is therefore possible that older adults attain similar CD4 counts to younger adults when on ART, but their immunological response to medication may be slower. Why the opposite would be true in Greig's study is unclear, especially as the demographic variables are similar to those found in the other African studies. It is possible that the difference in results is due to the comparatively lower income areas of Africa covered in this study, within which older adults may be more likely to seek care (improving their prospects of diagnosis) and to adhere to their medication. However, further evidence is needed to confirm this theory.

Viral load revealed a wider variation in results. No significant difference between older (>55 years) and younger adults was found in Fatti and colleagues' South African study of medical records (N=90,0771, Odds Ratio (OR) = 1.42, CI=1.23-1.64, p<.05) or by age in the Spanish study (N=2,726, HR = 3.58, CI= 1.07–11.99, p>.05)[107]. An analysis of the clinical records of participants from Uganda and Zimbabwe[78] showed a higher viral load at ART initiation in PWH over the age of 50 compared to those aged 18-49 (N=3,316, p=0.003) while the remaining three studies showed a lower viral load with increasing age in PWH on ART centred in Alabama (N=1478, p=0.018)[64], Milan (N=1,217, p<.0001)[131] and Rio de Janeiro (N=2,307, p<.001)[133] as assessed by medical records. Finally, a second study based in Rio de Janeiro showed that naive and central memory T cells were less frequent in PWH aged over 55 than PWH aged <40 (ps<.05) as assessed by blood sample[132]. This seems to suggest, overall, a better immunological - and possibly virological - response to ART in older than younger PWH despite age-related reductions in the efficacy of the immune system.

Mortality rates generally increased with age. This occurred in a Singaporean sample of 121 PWH aged over or under 50 as assessed via the VACS index (higher mean 5 year mortality rates of 25% vs. 50%, p<.001)[136], a Spanish[107] sample of 2,726 PWH aged <30 or ≥60 years (HR = 3.58, Confidence Intervals (CI)= 1.07–11.99, p<.05) as assessed by death rates, 1,478 PWH aged over 18 from Alabama[64] (p<.001) and two African studies[124;126] (Ns=22,087 (31.4 deaths per 1000 person-years in ages 40-44 vs. 58.9 in ages 60-64) & 17,561, ps=<.001 & .016 respectively). Similarly, mortality rates in the first 12 months of treatment also increased with age in 9,139 PWH from Johannesburg (HR = 1.67, 95% CI: 1.24-2.23, p<.05)[127]. A sample of 1,217 Italian[131] PWH aged over or under 50 showed no difference in mortality rates (assessed via survival) to younger PWH at study end (p>.05). However, this is likely due to the relatively short length of this study (two years).

Finally, *comorbidities* were assessed in eleven papers. Due to the wide variation in co-morbidities assessed the detailed break-down of these papers is shown in *table 2* in Appendix A. Briefly, compared to older adults without HIV, older PWH were more likely to show a frailty phenotype (an aging-related condition characterized by increased vulnerability to stressors and identified through decreased muscle mass, energy, weight, physical strength, and physical activity)[55], to have lower bone mineral density of the femoral neck, total hip, and lumbar spine[109;142], to show osteopenia or osteoporosis (reduced protein and mineral content of bones)[109], bone fracture, renal failure[130], hepatitis C[79], hypertriglyceridemia and low body mass index and were more likely to use lipodystrophy-related, antihypertensive, and lipid-lowering medications[141], and visit the hospital more frequently with age (p<.05)[55]. No difference was found, by HIV status, in relation to coronary heart disease, chronic viral hepatitis, non-AIDS-defining malignancies or cardiovascular risk[130;141]. Conflicting results were shown in relation to diabetes mellitus[130;141] and hypertension (high blood pressure)[130;141].

Compared to younger PWH, older PWH showed higher rates of comorbidities[64;130;133] and prescribed medications[64;128]. Specifically, older adults were identified as being at higher risk for drug-drug-interactions[128], cardiovascular risk[131;133], erectile dysfunction, hypertension[64;78;119], renal dysfunction, diabetes mellitus[64;119], dyslipidaemia/hypercholesterolemia (abnormal amounts of lipids (e.g. cholesterol, fat) in the blood) [64;133], non-AIDS-related cancers[133], insomnia, coronary artery disease, hypogonadism (reduction in sex hormones), reflux disease, shingles/Herpes Zoster[64], and to have progressed to AIDS[79]. Older PWH showed lower rates of condyloma (genital infection)[64] and chronic liver disease[131] than younger adults and no difference and/or conflicting results were found in relation to hepatitis C[64;78;79;128;133], hepatitis B[78;133], AIDS-related cancers[133], pneumonia, Kaposi sarcoma, and obesity[64]. Within older PWH, African American were more likely to have liver disease or diabetes mellitus[143].

As can be seen from the outcomes, a large number of co-morbidities have been explored, but rarely in more than one paper each. As such, while the results suggest a reduction in overall physical health with age and HIV status, the results are not conclusive. Furthermore, few studies have assessed patient-reported health and symptoms, leaving the effects of ill health on well-being to be assumed, and even fewer have included time with diagnosed HIV as a confounding factor.

1.3.2.3 Psychological Outcomes

Thirteen papers looked at depression[64;120;129;133-135;138;143-148], three at anxiety[64;120;140], two at mood[120;122], one at overall affective disorders (depression, anxiety, bipolar disorder)[79], and one at body change distress[146]. Quality of life was assessed in six studies[79;121;123;135;137;146] and wellbeing in two[122;139]. Other outcomes of interest included self-efficacy (an individual's belief in their own ability to complete tasks and achieve goals)[147], coping[134;135;144], positive affect[148], mastery[135;140], spirituality[149], successful aging, emotional functioning, resilience, optimism, and feelings towards aging[140].

Depression was by far the most explored psychological outcome in HIV/AIDS in older adults, but researched via seven standardised measures: the Center for Epidemiological Studies Depression (CES-D) Scale[129;134;135;138;146;147], the Beck Depression Inventory(BDI)[145], Participant Health Questionnaire (PHQ-9)[148], the Geriatric Depression Scale (GDS)[144], medical records[64;133;143], the Composite International Diagnostic Interview (CIDI)[79], and the Profile of Mood States (POMS)[120], making meta-analysis of results problematic.

Despite the use of separate measures and geographical regions, seven of the ten studies comparing depression by age found comparable results: no difference in depression prevalence between older and younger PWH. The details of these studies are documented here.

The Hawaii Aging with HIV Cohort study (n=285) assessed depression via the BDI and found no difference by age between PWH over 50 years of age and under 40 (mean scores = 9.1 vs. 8.6 (p = 0.42))[145]. Similarly, no difference in depression rates in PWH over or under 50 years was found in Philadelphia using the PHQ-9 (mean=7.78 (SD = 5.61) vs. 4.9(5.49), p=0.83)[148], in 226 male PWH in Florida aged 20-39, 40-49 and 50-70 via the CES-D Scale[138] (p = 0.523 and p = 0.557) or in 130 PWH from the Midwest (mean score = 15(sd=10.16) vs. 15.84(12.8) p=0.8)[147].

Depression, anxiety, and mood were measured by age via POMS in 113 PWH in San Diego and no significant difference was found in lifetime depression prevalence (58.5% of <40 year olds and 54.2% of >50 year olds, p=0.653) or anxiety (12.2% vs. 19.4%, p=0.322)[120]. Nokes et al.'s 2011[146] study of 1,217 PWH from around America measured depression and body change distress using the CES-D scale and Body Change Distress Scale and also found no age differences in depressive symptoms (t = −1.258, df = 925, p = .20), Health-related Quality of Life (HrQoL) (p=0.92), or body change distress (t = −1.258, df = 925, p = .209)[146], nor did a study of 440 Italian PWH (CES-D; 58.9% and 58.0% depression rates, respectively)[129]. Depression and anxiety were briefly mentioned in Vance et al.'s cross-section of American medical records[64] (N=1478) and no difference was found in prevalence of either with increasing age (40.6% of PWH aged 12-29 vs. 38.4% of ≥60s, p=0.685).

However, Emlet and colleagues' 2015 paper found that maladaptive coping strategies (methods of coping which do not impact upon the stressor, such as avoidance; measured via Brief COPE) were used less frequently with age (p<.05) in 960 PWH from Canada, and depression (CES-D) decreased with age (44.9% of<40s vs. 26.2% of >55s, p<.001). Moore et al.[79] identified a higher likelihood of affective disorders in younger than older PWH (N=302, p<.001). Torres and colleagues'[133] exploration of Brazilian medical records found an increase in prevalence of depression with age (14.3% of <40s vs. 19.3% of ≥60s, p<.001). It is unclear why these studies would have achieved results contrary to the rest of the literature. However, it is possible that Torres' results are due to geographical differences in mental health, or that, being based on medical record review, they are capturing age-related differences in diagnosis of depression. It is also possible, looking at the raw scores for each age group, that the overall increase reported in depression with age in the Brazilian population is due to the higher rates of depression reported in those aged 50-59 (23.3%) which overshadows the otherwise relatively stable rates across age groups. Why this age group is more depressed than older or younger PWH is still unclear. Emlet's results may be an artefact of the primary data collected in his study: namely data on stigma and social support. This may have biased younger adults towards more optimistic viewpoints, assuming that their levels of social support were higher than that of older adults. Finally, Moore et al.[79] did not differentiate between PWH suffering from depression or anxiety, which may explain the identification of an age difference.

In relation to sex differences within OPWH, Brennan's Canadian study on 136 older PWH measured depression via CES-D and found that women reported the highest mean scores for depression, followed by heterosexual men, (16.77(15.28) & 12.43(11.43), $p < .001$)[135]. These results reoccurred in an American study (N132)using medical records (p=0.012), which also found higher prevalence of depression in non-African American PWH (p=0.001)[143]. The GDS, however, found no difference by gender in older PWH (19.28(5.69) vs. 19.64(5.57), p=0.463)[144]. The difference in results is most likely to do with the variation in the scales used. The GDS is an age-related depression scale, which therefore focuses on measures of depression likely to occur in all older adults regardless of sex (e.g. "Is your mind as clear as it used to be?" and "Do you think it is wonderful to be alive now?"). On the other hand, the CES-D reports depressive behaviour in the past week and focuses on the clinical signs of depression (e.g. "I did not feel like eating", "I felt that everything I did was an effort") which may differ more between sexes. As such, this might suggest that adults with HIV do not differ in their ability to cope with ageing in relation to gender, but do differ in rates of clinical depression.

1.3.2.4 *Quality of Life*

Out of the six studies on quality of life (QoL), five explored differences by age[79;121;123;137;146] and one looked at sex differences in QoL in older PWH[135]. The Rand 36-item Short Form (RAND-36-SF) Health Survey was used to measure QoL in three studies[79;121;123], the EUROQOL-5D in one[21] and the HIV Assessment Tool - Quality of Life Instrument (HAT-QOL) in one[146]. No difference in QoL by age was found in three of the five studies, which are outlined below.

The HNRP group found no difference in QoL (physical (p=0.724) or mental (p=0.464)) by age or HIV status (p>.05) using the RAND-36-SF[123]. Another American study of 1,217 PWH aged above or below 50 years reported no difference in QoL by age in relation to the HAT-QOL (p=0.77)[146], as did a UK sample of 778 PWH using the EUROQOL-5D (mean=0.7 and 0.7, p=0.5)[137].

However, two other HNRP studies (2x2 factorial studies of 115 and 302 adults from San Diego respectively) found that older PWH reported worse general, physical, and mental health QoL scores on the RAND-36-SF than older HIV-negative people, younger HIV-positive, and younger HIV-negative groups (ps < .01)[121]. They also found lower SF-36 scores in PWH aged ≥50 compared to those aged ≤40 in relation to energy/fatigue (SF values=9.77 vs. 1.34, p<.01), emotional well-being (SFs=9.21 vs. 2.30, p<.01), social functioning (SFs=8.60 vs. 3.56, p<.01), and general health (SFs = 4.40 vs. 1.63, p=0.02) but not emotional role limitations (SFs=3.61 vs. 4.54, p=0.31)[79]. This occurred despite the use of the same geographical population, selection criteria and measures as the aforementioned HNRP study[123]. The primary difference between the studies is that Rodriguez-Penney et al.[123] reported a significantly larger number of ethnic minorities in the younger age group than the older, while Duarte et al.[121] and Moore et al.[79] report no such difference. It is possible, therefore, that there was a reduction in QoL with age in this population which was masked by the sociodemographic differences between age groups.

In relation to gender, women had the lowest physical health subscale scores (p < .05) in the older HIV-positive cohort when compared to men and MSM[121]. Women were also found to use avoidance coping - a method of regaining wellbeing by avoiding acknowledging the stressor e.g. stress eating - more than men (mean score=2.13(SD=.674) vs. 2.36(.724), p=0.014)[144], as assessed by the Way of Coping checklist. HrQoL, as assessed by the Medical Outcomes Study (MOS) SF-36 Health Survey in Brennan's study found that gay and bisexual men had significantly higher mean scores in the mental health–related quality of life compared to heterosexual men and women (49.05(10.76) and 49.48(9.29) vs. 42.90(15.87) & 47.72(11.96), $p = .003$)[135].

The HNRP also measured mental wellbeing and mood using the RAND 36-item Short Form Health Survey (SF-36) and Profile of Mood States (POMS). They found no significant age- or HIV-related effects on emotional well-being, role limitations or the social functioning subscales (ps > 0.05)[122]. Within older PWH, bisexual men reported lower wellbeing than other MSM, as found in 914 PWH from New York using the Ryff Scale of Psychological Well-Being ($F(12,1596) = 1.96$, $p < .024$)[139]. Bisexual men also had significantly lower scores than MSM in the "Personal Growth" domain, and significantly lower scores than both heterosexuals and homosexuals in the "Purpose in Life" domain. However, no values were given for these[139].

Many other measures of mental health and well-being were assessed by the HNRP group, but few were explored by any other researchers. They found that self-rated successful aging, emotional functioning, resilience, and feelings towards aging were lower in older PWH (p=0.005, .001, .007 and .009), stress was higher in older PWH (p=0.006) and optimism and personal mastery showed no difference (p=0.38 and .06) compared to younger PWH and HIV-negative adults[140]. Frain et al. measured self-efficacy and found no difference by age in PWH (mean = 7.83(sd=1.9) vs. 7.68(SD=2.06) p=0.9)[147] and Mavandadi found that 'Vigour' was higher in older PWH, based on results from the 37-item Profile of Mood States (POMS) (10.86(4.93) vs. 13.36(4.99), p=0.02)[148]. Brennan, looking at coping and personal mastery within older PWH, found that maladaptive coping - coping mechanisms which do not effectively mediate stress - was seen most often in heterosexual men, followed by women

(23.9(6.75) & 22.91(6.59), p<.001)[135]. Personal mastery was seen most often in MSM (20.48(3.27) vs. 19.22 (heterosexual men), 19.52 (women), p=0.006)[135].

In summary, depression prevalence does not seem to vary by age in PWH, while HrQoL may not, although reports are limited and conflicting. There is insufficient evidence to conclude upon the other measures of mental health and well-being, but it appears that older adults with HIV may have a reduced likelihood of 'ageing successfully' compared to the general ageing population. The interpretation of study results is complicated by differing use and patterns of adjustment for other factors, and the possibility that, by comparing broad age groups as done in most studies, a non-linear association between age and depression may be missed.

1.3.2.5 Social Outcomes

Social support was assessed in six studies[134;135;140;144;148;150] using five separate scales and stigma was assessed in four studies[134;135;150;151] using two scales. Despite the different measures, no studies found a difference in social support or stigma with age in people with HIV. The individual studies are presented below.

PWH from Ohio (N=101) categorised by social isolation via the Hawthorne Friendship Scale showed no significant differences in isolation by age (n=16.5(5.2) vs. 17.5(4.5), p=0.33)[150]. The HNRP study measured social interactions via the Duke Social Support Index Social Interaction sub-scale (DSSI) and found no difference by age or HIV status (p=0.51)[140]. Mavandadi compared social support via an abbreviated version of the DSSI and found no differences in social interaction (6.42(2.48) vs. 6.61(2.82), p=0.74) or instrumental (active) support (7.72(3.42) vs. 7.53(3.48), p=0.8) by age, but did find that subjective (satisfaction with) support was higher in older adults (16.42(3.24) vs. 17.87(3.2), p=0.04)[148]. No difference in social support was found by gender in 242 older PWH in regards to the Provision of Social Relations Scale (mean = 3.56(SD=.762) vs. 3.69(.774), p=1.98)[144] or in the MOS-HIV Social Support Survey (mean=66.85-72.60, p=0.26)[135].

However, again, Emlet and colleagues' 2015[134] paper differs from these results. In their Canadian sample (N=960) social support (MOS-HIV Social Support Survey) was found to increase with age in PWH (scores of 13.21 in <40s vs. 15.12 in >55s, $p<.05$). While this would aid in explaining the anomalous results relating to depression identified earlier from this study, it is unclear why social support would be higher in older adults in this population.

Using the HIV stigma scale, no difference in stigma was found by age (mean score = 24.0 (S.D.=9.0) vs. 21.3 (8.6), $p=0.14$) for 101 PWH in Ohio[150] . Using the same scale, no difference was found by age in 88 PWH from the Pacific Northwest (23.03 vs. 25.18, $p>.05$), although younger adults did score higher on the Discrimination subscales (7.82 vs. 6.04, $p<.01$)[151]. Within older PWH stigma, using the Modified HIV Stigma Scale, was lowest in MSM (mean =43.57(11.90) vs. 51.19-52.38, $p<.001$)[135]. Finally, Emlet's Canadian study[134] found no differences in 'enacted' (experienced) or 'anticipated' (internalised) stigma, but lower levels of 'internalised' stigma with increasing age (scores of 12.83 in <40s vs. 9.76 in over 50s, $p<.05$).

1.3.2.6 Limitations and risk of bias

The lack of studies and the variation in scales prevented much comparison between studies, so no meta-analysis was performed. PRISMA[119] note that studies with nonsignificant results are published less often. As such it is possible that these results are exaggerated towards a difference by age, although based on the number of non-significant results this appears unlikely. Similarly, no power calculations were given and so non-significant findings may be over-reported in the smaller studies.

Papers published from 2001 onwards were included where the data collection date was unclear to ensure that no studies occurring this century were likely to be excluded. However, papers published as late as 2007 were excluded due to data collection ending before the turn of the century. As such I cannot be sure that all these studies occurred within the 21st century.

The majority (66%) of studies compared older PWH to younger PWH rather than to HIV-negative adults, meaning that any differences found in psychosocial well-being or behaviour are likely to be due to age rather than HIV status.

America was the country of origin for 55% of studies, meaning that the majority of the data is from one geographic location. The likelihood of the US results applying to other populations is uncertain. UK data was apparent in only one study, showing comparable HrQoL in older and younger PWH[137]. Despite this concurring with US data it is unclear whether this reveals comparability in population data, due to the small number of studies and undocumented differences in demographics and sociocultural background. Furthermore, the lack of repeat studies within a UK population means that this information should only be used to direct future UK research.

1.4 Discussion

Of 390 papers reviewed, 38 (<10%) studies met the inclusion criteria. A large number (N=71) of papers on older PWH did not compare them to a control group, meaning that it was impossible to assess the effects of age, HIV-status, or other factors and they were removed from the review.

Of the studies included, the majority found no difference with age in CD4 count response to ART[64;77-79;126;128;132], but an increase in mortality rates[64;107;124;126;127;136], and higher rates of co-morbidities and prescribed medications with age and HIV status. Age differences in viral load response to ART were less conclusive. It appears likely that older PWH do achieve a comparable level of response to ART to younger adults; albeit at a slower rate. It also seems likely that the increased mortality rates with age are related to the increased number of co-morbidities found in older adults. However, it would be remiss to conclude with certainty that the increased mortality and physical illness is solely due to increased age as several studies reported an increase in illness in relation to age-matched HIV-negative controls as well as younger PWH. Therefore it is possible that an accumulation of HIV- and age-related physical insults likely interact to increase the likelihood of illness and mortality in older PWH. It is also worth noting that no studies reported the levels of distress physical illness caused, so it is unclear how much of an impact physical symptoms may have on the wellbeing of older and younger PWH.

Overall, no difference was found by age in rates of depression[64;120;129;138;145-148] or HrQoL[123;137;146], but there were too few studies on anxiety to form a conclusion and it is worth noting that, with the exception of depression, differences in the results were apparent. It appears likely that older PWH are not more at risk of depression than younger PWH, although three studies (30%) did find an increase with age. As such, I feel that it is important to note that, while alternative explanations for the results of these studies were found, their methodology was as reliable as that of the seven other depression studies and they should not be excluded from consideration. Similarly, I have claimed that 'overall' no difference in HrQoL was found with age, despite the fact that two of five papers (40%) reported worse HrQoL in older PWH than younger PWH. I can only suggest the likelihood of age-related differences based on the available data but it is possible that, should more information become available, older PWH may appear to have worse, or comparative, QoL. Therefore I would strongly suggest against ruling HrQoL (and to a far lesser extent depression) out of further research into the effects of age on wellbeing in adults with HIV.

Social isolation[135;140;150] and stigma[134;150;151] generally showed no difference by age, although few studies explored these factors. Similarly, very little focus was given to the potential positive effects of ageing, or factors which protect against the negative effects discussed so far. Such positive effects could include resilience and hardiness which are thought to be related to 'successful ageing'; the ability to maintain mental health despite age-related health losses[152]. A relatively small study (N=83) by Moore et al.[140] found that people with HIV reported lower self-rated successful ageing, resilience, happiness and feelings towards ageing along with higher rates of depression, anxiety and stress compared to HIV-negative adults[40]. This suggests that HIV has a negative effect on ageing and the ability to age 'successfully'. However, no similar studies were identified and so the results are not conclusive. Based on the identified contrasts in physical and mental health reported, 'successful ageing' appears possible in an HIV positive population and warrants further study.

Disclosure was lower in older PWH[93], as was knowledge of HIV transmission[153] although the lack of studies in these areas makes the results unclear. As disclosure is related to transmission risk and likelihood of accessing informal care this seems to be an important factor to expand upon further both in relation to assessing wellbeing and risk in relation to age.

In conclusion, this systematic review identified the small amount of research available on the association of age with biopsychosocial wellbeing of PWH, in particular in relation to UK data. Clearly, any result which could increase the size of the pool of knowledge would be beneficial but in particular anxiety, positive psychology and HrQoL require further investigation, as do disclosure rates and social support. CD4 count appears to be well-researched and, promisingly, shows little difference by age in PWH regularly taking cART medication. However, mortality and comorbidity rates still increased with age. As such, CD4 count appears not to be an encompassing measure of physical well-being, especially in populations where high adherence is common. Furthermore, no studies reported data on the distress caused by ill physical health, meaning that it is unclear whether HIV affects the well-being of older and younger adults in the same way. As described in chapter 1, section 1.2.2 and 1.2.3, this thesis will explore possible differences between older and younger PWH in the UK in relation to physical, mental, and social health in detail to improve the overall knowledge in this area.

2 The ASTRA study - Methodology

The ASTRA study is a multi-centre cross-sectional questionnaire study which was designed to assess sexual risk behaviours, beliefs about HIV transmission risk, and attitudes to use of early antiretroviral treatment in PWH in the UK. The methods of the study have been described in a published report[118] but are presented here with particular focus on aspects relevant to this thesis.

ASTRA recruited 3,258 HIV-diagnosed individuals from eight HIV out-participant clinics in the UK between February 2011 and December 2012. The clinics included were: Royal Sussex County Hospital, Brighton, Eastbourne Sexual Health Clinic, Homerton University Hospital, London, Mortimer Market Clinic, London, Newham University Hospital, London, North Manchester General Hospital, Royal Free Hospital, London and Whipps Cross University Hospital, London. The sample size was based on a calculation (80% power, 5% two-sided significance level) powered to detect the 4% expected difference in the prevalence of high risk sexual behaviour between patients on ART and not on ART.

All clinic participants were eligible assuming that they fulfilled the following inclusion criteria: participants must be a) over 18 years of age, b) have sufficient English or French to be able to understand the questionnaire (which was available in both languages) and c) not be too ill or distressed to participate, as indicated by clinic staff. During the study period, 5,112 eligible participants were invited to take part in the study of which 3,258 completed the questionnaire, a response rate of 64%.

Participants completed the self-administered pen-and-paper questionnaire on a range of demographic, health, and lifestyle issues. They were encouraged to complete the questionnaire at the clinic, but pre-paid envelopes were provided for participants who wanted to take the questionnaire away to complete[118]. In addition, the clinic-recorded viral load and

CD4 count (latest value at the time of the questionnaire that had been communicated to the participant) were documented for all participants.

2.1 Ethical considerations

NHS Ethical approval was obtained for this study (REC reference number: 10/H0720/70).

Patients who were invited to participate were given an information sheet about the study and were asked to sign a consent form. The information sheet recognised that the questionnaire included personal questions on sexual lifestyle and suggested that if the questionnaire raised any issues or concerns for the participant they could ask the nurse to arrange a meeting with an appropriate professional, for example the clinic HIV counsellor. It also specified that participants were free to withdraw consent for the study at any time, including after completing the questionnaire, and that this would not affect their standard of care. A second, optional, consent form was also given to participants to request linkage of their questionnaire responses with routine clinic data.

Private areas in the clinic were made available for completion of questionnaires, if preferred by participants. The questionnaires themselves contained a study number and no identifying personal information. Participants were able to place their completed paper questionnaires in a sealed envelope in a box in the clinic and were informed that their questionnaire responses would not be seen by clinical staff or recorded in their clinical notes. All information was treated as confidential and the study database was held securely in the research department (HIV Biostatistics and Epidemiology Group, Research Department of Infection and Public Health, Royal Free Campus) on encrypted PC and laptop drives. Paper forms (including questionaires and copies of the study log) were stored in locked cabinets within the department.

2.2 Symptom measures

The primary aim of this research was to explore age-related differences in physical, mental, and social health. As such, the participants were grouped according to their age into: <30, 30-39, 40-49, 50-59 or ≥60 years of age. Age groups were used to allow the exploration of non-linear age differences. However, age as a continuous variable was also used in some analyses. Time with diagnosed HIV was defined based on self-reported month and year of HIV diagnosis and categorised as follows: <2 years diagnosed with HIV, 2-5 years, 5-10 years, 10-20 years and >20 years. The associations of these age and time-related groups with measures of biopsychosocial symptom prevalence were then assessed.

The relationships between physical, psychological, and social symptom measures were also calculated. This was done overall and by age- and 'time diagnosed with HIV'- interactions to identify any age or 'ageing'-related changes in relationship strength.

In relation to the analysis included here, these symptom measures can be divided into physical ability and symptoms measures, mental distress, and social factors. These were used to identify biopsychosocial factors which may be in need of intervention in the UK HIV-positive population, as well as age-related differences in these factors. The symptom measures included are listed below, and in their associated chapters (Chapters 3-5).

2.2.1 Physical ability and symptom measures

In relation to physical ability and symptom measures, age- and time-related differences in symptom prevalence, symptom-related distress and difficulty with activities of daily living (ADLs) were explored. For the purpose of logistic regression analysis these were categorised as binary variables.

2.2.1.1 *Physical symptoms*

Symptom prevalence was assessed using a modified version of the MSAF-SF[154], a 32 item, 5-point Likert scale. This scale asks participants to report whether or not they have had any of the 32 symptoms in the past two weeks and, if so, whether it caused them distress. Response options were: 'No did not have symptom', 'Yes, had symptom but it did not bother me', 'Yes, had symptom and was bothered/distressed a little bit', 'Yes, had symptom and was bothered/distressed quite a bit' or 'Yes, had symptom and was bothered/distresses very much'. For the purpose of this analysis, the "psychologic symptom subscale" was removed: four questions on 'feeling sad', 'worrying', 'feeling irritable' and 'feeling nervous'. This was due inclusion of other 'psychological symptom distress' inventories and concern about overlap between the scales. The symptoms 'I don't look like myself', 'changes in skin', 'problems with urination', 'itching', 'difficulty swallowing', 'hair loss', and 'swelling of arms/legs' were also removed and replaced with the more HIV-specific symptoms: 'Trouble remembering things', 'Headache', 'Muscle aches or joint pains', 'Skin problems (e.g. rash, itching, dryness)', and 'Changes in fat in face or body'. This resulted in 26 symptoms which are listed in *Table 5, chapter 3, section 3.3.2.* Several symptom subgroups were also considered (*Table 5*), where symptoms of similar prevalence and type were combined. Symptom prevalence was then indicated by participants reporting 'yes' to the presence of an individual symptom in the past two weeks. This was explored in relation to the number of symptoms present and the presence of specific symptoms of interest (identified through high prevalence or distress scores). An overall symptom prevalence measure was also created of participants identifying ten or more symptoms as being present. Where symptoms were grouped into specific sub-categories, the group was analysed as 'present' if participants reported at least one of the symptoms in that category.

Symptom distress was analysed using the same modified scale. A symptom was considered distressing if participants reporting that the symptom 'bothered/distressed quite a bit' or 'very much'. Identical to symptom prevalence, 'overall symptom distress' was also developed as a variable, wherein participants reported at least one symptom as distressing, symptom distress for sub-categories of symptoms, and number of distressing symptoms. While a low cut-off point, the presence of one symptom was chosen to indicate ‘overall distress’ as experiencing even one symptom as 'quite a bit' or 'very much' distressing was considered to have a significant impact on participant well-being.

2.2.1.2 Difficulties with activities of daily living (ADLs)

Finally, difficulty with ADLs were identified using the EQ-5D[155], a five-item, three-point Likert scale. This scale asks participants to report their 'status of health today' in relation to Mobility, Self-care, 'Usual activities (e.g. work, study, housework, family or leisure activities)', Pain/discomfort and Anxiety/depression. Participants could report 1) no problems, 2) some problems or 3) being unable to perform each activity. For the purpose of this analysis the last two questions were discarded, as they overlapped with other measures, and difficulty with ADLs was assessed through the problems with mobility, self-care of usual activities. The three ADL domains were divided into participants having no problems compared to those showing some problems or being unable to perform each activity. This was assessed by individual domain and as an overall measure, where participants were classified as having ADL problems if reported issues with at least one of the three activities.

2.2.2 **Psychological distress**

Psychological distress was explored using questionnaire-assessed measures of depression and anxiety. Specifically, depression and anxiety were measured according to self-reported symptoms, using the PHQ-9[156] and GAD-7 scales[157]. Both of these scales are validated diagnostic instruments for measuring the prevalence and severity of mental health issues and based on the DSM-IV criteria for depression[156] and generalised anxiety disorder (GAD)[157].

For both scales participants were asked to respond to the question "Over the past 2 weeks, how often have you been bothered by any of the following problems?". Participants could respond with 'not at all', 'several days', 'more than half the days' or 'nearly every day' to each of the symptoms. These responses were scored from 0-3 respectively and summated to create a score which can be used to measure the participant's diagnostic group for depression and GAD. Specifically, in the PHQ-9, there is a potential maximum total score of 27 (9 items). A score if 0-4 is indicative of no depression, 5-9 of mild depression, 10-14 of moderate depression, 15-19 of moderately severe depression and 20-27 of severe depression. In the GAD-7, there is a potential maximum score of 21 (7 items): a score of 0-4 is indicative of a no GAD, 5-9 of mild GAD, 10-14 of moderate GAD and 15-21 of severe GAD.

For the purpose of this analysis the standard score-based definitions of depression and anxiety was used, defined by a score ≥10 in each case. In addition, for individual symptoms, those reporting the symptom for 'more than half the days' or 'nearly every day' were compared to those reporting the symptom 'not at all' or for 'several days' in the past two weeks. These comparisons were used to allow us to identify participants in significant distress, in comparison to those showing no - or mild - distress. This method was considered to be more clinically useful than the use of continuous scales.

2.2.3 **Social factors**

Finally, the social factors explored involved measures of social support, relationship status, partner's HIV status, disclosure of HIV status, and employment and financial status.

2.2.3.1 Social support

Social support was quantified using the modified Duke–UNC FSSQ scale[158], a five point Likert scale including five measures of social support. Participants were asked to report the level of support closest to their own situation, from 'as much as I would like' to 'much less than I would like' in response to: 'I have people who care what happens to me', 'I get love and affection', 'I get chances to talk to someone I trust about my personal problems', 'I get invitations to go out and do things with other people', and 'I get help when I am sick in bed'. For the purpose of this analysis social support was classified as 'sufficient' if participants scored ≥20 on the scale, which correlated with average responses of 'almost as much as I would like' on all five measures or 'as much as I would like' on four measures. Scores under 20 (correlating with responses of 'some, but I would like more', 'less than I would like' or 'much less than I would like' on all five measures) were classified as 'insufficient' social support. Answers to each individual social support question was also assessed, where social support was considered to be present if participants reported having 'almost as much as I would like' or 'as much as I would like' in response to the individual question.

2.2.3.2 Relationship status and disclosure of HIV status

Relationship status was divided into those in an on-going relationship (living, or not living with partner) or not as assessed by the question "Are you currently in an ongoing relationship with a partner (wife/husband or civil partner or girlfriend/boyfriend)?". Length of relationship was divided into ≥10 years or less than ten years and partner's HIV status was analysed as 'HIV positive/HIV-negative or unknown. Participants were also asked to report whether or not they had children, which was categorised as 'yes' or 'no'.

Disclosure was assessed as a combined measure, defined as responding 'yes' or 'no' to the question "Apart from health care staff, have you told anyone that you have HIV?", and additionally by self-report of disclosing HIV status to 'some' or 'most or all' of each individual social group (partner, family, friends, and colleagues).

2.2.3.3 Employment status

Finally, employment status was categorised as 'employed', 'unemployed', 'sick/disabled', or 'retired'. 'Money for basic needs' was assessed as a binary variable based on the question "Do you have enough money to cover your basic needs? (e.g. food, heating)". This was categorised as ‘always having money for basic needs' or not.

2.2.4 **Demographic variables**

Demographic variables were based on self-report. Participants were asked their date of birth (month, year) and when they first found out that they were HIV positive (month, year), which was used to calculate time diagnosed with HIV. They were asked to identify the ethnic group that best described them from a standardised list and whether they were both in the UK (yes/no). Participants were also asked to identify any religion that they belonged to, their work status (employed full/part-time, in education, unemployed registered/not registered for benefits, sick disabled for ≥3 months, sick/disabled for <3 months, look after home/family/dependents, retired or other) and their housing status (own, renting from council/housing association, renting from private landlord, temporary accommodation, staying with partner/friend/family, homeless or 'other'), their highest level of education (no qualifications, O levels/GCSEs, A levels or equivalent, university degree or higher or other) and whether they had enough money to cover their basic needs (all of the time, most of the time, some of the time or never).

Gender was identified at participant recruitment and participants were given a gender-specific booklet. Within the booklet they were asked to describe their sexuality as 'gay/homosexual', 'straight/heterosexual', 'bisexual', or 'other'. Using this data the participants were divided into women, heterosexual men, and men who have sex with men (MSM: homosexual or bisexual men).

2.2.5 **Health and lifestyle factors**

Participants were asked whether they were currently on ART, which was corroborated using clinic data where permission was given. Participants were also asked their most likely form of HIV acquisition from sex with a man, sex with a woman, shared needles, blood transfusion, needle stick or exposure at work, born with HIV infection, unknown, or other. CD4 count and viral load were measured via clinic recorded values at the most recent test. For the purpose of the analysis participants reporting a CD4 count of above or below 350 cells/mm^3, and a viral load above or below 50 copies/mL were compared.

In relation to lifestyle factors, participants self-reported whether they were current, ex, or never-smokers, whether they had used recreational drugs in the past three months (and which drugs they had used), and completed the CAGE questionnaire[159] on alcohol dependency.

2.2.6 **Missing data**

Missing values for individual questions on symptom questionnaires were counted as the absence of symptoms. For example, a participant who skipped answering the PHQ-9 would be categorised as having a PHQ-9 score of zero and not having depression. Results mentioned here can be treated as minimal estimates of symptom prevalence.

2.3 Statistical analysis

In this section the main analyses methods used in the subsequent three results chapters of the thesis are described. Additional analyses specific to individual chapters are described in the relevant chapter. Categorical variables are summarised by proportions; continuous variables are summarised by means and standard deviations. Differences in participant characteristics by age group were assessed using chi-squared tests for trend. The prevalence of demographic variables was calculated overall and according to age group and time diagnosed with HIV group.

Logistic regression was used to assess the association between age group, time with diagnosed HIV, and each of the well-being measures (dependent variables) used in the following chapters. These calculations were adjusted for demographic factors, where the causal direction of association was clear. Namely, they were adjusted for gender/sexuality (MSM; heterosexual man; woman) and ethnicity (white/non-white). Results are presented as adjusted odds ratios with 95% confidence intervals (CIs). Significance was assessed using the likelihood ratio statistic. Tests for trend in age and time with diagnosed HIV were assessed using the respective variables as ordinal variables in the model, rather than defining them as categorical.

The associations between physical, mental, and social factors of well-being were also assessed using chi squares tests for trend and logistic regression analysis, adjusted for gender/sexuality (MSM; heterosexual man; woman) and ethnicity (white/non-white). Interaction tests were used to assess whether the associations between mental (depression and anxiety), physical (symptom prevalence, distress, problems with ADLs) and social (social support, partner and parental status, disclosure, employment, money for basic needs) differed according to a) age group and b) time with diagnosed HIV group as a grouped variables in a continuous form (Chapters 4 and 5).

2.4 Subject characteristics

2.4.1 Geographic distributions

Most participants were recruited from Mortimer Market Clinic (N=907, 27.8%), the Royal Free (N=899, 27.6%) and Brighton (N=523, 16.1%) clinics. Of the rest, 355 (10.9%) were recruited from North Manchester, 269 (8.3%) from Homerton, 179 (5.5%) from Newham, 65 (2.0%) from Whipps Cross and 61 (1.9%) from Eastbourne clinics.

2.4.2 Demographic variables

The mean age was 45 years (SD=9.6, range 18-88 years). By age, 173 (5.4%) participants were aged <30 years, 740 (23.3%) were aged 30-40, 1364 (42.9%) were aged 40-50, 686 (21.6%) were aged 50-60 and 215 (6.8%) were aged 60 and over years. By time diagnosed with HIV, 410 (12.6%) participants had been diagnosed with HIV for 0-2 years, 498 (15.3%) for 2-5 years, 878 (26.9%) for 5-10 years, 1130 (34.7%) for 10-20 years and 342 (10.5%) for more than 20 years.

The majority (N=2248, 69.0%) of participants were MSM, 373 (11.4%) were heterosexual men and 637 (19.6%) were women. 1751 (53.7%) were born in the UK. For the non-UK born participants, 614 (18.8%) were black African, 99 (3.0%) were black Caribbean, 26 (0.8%) were black other, 160 (4.9%) were Indian/Pakistani/Bangladeshi/Asian other, 133 (4.1%) were of mixed race, 13 (0.4%) were Chinese and 29 (0.9%) were 'other' ethnicity. Overall, 2310 (70.9%) were British citizens, 402 (12.3%) were EU citizens, 294 (9.0%) had 'indefinite leave to remain' in the UK, 72 (2.2%) had 'exceptional leave to remain' in the UK, 40 (1.2%) were refugees, 20 (0.6%) had a UK student visa, 18 (0.6%) a work permit, 20 (0.6%) had no immigration papers to be in the UK and 29 (0.9%) reported 'other' immigration status.

The participants mainly reported having no religion (N=1418, 43.5%) or Christianity (N=1527, 46.9%), but 85 (2.6%) were Islamic/Muslim, 67 (2.1%) were Buddhist, 36 (1.1%) were Jewish, 12 (0.4%) Hindu, 1 was Sikh and 84 (2.6%) reported 'other' religion.

371 (11.4%) of the sample had no academic qualifications, 716 (22.0%) had GCSE/O-levels, 632 (19.4%) had A level qualifications, 1317 (40.4%) had university level or above qualifications and 136 (4.2%) had ‘other’. 1821 (55.9%) were employed, 577 (17.7%) unemployed, 420 (12.9%) were not working due to sickness/disability, 192 (5.9%) were retired and 164 (5.0%)reported 'other' work status. 1083 (33.2%) owned their home, 971 (29.8%) rented council or housing association houses, 786 (24.1%) rented from private landlords, 248 (7.6%) were staying with family/partner/friends, 59 (1.8%) were in temporary accommodation and 35 (1.1%) were homeless. 1392 (43.6%) of participants always had money for basic needs, 836 (26.2%) mostly had money for basic needs, 565 (17.7%) 'sometimes' had money and 400 (12.5%) never had enough money for basic needs (e.g. food, heating).

2.4.3 **HIV, health and lifestyle-related factors**

The majority of participants were currently on ART (N=2771, 86.5%), had a CD4 count of 500 cells/mm^3 or above (N=1836, 57.1%) and an 'undetectable' viral load (lower than 50 copies/mL; N=2439, 75.9%). Of those who had never taken antiretroviral treatment, 406 (55.2%) had been advised to start by their HIV doctor. Sex with a man was the most likely form of HIV acquisition (N=2517, 77.3%), followed by 233 participants who reported transmission route as 'having sex with a woman' (7.2%), 67 from blood products (2.1%), 60 from IVDU (1.8%), 26 from occupational needle stick (0.8%), four from vertical transmission (0.1%) and 310 (9.5%) from unknown causes.

In regards to risk factors, 1011 (31.5%) participants were current smokers, 938 (29.2%) were ex-smokers and 1264 (39.3%) had never smoked. Evidence of alcohol dependency was apparent in 571 (17.7%) participants (based on CAGE questionnaire[159] scores) and 1242 (38.1%) reported recreational drug use in the past three months. Of these, 607(18.6%) reported using amyl nitrate, 549(16.9%) used cannabis, 475(14.6%) used cocaine, 459(14.1%) used Viagra, 280 (8.6%) used Ketamine, 263(8.1%) ecstasy, 220(6.8%) liquid ecstasy, 175(5.4%) Meth-amphetamines, 163 (5%) Mephedrone, 80(2.5%) Amphetamine, 61(1.9%) Anabolic steroids, 44(1.4%) Acid/LSD/magic mushrooms, 45(1.4%) Codeine, 27(0.8%) crack, 17(0.5%) heroin, 14 (0.4%) khat, 10 (0.3%) morphine, 5(0.2%) opium and 38(1.2%) other drugs. Intravenous drug use was reported by 74 (2.3%) participants.

2.4.4 **Age-related demographic differences**

Using chi-squared, demographic differences by age group were assessed. In terms of ethnicity, the proportion of participants who were Caucasian increased with age (58.4% of under 30s to 77.2% of participants aged 60 and over), as did the proportion born in the UK (50.9% to 64.7% respectively). In terms of gender/sexuality, the proportion of participants who were MSM and the proportion who were heterosexual men increased with age (63.6 to 71.6% from <30 to 60 or over for MSM and 5.2-17.2% respectively for heterosexual men), while the proportion of women decreased with older age (31.2-11.2%). The proportion of participants who identified as Christian also increased with age (44.5 - 52.6%).

Levels of education were highest in the 30-40s age group and lowest in the >60s (15.6% vs. 23.3% respectively with no qualifications). Employment was highest in the 30-40s age group, while the proportion who were unemployment stayed relatively stable from age <30 to 50-60 (17.4 to 20.8%). Being unable to work due to sickness/disability increased with age between the same ages (5.2% to 20.1%) and retirement was highest in those ≥60. Participants aged ≥60 also reported lower levels of employment, unemployment and sickness/disability than those aged 50-60. Being a homeowner increased with age (7.5 to 57.7%) and odds of renting or being in temporary accommodation decreased (48.6 to 8.8% and 25.4% to 9.1% respectively). Non-private rented housing status was highest in those aged 40-50 (35.7%) and homelessness stayed low across all age groups (0.7 to 1.8%). Always having money for basic needs increased with age (30.8 to 55.2%).

The percentage of participants on ART increased with age (from 61.2% of those aged <30 to 98.8% of those aged 60 and over) and, of those not on ART, those who had been advised to start by their doctor decreased (16.2 - 8.8%). Adherence (participants reporting ≥95% adherence to ART) rates among participants who were on ART were high across participants, but increased with age (83.8 - 91.8%). There was no overall difference in CD4 count with age – CD4 count stayed relatively stable at a rate of 75.9-83.0%. However, the odds of having an undetectable viral load increased with age, from a rate of 48.8% of participants aged <30 years to 88.7% of those aged 60 and over.

Being a current smoker decreased with age (29.1 - 18.7%), as did being a non-smoker (45.0 - 37.4%) while being an ex-smoker increased (16.0 - 43.9%). Evidence of alcohol dependence according to CAGE questionnaire was lowest in those aged 60 and over (11.7%) and highest in those aged 30-40 (19.8%) while recreational drug use and IVDU decreased with age (46.2 - 21.9% and 5.8 - 0.9% respectively). These differences are reported in *table 3* below.

Table 3. **The demographic and health-related risk factors of the ASTRA population by age (N & percentage of age group).**

Characteristic	<30 years	30-40	40-50	50-60	>60	*Overall*
Years since diagnosis						
0-2	59 (34.1%)	124 (16.8%)	135 (9.9%)	62 (9.0%)	20 (9.3%)	*p<.0001*
2-5	55 (31.8%)	185 (25.0%)	171 (12.5%)	53 (7.7%)	19 (8.8%)	
5-10	50 (28.9%)	257 (34.7%)	355 (26.0%)	146 (21.3%)	42 (19.5%)	
10-20	4 (2.3%)	166 (22.4%)	561 (41.1%)	290 (42.3%)	84 (39.1%)	
20+	5 (2.9%)	8 (1.1%)	142 (10.4%)	135 (19.7%)	50 (23.3%)	
Gender/Sexuality						
MSM	110 (63.6%)	502 (67.8%)	946 (69.4%)	509 (74.2%)	154 (71.6%)	*p<.0001*
Het. Male	9 (5.2)	64 (8.6%)	164 (12.0%)	86 (12.5%)	37 (17.2%)	
Female	54 (31.2%)	174 (23.5%)	254 (18.6%)	91 (13.3%)	24 (11.2%)	
Religion						
None	76 (43.9%)	342 (46.2%)	617 (45.2%)	311 (45.3%)	80 (37.2%)	*p<.0001*
Christian	77 (44.5%)	327 (44.2%)	629 (46.1%)	328 (47.8%)	113 (52.6%)	
Other	20 (11.6%)	71 (9.6%)	118 (8.7%)	47 (6.9%)	22 (10.2%)	
Ethnicity						
Born in the UK	88 (50.9%)	317 (42.8%)	761 (55.8%)	430 (62.7%)	139 (64.7%)	*p<.0001*
Caucasian	101 (58.4%)	472 (63.8%)	931 (68.3%)	531 (77.4%)	166 (77.2%)	
Black African	34 (19.7%)	160 (21.6%)	279 (20.5%)	86 (12.5%)	22 (10.2%)	
Black Other	14 (8.1%)	30 (4.1%)	45 (3.3%)	25 (3.6%)	5 (2.3%)	
Other	24 (13.8%)	78 (10.5%)	109 (7.9%)	44 (6.5%)	22 (10.3%)	
Work status						
Employed	103 (59.5%)	503 (68.0%)	816 (59.8%)	324 (47.2%)	41 (19.1%)	*p<.0001*
Unemployed	36 (20.8%)	129 (17.4%)	253 (18.5%)	130 (19.0%)	15 (7.0%)	
Sick/disabled	9 (5.2%)	50 (6.8%)	193 (14.1%)	138 (20.1%)	25 (11.6%)	
Retired	0 (0.0%)	1 (0.1%)	13 (1.0%)	53 (7.7%)	125 (58.1%)	
Housing status						
Home owner	13 (7.5%)	169 (22.8%)	444 (32.6%)	318 (46.4%)	124 (57.7%)	*p<.0001*
Renting	84 (48.6%)	288 (28.9%)	293 (21.5%)	88 (12.8%)	19 (8.8%)	
Temporary	44 (25.4%)	91 (12.3%)	110 (8.1%)	36 (5.2%)	19 (9.1%)	
Non-private rented housing	28 (16.2%)	164 (22.2%)	487 (35.7%)	220 (32.1%)	45 (20.9%)	
Homeless	3 (1.7%)	13 (1.8%)	9 (0.7%)	7 (1.0%)	2 (0.9%)	
Highest education level						
University or above	61 (35.3%)	329 (44.5%)	553 (40.5%)	276 (40.2%)	73 (34.0%)	*p<.0001*
A levels	44 (25.4%)	149 (20.1%)	254 (18.6%)	129 (18.8%)	40 (18.6%)	
GCSE/O-level	32 (18.5%)	144 (19.5%)	351 (25.7%)	141 (20.6%)	36 (16.7%)	
None	27 (15.6%)	61 (8.2%)	129 (9.5%)	98 (14.3%)	50 (23.3%)	
Money for basic needs						
Always	146 (84.9%)	634 (87.1%)	1192 (88.4%)	576 (85.7%)	197 (93.8%)	*p<.0001*
Never	26 (15.1%)	94 (12.9%)	156 (11.6%)	96 (14.3%)	13 (6.2%)	

p values by chi-squared test and chi-squared test for trend

***Table 3 cont*. The demographic and health-related risk factors of the ASTRA population by age (N & percentage of age group).**

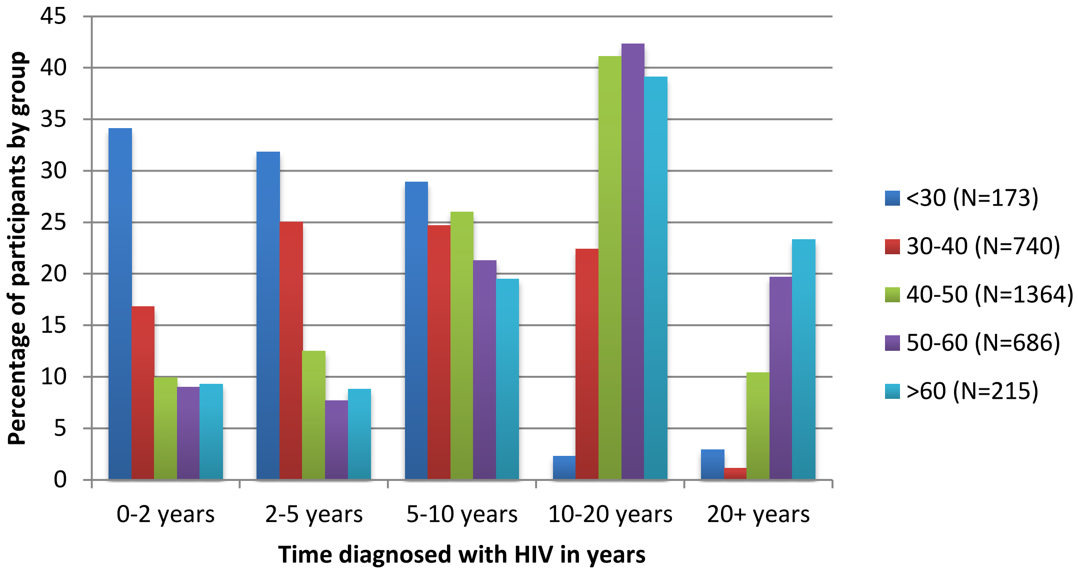
Characteristic	0-2 years	2-5 years	5-10 years	10-20 years	>20 years	*Overall*
ART status						
Currently on ART	104 (61.2%)	565 (77.8%)	1200 (89.0%)	638 (94.7%)	198 (98.8%)	*p<.0001*
Advised to start ART	28 (16.2%)	108 (14.6%)	172 (12.6%)	66 (9.6%)	19 (8.8%)	
CD4 count						
>350 cells/mm^3	129 (75.9%)	591 (81.0%)	1117 (83.0%)	549 (80.6%)	172 (80.8%)	*P=0.22*
<350 cells/mm^3	41 (24.1%)	139 (19.0%)	229 (17.0%)	132 (19.4%)	41 (19.2%)	
Viral load						
Detectable (>50 copies/mL)	87 (51.2%)	253 (24.8%)	297 (22.1%)	96 (14.1%)	24 (11.3%)	*p<.0001*
Undetectable (<50 copies)	83 (48.8%)	474 (65.2%)	1047 (77.9%)	585 (85.9%)	189 (88.7%)	
Adherence ≥95% among those on ART	88 (83.8%)	497 (87.8%)	1042 (87.1%)	580 (91.2%)	178 (91.8%)	*p=0.02*
Smoking status						
Current	66 (39.1%)	257 (35.4%)	435 (32.2%)	197 (29.1%)	40 (18.7%)	*p<.0001*
Ex-smoker	27 (16.0%)	173 (23.8%)	400 (29.6%)	232 (34.3%)	94 (43.9%)	
Non-smoker	76 (45.0%)	296 (40.8%)	516 (38.2%)	248 (36.6%)	80 (37.4%)	
Alcohol dependence	27 (15.9%)	144 (19.8%)	262 (19.3%)	107 (15.8%)	25 (11.7%)	*p=0.02*
Recreational drug use	80 (46.2%)	330 (44.6%)	536 (39.3%)	232 (33.8%)	47 (21.9%)	*p<.0001*
IVDU	10 (5.8%)	18 (2.4%)	33 (2.4%)	10 (1.5%)	2 (0.9%)	*p=0.01*

p values by chi-squared test and chi-squared test for trend

2.4.5 Time with diagnosed HIV-related demographic differences

Demographic differences by time with diagnosed HIV were also assessed. Unsurprisingly, as age increased so did time with diagnosed HIV (p<.001). As shown in *figure 5* below, adults under the age of 30 had primarily been diagnosed for less than ten years. Those aged 30-40 had been diagnosed with HIV for primarily between 2-20 years, with relatively stable percentages across these time groups. Participants aged 40 and over all showed the same pattern of time diagnosed with HIV; an increase in the percentage of participants in each group, peaking at 10-20 years (39.1-42.3%).

Figure 5. **Time with diagnosed HIV by age group.**



In terms of ethnicity, the proportion of White participants increased with time with diagnosed HIV (62.9% of participants diagnosed for 0-2 years vs. 82.5% diagnosed for over 20 years), as did the number of participants born in the UK (46.6 – 62.6%). In regards to gender/sexuality, MSM were more likely to have had HIV for a longer time (63.4% of participants diagnosed for 0-2 years – 81.9% of participants diagnosed for >20 years) and heterosexual men and women were more likely to be new to HIV (15.6 – 6.1% and 21.0 – 12.0% respectively). The number of non-religious participants also increased with time with diagnosed HIV (41.2 – 51.5%).

Levels of education were highest in participants diagnosed for 2-5 years (47.0% university educated) and lowest in those diagnosed for over 20 years (17.2% with no qualifications). The proportion of people who were employed was also highest in participants diagnosed for 2-5 years (67.8%) and decreased with time with diagnosed HIV to 35.4% of people diagnosed for over 20 years. Unemployment stayed relatively stable across categories of time with diagnosed HIV (19.0 – 19.6%) but not working due to sick/disabled increased with time with diagnosed with HIV (6.3 – 26.3%) as did retirement (3.4 – 13.2%). Being a homeowner increased with time with diagnosed HIV (30.5 – 40.1%) and odds of renting decreased (33.9 – 11.1%). Non-private rented housing status, however, was highest in those diagnosed for 10 or more years

(40.8 and 40.4%) and homelessness stayed low across all groups (0.3 – 0.6%). Always having money for basic needs increased with time with diagnosed HIV (85.4 – 90.4%).

The percentage of participants on ART increased with time with diagnosed HIV (57.6 – 96.4%) and, of those not on ART, those who had been advised to start by their doctor decreased (15.4 – 10.2%). However, adherence to ART decreased with time diagnosed with HIV (92.1 – 81.7%). %). CD4 count increased with increasing time with diagnosed HIV from 63.0% - 87.4%, up until >20 years, where it declined slightly to 81.8% prevalence. The odds of having an undetectable viral load also increased with time diagnosed with HIV, from a rate of 39.6% of participants diagnosed for less than two years to 85.6% of those diagnosed for twenty or more years.

The prevalence of current smoking was highest in those diagnosed for over 20 years (37.1% current smokers) and lowest in those diagnosed for 10-20 years (35.6% current smokers), while prevalence of ex-smoking increased with time (24.8 – 36.5%). Evidence of alcohol dependence remained stable across time diagnosed with HIV categories (18.8 – 17.9%), as did recreational (39.8 – 37.4%) and intravenous (2.9 – 2.0%) drug use. These differences are reported in *table 4* below.

Table 4. **The demographic and health-related risk factors of the ASTRA population by time with diagnosed HIV (N & percentage of age group).**

Characteristic	0-2 years	2-5 years	5-10 years	10-20 years	>20 years	*Overall*
Gender/Sexuality						
MSM	260 (63.4%)	335 (67.3%)	548 (62.4%)	825 (73.0%)	280 (81.9%)	*p<.0001*
Het. Male	64 (15.6%)	65 (13.1%)	105 (12.0%)	118 (10.4%)	21 (6.1%)	
Female	86 (21.0%)	98 (19.7%)	225 (25.6%)	187 (16.5%)	41 (12.0%)	
Religion						
None	169 (41.2%)	214 (43.0%)	361 (41.1%)	526 (46.5%)	176 (51.5%)	*p=0.02*
Christian	198 (48.2%)	244 (49.0%)	442 (50.3%)	507 (44.9%)	136 (39.8%)	
Other	43 (10.5%)	40 (8.0%)	75 (8.5%)	97 (8.6%)	30 (8.8%)	
Ethnicity						
Born in the UK	191 (46.6%)	217 (43.6%)	422 (48.1%)	611 (54.1%)	214 (62.6%)	*p<.0001*
Caucasian	258 (62.9%)	319 (64.1%)	544 (62.0%)	817 (72.3%)	282 (82.5%)	
Black African	89 (21.7%)	103 (20.7%)	219 (24.9%)	181 (16.0%)	22 (6.4%)	
Black Other	21 (5.1%)	22 (4.4%)	38 (4.3%)	34 (3.0%)	10 (2.9%)	
Other	36 (8.8%)	47 (9.4%)	54 (6.2%)	71 (6.3%)	18 (5.3%)	
Work status						
Employed	264 (64.4%)	338 (67.8%)	521 (59.4%)	577 (51.1%)	121 (35.4%)	*p<.0001*
Unemployed	78 (19.0%)	84 (16.8%)	152 (17.3%)	196 (17.3%)	67 (19.6%)	
Sick/disabled	26 (6.3%)	23 (4.6%)	80 (9.1%)	197 (17.4%)	90 (26.3%)	
Retired	14 (3.4%)	18 (3.6%)	33 (3.8%)	82 (7.3%)	45 (13.2%)	
Housing status						
Home owner	125 (30.5%)	157 (31.5%)	262 (29.8%)	402 (35.6%)	137 (40.1%)	*p<.0001*
Renting	139 (33.9%)	187 (37.6%)	244 (27.8%)	178 (15.8%)	38 (11.1%)	
Temporary	11 (2.7%)	11 (2.2%)	30 (3.4%)	5 (0.4%)	2 (0.6%)	
Non-private rented housing	72 (17.6%)	78 (15.7%)	222 (25.3%)	461 (40.8%)	138 (40.4%)	
Homeless	9 (0.3%)	6 (1.2%)	11 (1.3%)	7 (0.6%)	2 (0.6%)	
Highest education level						
University or above	177 (43.2%)	234 (47.0%)	338 (38.5%)	434 (38.4%)	134 (39.2%)	*p=0.04*
A levels	69 (16.8%)	90 (18.1%)	167 (19.0%)	243 (21.5%)	63 (18.4%)	
GCSE/O-level	92 (22.4%)	106 (21.3%)	189 (21.5%)	253 (22.4%)	76 (22.2%)	
None	58 (14.1%)	47 (9.4%)	139 (15.8%)	154 (13.7%)	59 (17.2%)	
Money for basic needs						
Always	345 (85.4%)	433 (87.8%)	726 (84.7%)	987 (89.3%)	302 (90.4%)	*p<0.01*
Never	59 (14.6%)	60 (12.2%)	131 (15.3%)	118 (10.7%)	32 (9.6%)	

p values by chi-squared tests and chi-squared test for trend

***Table 4 cont*. The demographic and health-related risk factors of the ASTRA population by time with diagnosed HIV (N & percentage of age group).**

Characteristic	0-2 years	2-5 years	5-10 years	10-20 years	>20 years	*Overall*
ART status						
Currently on ART	230 (57.6%)	380 (76.9%)	778 (90.5%)	1059 (95.1%)	324 (96.4%)	*p<.0001*
Advised to start ART	63 (15.4%)	57 (11.4%)	114 (13.0%)	137 (12.1%)	35 (10.2%)	
CD4 count						
<350 cells/mm^3	150 (37.0%)	107 (21.7%)	139 (16.1%)	140 (12.6%)	62 (18.2%)	*p<.0001*
>350 cells/mm^3	255 (63.0%)	385 (78.3%)	726 (83.9%)	975 (87.4%)	279 (81.8%)	
Viral load						
Detectable (>50 copies/mL)	243 (60.4%)	166 (33.8%)	162 (18.7%)	154 (13.8%)	49 (14.4%)	*p<.0001*
Undetectable (<50 copies)	159 (39.6%)	325 (66.2%)	704 (81.3%)	959 (86.2%)	292 (85.6%)	
Adherence ≥95% among those on ART	210 (92.1%)	347 (91.1%)	707 (91.3%)	913 (86.3%)	264 (81.7%)	*p<.0001*
Smoking status						
Current	131 (32.8%)	152 (30.6%)	252 (29.3%)	350 (31.3%)	126 (37.1%)	*p<.0001*
Ex-smoker	99 (24.8%)	128 (25.8%)	217 (25.2%)	370 (33.1%)	124 (36.5%)	
Non-smoker	169 (42.4%)	216 (43.5%)	391 (45.5%)	398 (35.6%)	90 (26.5%)	
Alcohol dependence	75 (18.8%)	93 (18.8%)	139 (16.1%)	203 (18.1%)	61 (17.9%)	*p=0.66*
Recreational drug use	163 (39.8%)	198 (39.8%)	308 (35.1%)	445 (39.4%)	128 (37.4%)	*p=0.26*
IVDU	12 (2.9%)	12 (2.4%)	18 (2.1%)	25 (2.2%)	7 (2.0%)	*p=0.89*

p values by chi-squared test and chi-squared test for trend

2.5 Conclusions

According to a Public Health England report, in 2011-12[160] the HIV positive population were UK born (52%), on ART (84%), and lived in London, and one in five (22%) PWH were over the age of 50. These proportions match the sample identified here, suggesting that it is representative of the UK HIV positive population. However, a smaller proportion of the general PWH population were MSM (44%) than reported here (69%) and no data was available on the general population's average time diagnosed with HIV or health risk behaviours such as smoking, alcohol dependence and recreational drug use during this time.

The ASTRA study population were predominantly white, UK-born, MSM, and well-educated. However, only 43.6% always had money for basic needs. Overall, 17.7% had evidence of alcohol dependency and 38.1% currently used recreational drugs. As such this population may be considered to be at risk of lifestyle factors affecting their biopsychosocial health. As in the overall HIV population[160], the vast majority of participants were currently on ART and had a CD4 count greater than 350 cells/mm^3 and an undetectable viral load. Of those who had not started ART, over half had been advised to start by their HIV doctor. This suggests that a small percentage of participants have unresolved issues with HIV care, but that most have a well-managed HIV infection.

The mean age of the ASTRA population was 45 (+/- 9.6) years and most participants had been diagnosed with HIV for 5-10 years. This suggests that the population overall is ageing and with time an increasing proportion of people with diagnosed HIV will be aged 50 years of over. This stresses the requisite for research which identifies treatment needs for this future population of older adults with HIV. However, only a small percentage of adults in any age group reported having HIV for longer than 20 years, suggesting that mortality rates, at least before the year 2000, prevent very long-term HIV infection.

Older adults were more likely to be diagnosed for longer, on ART, MSM, retired, and home-owners with money for basic needs than younger adults in the ASTRA study. Older adults were also less likely to report being disabled/permanently sick as their employment status. However, it is likely that this difference is simply due to an increase in retirement rates. They were less likely to report use of recreational drugs or evidence of alcohol dependency (although 21.9% still used drugs) and were mostly ex-smokers. As such, their physical and mental health may be less diminished by behavioural factors than that of younger PWH. This is worth noting as it may impact our ability to recognise age-related differences.

However, the results also showed that CD4 count did not differ with age, and the odds of having an undetectable viral load increased. This ties in with the literature which suggests that good response to cART is possible regardless of age, when adherence to ART is high. As adherence to ART increased with age, it is possible that the better response to ART observed in older adults is related to higher levels of adherence[161-163]. As such, it appears that, thanks to high medication adherence, immunological and virological responses are not concerns for OPWH.

It is also worth noting that roughly 9% of those aged 50 years and over had been diagnosed for less than two years and 16.7% (aged 50-60) and 18.1% (aged over 60) had been diagnosed for less than five years, respectively. This suggests that some adults are also becoming infected with HIV at older ages and therefore that older adults are still at risk of HIV infection.

Participants who had been diagnosed with HIV for longer were more likely to be MSM, not identify with a religion, Caucasian, born in the UK, not working due to sickness/disability, non-private rented house or home-owners, educated to a low level, and always have money for basic needs. They were more likely to be on ART, but less likely to be adherent and more likely to be current/ex-smokers. No difference was found in relation to alcohol or drug use. Unlike older adults, therefore, participants who have been diagnosed with HIV for longer were likely to show physical health issues in relation to smoking behaviour, non-adherence and disability. In comparison to OPWH, participants diagnosed with HIV for longer were more likely to be employed or sick/disabled (rather than retired). They were less likely to own a home and more likely to live in council/housing association housing. They were less likely to be adherent to ART and more likely to be current smokers, show alcohol dependency, drug use and IVDU. As such, they are likely to show worse physical and mental health and may show more concerns over financial issues.

2.5.1 **Contributions**

The ASTRA project was designed and implemented by the ASTRA team (see appendix E) and the data was entered and cleaned externally. The analysis and discussion of results shown here and in the following three chapters are the work of the author as identified on the cover of the thesis.

The ASTRA results displayed over the subsequent two chapters have been published as an abstract[164], an oral and poster presentation at HIV Drug Therapy Glasgow 2014 (Junior Scholarship) and as a full text paper[165] (*Appendix G*).

3 Age, time with diagnosed HIV, and physical well-being

3.1 Background

Physical function - the ability to carry out activities requiring physical capability - is an indispensable aspect of everyday self-care and is essential for promoting autonomy and participation in social and physical activities[54]. It can be reduced by ill health, disability, and fatigue, which in turn are thought to increase in prevalence with age and chronic illness[54]. As such, loss of physical function is a significant threat to the well-being of older adults.

The decline of physical health with age is well documented, but the reason behind 'physical ageing' is more complicated and likely involves a mix of genetic, socio-demographic, behavioural, and environmental factors[166]. The physical changes that occur with age in the general and HIV-specific populations are summarised below, including their relation to physical function and mobility.

3.1.1 Health and Mortality

As people age there is an increase in morbidity and mortality rates. Current research suggests that this is due to the combined effects of oxidative stress and mitochondrial dysfunction[167-170] with age. During the process through which mitochondria create useable energy, oxygen is bonded and released from molecules. An oxygen molecule with free electrons is highly reactive, and so excess oxygen is usually rapidly converted into water. However, it is also possible for oxygen to bind with an electron from the mitochondrial cell wall, proteins or DNA, causing damage to the mitochondrial cell structure[171]. This imbalance is known as oxidative stress[171] and can be a cause of mitochondrial dysfunction[169;170]. Dysfunction of mitochondria, in turn, increases the risk of oxidative stress occurring by decreasing the efficacy of the energy-converting process[172]. It also increases the risk of bonded molecules being released into the surrounding cell; thus increasing the risk of cell damage[170]. Over time the damage caused by these processes accumulates and causes physical signs of ageing, as well as immune function decline (immunosenescence)[25;52;53;127;173], and a loss of homeostasis[8]. This, in turn, results in fatigue[69;76;174], a poorer response to pathogens[52], and an accumulation of chronic and complex illnesses such as coronary heart disease (CHD), hypertension (high blood pressure), diabetes, arthritis and chronic obstructive pulmonary diseases (such as bronchitis and emphysema)[54;69;173]. For example, the Health and Retirement Study[54] (N=23,186) - a longitudinal study performed between the years 1992-2010 in America - found that older adults (60 and over years of age) not only had more difficulties with activities of daily living and chronic illnesses than younger adults, but showed worse physical function with the accumulation of illnesses. However, they also found that when participants were free of chronic illness, age had no effect on physical function[54]. This suggests that it is possible to achieve good physical function at any age, should illness be avoided. Unfortunately for people with HIV, the burden on immune function may make illness increasingly likely with age.

Mobility and physical activity also generally reduce with increasing age[26;55;175]. The Office of National Statistics reports that prevalence of disability, for example, was 16% in the general adult population in 2011/12, but was 45% among adults over retirement age[176]. This is primarily due to increases in fatigue[69;76;174] and frailty[177] - a syndrome encompassing a number of features (unintentional weight loss, exhaustion, weakness, slow walking speed, and low physical activity[26;55;175]) - with age. This reduction in physical activity, subsequently, increases the risk of CHD, hypertension, diabetes, and musculoskeletal and connective tissue diseases such as osteoporosis (brittle/fragile bones) and osteoarthritis[69]. Physical activity is further reduced in older adults due to social and psychological pressures. For example, many older adults report giving up group and gym memberships because they believed that they no longer possess the minimum levels of fitness required to participate[50]. Others report that they were afraid to move too far away from home or over-exert themselves in case illness hit[69;76]. An Australian focus group of older adults with and without chronic illness (N=99) further identified ‘community’, ‘maintaining independence’, and ‘the safety/flatness of nearby terrain’ as motivators for undertaking physical activity, while ‘health’ and the ‘family's attitudes to exercise’ were identified as barriers[69]. These reports highlight the importance of social and contextual factors in promoting older adult's physical health.

Finally, self-rated health has been found to predict mortality in older adults[166;178]. One longitudinal study of 1,198 Danes aged 40 and over showed that poor self-rated health (assessed via Likert scale) was related to mortality at 10- 20- and 29-year follow-up, even when lifestyle, age, sex, and socioeconomic status were accounted for[178]. Another Australian Longitudinal Study of 12,422 women aged 70-75 in 1996 found that the strongest predictor of mortality by 2005 (according to a proportional hazards models) was 'poor' or 'fair' self-rated health, with 52.3% and 28.0% of women rating their health this way dying during this period[166].

In summary, while high levels of physical function are possible in older adults, older age is known to be related to higher rates of morbidity and mortality and lower rates of physical activity.

3.1.2 Physical factors related to ageing with HIV

Due to increases in the efficacy of HIV treatment, the impact of HIV on risk of morbidity and mortality has been greatly reduced[179]. Physical health is by far the most researched area of well-being in OPWH and, on examination of the literature, 95 papers were found which focused on physical health in older adults with HIV published since 2000 (51 papers since 2010). Of these, 60 defined older adults as PWH '50-years of age'. In relation to country, 45 papers (47%) were conducted in America, 19 from Europe, eight from Africa, eight from Brazil, three from Canada, three from more than one country and one each from Australia, Mexico, South America and Singapore. Five papers were from the UK, which will be discussed separately in section 3.1.3.

The majority (n=57) of papers were quantitative studies, of which 20 included a control group and validated instruments and were included in the systematic review (section 1.3.2.2). The remaining papers included 22 summaries and opinion pieces, two mathematical models, eleven reviews, and three quantitative studies. No studies were identified relating to distress related to symptoms, although one did mention that the risk of physical limitations due to physical health problems increased with age[122].

In interviews, similar to adults ageing in the general population, PWH reported becoming more selective of their activities to conserve energy (N=49)[76]. However, they also reported concern about a) whether their health challenges were related to ageing or HIV, b) the length of time it took to recover from illness comparative to HIV negative older adults, and c) the future effects of cumulative illnesses[76]. In some cases, specific illnesses were identified such as diarrhoea - a commonly reported effect of HIV and HIV medication[87]. Participants (100 PWH aged over 50) reported feelings of being controlled by their diarrhoea - often limiting their social mobility to reduce embarrassment - and fear of what the symptom meant for their health, weight, and HIV progression[87]. This suggests that side effects of HIV and HIV-medication may put OPWH at greater risk of reduced physical activity than adults ageing in the general population. It also suggests that illness causes greater distress to older adults with HIV, as it is unclear to them whether symptoms are benign or signify a drop in their immune function, or even progression to AIDS. With the increase in morbidities with age in both populations, this indicates the strong possibility of worse well-being in OPWH compared to both young PWH and the general population.

While contentious, there is a train of research that suggests that the effects of HIV are comparable to 'accelerated' ageing[47;80;81;167]. That is, that the decreased efficacy of the immune system caused by HIV infection accumulates cell damage in a similar, but faster, way to that described in natural physical ageing[50;80;180]. Similarly, oxidative stress and mitochondrial dysfunction can have pathological origins, including though inflammation and the metabolism of drugs (such as anitretrovirals[181;182]). Therefore it is arguable that HIV and HIV medication may speed up the process of physical ageing. This is thought to have a bearing on the shorter life expectancy and increased symptom burden of adults facing the effects of ageing and HIV infection simultaneously[81]. For example, one study (N=66, California-based) found that PWH aged 39-58 had a similar immune function to HIV negative adults 17-28 years older, suggesting that, while immune function may decline naturally with age in general population, it may decline more rapidly in adults with HIV[183]. Importantly, these researchers reported that the effects of age and HIV on immune function were additive - with no interaction between the variables. This implies that PWH are at an increased risk of illness due to their age and HIV status independently. However, evidence for the direct impact of HIV (as oppose to relation conditions or behavioural factors) on the speed of cellular dysfunction is limited and inconsistent[80;184;185]. Therefore, I will focus on the accelerated 'signs' of ageing associated with HIV. That is, I will argue that HIV - and the associated medications and medical conditions - may be related to an accumulation of age-related physical insults while not necessarily affecting the cellular ageing process directly.

Evidence in support of accelerated signs of ageing include studies showing that age-related health issues such as frailty[55], bone mineral density[109;142] and possibly hypertension and diabetes[130;141] are more apparent in the HIV-positive population[23;45;186]. Immunosenescence is also similar in younger OPWH and older adults in the general population (N=486)[26;81], while frailty[187;188] and difficulties with activities of daily living (N=1,536)[189] are apparent at a younger age in PWH[81] and there is some evidence that coronary artery "age" (N=440, assessed by coronary artery calcium score) can be accelerated by an average of 15 years (range = 1-43 years) in PWH[190]. As such it seems possible that HIV does accelerate signs of ageing, along with the associated reductions in physical health. However, lifestyle factors (smoking, alcoholic intake, recreational drug use) and co-infections (e.g. hepatitis C, cytomegalovirus) may also be implicated as causes for the differences in health between adults with and without HIV. The extent to which the roles of these factors are specific to HIV-positive populations or play a part in other chronic illnesses is questionable. Belsky et al.[191], for example, reported 'visible variations in biological ageing' and health in adults aged 38 in the general population, which then related to mortality over a twenty-year follow-up.

Related to a decrease in physical health is a decrease in independence and ability to perform activities of daily living (ADLs) with age and HIV status. In one Canadian study, difficulty with ADLs were reported in 81% of PWH (N=3,600)[192], while a UK study found - using the EuroQoL-5D - that 28% of PWH reported difficulty with mobility, 19% reported difficulty with self-care, and 38% reported difficulty with usual activities; which increased in prevalence with age (N=800, mean age =40.4 years (SD = 8.6))[193]. Unfortunately the first study did not explore age differences and the second primarily involved adults under the age of 50 and so OPWH's ability to perform ADLs in comparison to younger age groups is not known. Based on the evidence, however, it can be suggested that ability to perform ADLs decreases with age in PWH, as it does in the general population.

In brief, older PWH experience lowered immune function and mobility and increased rates of mortality, morbidity and medications. This is similar to age-related changes found in the general population, but may begin at a younger age or become more severe in prevalence. It is also conceivable that OPWH may experience greater levels of distress due to uncertainty over the meaning and source of illness which could greatly affect well-being. Despite this, their response to cART medication appears to be similar to younger adults, with no difference found in CD4 count by age in the systematic review (section 1.3.2.2) or in the ASTRA analysis (Chapter 2). Information on self-rated health and health-related distress was not included in any studies. These therefore should be areas of exploration when researching the effects of physical function on the well-being of OPWH, especially in relation to the evidence of decreased health in this population.

3.1.3 UK-specific data on physical well-being in PWH

Fewer studies were available on physical well-being in OPWH using UK-specific data, but since changes in health are often identified based on geographical region and this thesis relates specifically to health among people with HIV in the UK, I felt it necessary to summarise this data separately. The Irish Longitudinal Study on ageing compared the health, social, and economic circumstances of older adults (aged 50+, N=16,242) in Ireland, England, and the USA[194]. They found that chronic disease (hypertension, diabetes mellitus, myocardial infarction, all cancers excluding skin, and lung disease) was reported more commonly in the US than UK[194]. As such it is important to identify evidence from the same region as this study data.

A cohort study of 1,536 PWH (1996-2010) from Brighton reported a higher mortality rate in PWH over the age of 50 compared to younger PWH[40]. In relation to mortality, the D:A:D study[195] - an observational study of eleven HIV-positive cohorts (N≥20 000) from 188 clinics in 20 countries - reported reductions in overall mortality in PWH in the UK between 1999 and 2008, with AIDS-related deaths reducing the most. However, they also reported that deaths due to cardiovascular disease and non-AIDS malignancies remained stable[195], suggesting that these are increasingly becoming the primary cause of mortality in the HIV positive population. While this did not explore age-related differences, it does identify the most likely causes of mortality in OPWH. Furthermore, an 'over 50' clinic set up in Chelsea and Westminster hospital in 2009 reported that PWH are at high risk of 'age-related' morbidities such as CVD and reduced bone mineral density[196], suggesting that the risk of mortality is high in older adults.

In summary, morbidity and mortality increased with age in the UK data, similar to the global literature. No information from UK studies was found on mobility, difficulty with ADLs, self-rated health, or health-related distress. Moreover, only one paper from the UK was considered methodologically rigorous enough to be included in the systematic review and, as such, data comparing physical well-being by age is lacking in the population. However, we do acknowledge that it is possible that age-related differences are mentioned in papers which do not refer to age in their title or abstract and, as such, were missed by the review.

While UK-related data was not forthcoming, mortality and morbidity appear to be fairly established as high in prevalence in OPWH in comparison to both younger PWH and older people without HIV, suggesting that they are at greater risk of reduced well-being due to physical health. Immune function, difficulty with ADLs and self-rated health require further research and need to be assessed in order to identify potential hazards to well-being.

3.1.3.1 Aims

The aim of this chapter, therefore, is to assess (amongst the ASTRA population) the association of age with a) symptom prevalence, b) symptom distress, and c) difficulty with ADLs taking into account time since HIV diagnosis, gender/sexuality and ethnicity.

3.2 Methods

The methodology of the ASTRA study and an overview of the statistical methods used for this thesis have been described in Chapter 2 (section 2.2). In this section, analysis methods relevant to this chapter will be described in relation to the variables of interest.

Participants completed a self-administered questionnaire including, in relation to this analysis, questions on: issues with mobility, self-care and usual activities and the prevalence of symptoms related to age and HIV and associated distress. These variables are reported in overall prevalence and in relation to age group, time with diagnosed HIV, and other key socio-demographic characteristics (gender/sexuality and ethnicity).

3.2.1 **Symptom measures**

Symptom prevalence was assessed using a modified version of the MSAF-SF[154]. This included 26 symptoms, listed in *table 5 (section 3.3.2).* Several symptom subgroups were also considered (*table 5*). Symptom prevalence was indicated by participants reporting the presence of a specific symptom in the past two weeks. In addition, the number of symptoms present by age and the presence of specific symptom subgroups of interest (identified through high prevalence or distress scores) were assessed. An overall symptom prevalence measure was also created of participants identifying ten or more symptoms as being present. Where symptoms were grouped, the group was analysed as 'present' if participants reported at least one of the symptoms in that category.

Symptom distress was analysed using the same modified scale. A symptom was considered distressing if participants reporting that the symptom 'bothered/distressed quite a bit' or 'very much'. The number of distressing symptoms, grouped symptoms, and 'overall symptom distress'; where participants reported at least one symptom as distressing, were also assessed.

Finally, difficulty with ADLs was identified using three domains from the EQ-5D[155] on mobility, self-care and 'usual activities (e.g. work, study, housework, family or leisure activities)'. Responses were categorised as having no problems compared to some problems or being unable to perform each activity. This was assessed by individual domain and as an overall measure, where participants were classified as having difficulties with ADLs if reported issues with at least one of the three activities.

3.2.2 **Statistical analysis**

Age in years was grouped into the following categories: <30, 30-39, 40-49, 50-59, and ≥60 years. Differences in participant characteristics by age were assessed by comparing means for continuous variables, and chi squared tests and chi-squared tests for trend for categorical variables.

Symptom prevalence, symptom distress, and difficulty with ADLs were calculated as overall prevalence and in association with age group and time with diagnosed HIV group, using chi squared test for trend. Logistic regression was used to assess the association between age group and each of the measures (dependent variables), adjusting for gender/sexuality (MSM, heterosexual man, woman), ethnicity (White, other), and time since diagnosis of HIV (<2 years, 2-5 years, 5-10 years, 10-20 years, >20 years). Age was fitted as a categorical variable in the models, with age>=60 years used as the reference category. In additional models, age was fitted as an ordinal variable with values 1 to 5, rather than defined as categorical and tests for linear trend across age groups were performed. Results are presented as odds ratios with 95% confidence intervals.

Where significant differences in symptom prevalence were found in relation to age or time with diagnosed HIV, further regression analysis was conducted adjusting for potential confounding or mediating health-related risk factors which had been identified as differing by age or time diagnosed with HIV in Chapter 2: money for basic needs (always/not always), alcohol dependence assessed by CAGE questionnaire (yes/no), recreational drug use in the past three months (yes/no) and smoking status (smoker/non/ex-smoker).

3.3 Results

3.3.1 Symptom prevalence

Table 5 reports the prevalence of each symptom. At least one of the 26 symptoms was reported as 'present' by 92.8% of participants, with 45.2% reporting over ten. The mean number of symptoms present was 9.47 (S.D.=6.6), the mode was 9. The five most prevalent symptoms were ‘lack of energy’ (64.9%), ‘Feeling drowsy/tired’ (64.6%) ‘Difficulty sleeping' (58.0%), ‘Muscle aches or joint pains’ (53.4%), and ‘Trouble remembering things' (47.0%).

***Table 5*. Physical symptoms ordered in relation to prevalence.**

Symptom	Present
N=3258	N (%)
Lack of energy	2116(64.9%)
Feeling drowsy/tired	2105 (64.6%)
Difficulty sleeping	1890(58.0%)
Muscle aches or joint pains	1740 (53.4%)
Trouble remembering things	1678 (51.4%)
Problems with sexual interest/activity	1530 (47.0%)
Difficulty concentrating	1514 (46.5%)
Skin problems (e.g. rash, itching, dryness)	1375 (42.2%)
Numbness, tingling or pain in hands or feet	1338 (41.1%)
Headache	1294 (39.7%)
Pain	1282 (39.3%)
Feeling bloated	1253 (38.5%)
Diarrhoea	1201 (36.9%)
Sweats/fever	1192(36.6%)
Shortness of breath	1056 (32.4%)
Cough	981 (30.1%)
Dry mouth	970 (29.8%)
Dizziness	961 (29.5%)
Changes in fat in face or body	947 (29.1%)
Nausea	811 (24.9%)
Lack of appetite	754 (23.1%)
Constipation	663 (20.3%)
Changes in way food tastes	564 (17.3%)
Weight loss	543 (16.7%)
Mouth sores	531 (16.3%)
Vomiting	392 (12.0%)
Sleep/energy/tiredness problems*	2556 (78.5%)
Memory/concentration problems#	1927 (59.1%)
Pain/headache$	1746 (53.6%)
Gastrointestinal symptoms£	1986 (61.0%)

*Includes ‘lack of energy’; ‘feeling drowsy/tired’; ‘difficulty sleeping’

#Includes ‘trouble remembering things’; ‘difficulty concentrating’

$Includes ‘pain’; ‘headache’

£Includes ‘feeling bloated’; ‘diarrhoea’; ‘nausea’; ‘constipation’; ‘vomiting’

When looking at symptom prevalence by age group, the mean and median number of symptoms present was highest in the 50-60s age group, but no general relationship was apparent in number of physical symptoms reported in relation to age (*table 6*).

***Table 6*. The average number of physical symptoms present by age group.**

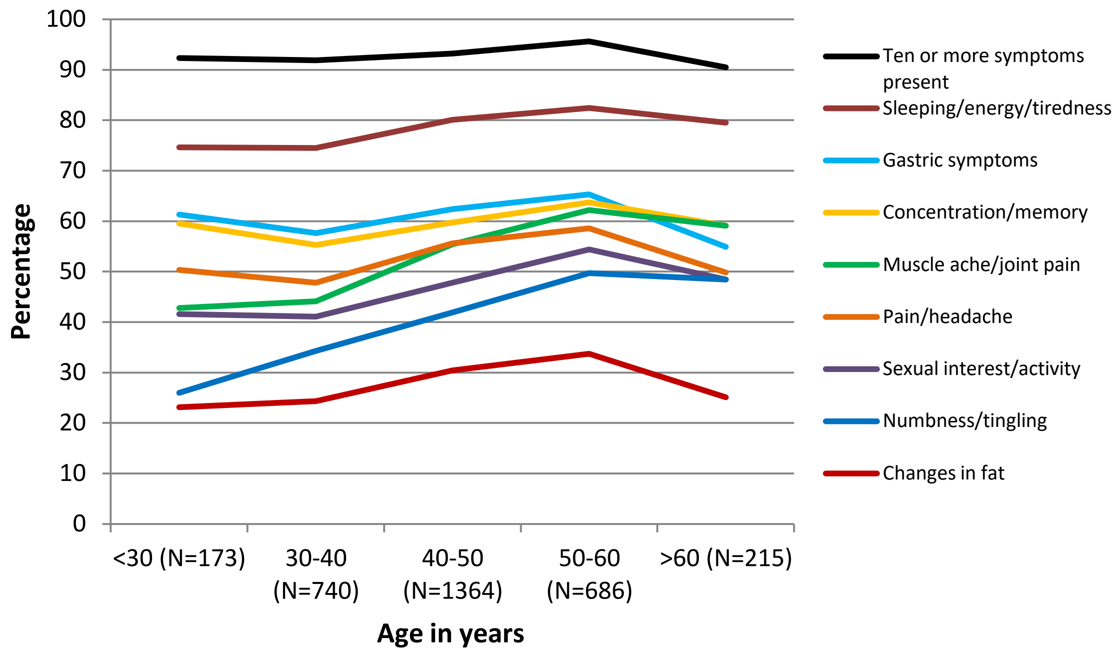
Age in years	Mean	S.D.	Median
<30 (N=173)	9.3	6.7	8
30-40 (N=740)	8.4	6.4	7
40-50 (N=1364)	9.7	6.7	9
50-60 (N=686)	10.5	6.7	10
≥60 (N=215)	8.5	5.7	8

Similarly, the number of participants reporting ten or more symptoms was highest in the 50-60s group (52.3%). This was a significant increase, compared to the other age groups, in unadjusted analysis (χ^2, (N=3178)=37.30, p<.001).

The three most prevalent individual symptoms, however, differed by age group. In those aged 50 and under the most prevalent symptoms were 'lack of energy' (reported by 62.4% of participants aged <30 to 66.1% of participants aged 50-60 years of age), 'tiredness' (62.0% - 64.0%), and 'difficulty sleeping' (51.8% -61.1%). In those aged 50 and over the two most prevalent symptoms were also 'tiredness' (65.5% -71.4%) and 'lack of energy' (60.0% -71.2%), but these were followed by 'muscle-ache/joint pain' in those aged 60 and over (59.5%), and those aged 50-60 (61.8%).

Figure 6 shows the symptom prevalence overall and for specific symptom subgroups in relation to age group. In every group symptom prevalence was highest in participants aged 50-60 and decreased in those aged ≥60. In unadjusted analysis an increase in symptom prevalence with age was found for all subgroups except 'gastric symptoms' which had no overall change. The largest increases in prevalence with age were found in relation to 'numbness/tingling or pain in hands or feet' (prevalence from 26.0% in participants aged <30 to 49.7% in those aged 60 and over) and 'muscle ache/joint pain' (42.8 to 62.2% respectively). Interestingly, symptom prevalence was also often higher in those aged <30 than those aged 30-40, then increased with age between the ages 30 and 60.

***Figure 6*. Prevalence of physical symptoms (%) by age.**



When looking at symptom prevalence by time diagnosed with HIV, the mean and median number of symptoms present increased steadily with time diagnosed with HIV, before increasing sharply in participants diagnosed for over twenty years (*table 7*).

***Table 7.* The average number of physical symptoms present by time diagnosed with HIV.**

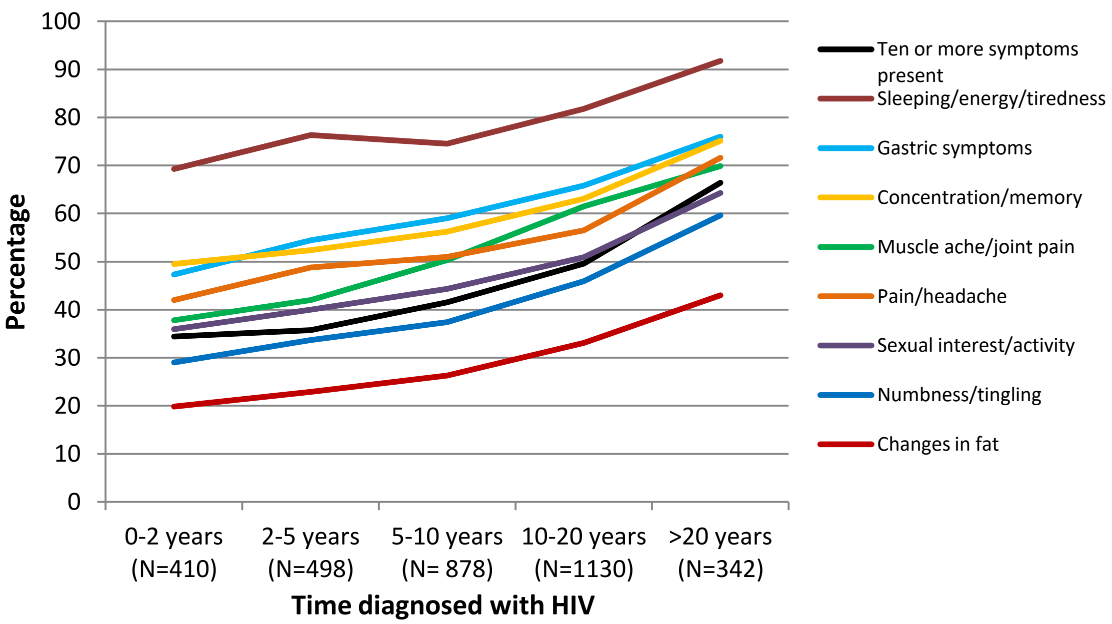
Time diagnosed with HIV	Mean	S.D.	Median
0-2 years (N=410)	7.7	6.5	6
2-5 years (N=498)	8.2	6.1	7
5-10 years (N= 878)	8.8	6.4	8
10-20 years (N=1130)	10.1	6.6	9
>20 years (N=342)	12.8	6.6	13

Similarly, the number of participants reporting ten or more symptoms increased significantly with time diagnosed with HIV from 34.4% of participants diagnosed for 0-2 years to 66.4% of participants diagnosed for over twenty years, in unadjusted analysis (χ^2, (N=3258)=113.23, p<.001).

The three most prevalent individual symptoms did not differ by time diagnosed HIV, with 'feeling drowsy/tired' (55.4% of participants diagnosed for 0-2 years to 80.4% of participants diagnosed for twenty or more years), 'lack of energy' (55.4% - 80.1%), and 'difficulty sleeping' (47.3% - 74.9%) being the most common symptoms across all groups.

Figure 7 shows the symptom prevalence overall and for specific symptom subgroups in relation to time diagnosed with HIV. In relation to every symptom group, prevalence increased with increased time diagnosed with HIV. It then increased further in those who had been diagnosed for longer than twenty years. In unadjusted analysis an increase in symptom prevalence with time diagnosed with HIV was found for all subgroups except 'mouth sores' which had no overall change.

***Figure 7*. Prevalence of physical symptoms (%) by time diagnosed with HIV.**



The adjusted associations of age and time diagnosed with HIV with symptom prevalence are presented in *Table 8*. Using the overall symptom prevalence measure, after adjustment for gender/sexuality and ethnicity, there was no overall trend with age in prevalence of overall symptom distress, as was the case for the majority of subgroups. For 'gastric symptoms', however, there was a significant decrease in prevalence with age, and for 'muscle ache/joint pain' and 'numbness/tingling or pain in hands or feet', there was a significant increase in prevalence with age.

Time diagnosed with HIV, however, was strongly related to overall symptom prevalence and each symptom subgroup: those diagnosed for longer were more likely to report distressing symptoms (test for trend across categories, ps<0.001) for overall symptom prevalence and all symptom measures in adjusted models). As before, a further increase in symptom prevalence was present between participants diagnosed for 10-20 and over 20 years. This relationship was not materially altered when further adjusted for by smoking status, alcohol, and drug use and money for basic needs (Odds Ratio=1.35, 95% C.I.=1.25-1.47, p=<.001).

There were also differences in symptom distress by gender/sexuality. For many symptom subgroups the pattern was similar: compared to MSM, prevalence of distressing symptoms tended to be lower amongst heterosexual men, and equivalent (or somewhat lower) amongst women. Finally, being White was related to a higher chance of symptom prevalence in relation to the majority of symptom measures.

Table 8. **Adjusted association of age, time with diagnosed HIV, gender/sexuality and ethnicity with symptom prevalence (logistic regression analysis).**

(N=3178)	Overall symptom prevalence[x]			Sleep/energy/tiredness			Gastric symptoms			Memory/concentration			Muscle ache/joint pain		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	0.02			0.61			0.02			0.37			0.01		
Test for trend[$]	*0.93*	*1.00*	*(0.93, 1.09)*	*0.75*	*1.02*	*(0.92, 1.12)*	*0.02*	*0.91*	*(0.84, 0.99)*	*0.34*	*0.96*	*(0.89, 1.04)*	*0.002*	*1.14*	*(1.05, 1.23)*
<30	0.06	1.52	(0.99, 2.33)	0.61	1.14	(0.69, 1.89)	0.001	2.04	(1.32, 3.14)	0.06	1.52	(0.99, 2.33)	0.36	0.82	(0.53, 1.25)
30-40	0.37	1.16	(0.84, 1.62)	0.75	1.07	(0.72, 1.58)	0.01	1.56	(1.12, 2.16)	0.37	1.16	(0.84, 1.61)	0.07	0.74	(0.54, 1.03)
40-50	0.03	1.40	(1.03, 1.89)	0.27	1.23	(0.85, 1.79)	0.003	1.58	(1.17, 2.14)	0.31	1.17	(0.86, 1.58)	0.76	0.96	(0.71, 1.29)
50-60	0.01	1.53	(1.11, 2.10)	0.31	1.23	(0.83, 1.83)	0.01	1.59	(1.15, 2.19)	0.19	1.24	(0.90, 1.71)	0.39	1.15	(0.84, 1.58)
60+*		1			1			1			1			1	
Years with HIV	<.001			<.001			<.001			<.001			<.001		
Test for trend[$]	*<.001*	*1.31*	*(1.23, 1.40)*	*<.001*	*1.25*	*(1.16, 1.35)*	*<.001*	*1.31*	*(1.23, 1.40)*	*<.001*	*1.26*	*(1.18, 1.34)*	*<.001*	*1.34*	*(1.26, 1.43)*
0-2*		1			1			1			1			1	
2-5	0.57	1.09	(0.82, 1.43)	0.06	1.35	(0.99, 1.83)	0.03	1.34	(1.02, 1.76)	0.42	1.12	(0.86, 1.46)	0.17	1.21	(0.92, 1.59)
5-10	0.03	1.32	(1.03, 1.70)	0.19	1.20	(0.92, 1.58)	<.001	1.61	(1.26, 2.05)	0.04	1.30	(1.02, 1.65)	<.001	1.62	(1.27, 2.08)
10-20	<.001	1.78	(1.39, 2.27)	<.001	1.73	(1.31, 2.28)	<.001	2.13	(1.67, 2.72)	<.001	1.71	(1.34, 2.17)	<.001	2.33	(1.83, 2.98)
20+	<.001	3.36	(2.44, 4.61)	<.001	3.86	(2.44, 6.10)	<.001	3.36	(2.41, 4.68)	<.001	2.85	(2.06, 3.96)	<.001	3.04	(2.21, 4.18)
Sex	0.03			<.001			<.001			0.01			0.01		
MSM*		1			1			1			1			1	
Hetero male	0.01	0.71	(0.56, 0.91)	<.001	0.50	(0.38, 0.64)	<.001	0.51	(0.40, 0.65)	0.002	0.69	(0.54, 0.87)	0.003	0.69	(0.55, 0.88)
female	0.55	0.94	(0.77, 1.15)	0.02	0.75	(0.59, 0.95)	0.74	0.97	(0.79, 1.19)	0.17	0.87	(0.71, 1.06)	0.79	1.03	(0.84, 1.26)
Ethnicity Other*		1			1			1			1			1	
White	0.004	1.27	(1.08, 1.49)	<.001	1.60	(1.30, 1.95)	<.001	1.44	(1.22, 1.70)	0.01	1.25	(1.06, 1.47)	0.002	1.29	(1.10, 1.52)

[x] Reports ten or more symptoms *reference group [$] trend across age groups

(N=3178)	Pain/headache			Sexual interest/activity			Numbness/tingling			Changes in fat		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	0.04			0.22			0.001			0.07		
Test for trend[$]	*0.68*	*1.02*	*(0.94, 1.10)*	*0.48*	*1.03*	*(0.95, 1.12)*	*<.001*	*1.19*	*(1.09, 1.29)*	*0.53*	*1.03*	*(0.94, 1.12)*
<30	0.20	1.32	(0.86, 2.01)	0.40	1.20	(0.79, 1.84)	0.01	0.53	(0.34, 0.84)	0.46	1.20	(0.74, 1.97)
30-40	0.46	1.13	(0.82, 1.56)	0.83	1.04	(0.7, 1.43)	0.04	0.72	(0.52, 0.99)	0.39	1.18	(0.81, 1.70)
40-50	0.04	1.37	(1.02, 1.85)	0.39	1.14	(0.85, 1.53)	0.26	0.84	(0.63, 1.13)	0.06	1.38	(0.99, 1.94)
50-60	0.02	1.45	(1.06, 1.99)	0.09	1.32	(0.96, 1.80)	0.66	1.07	(0.79, 1.47)	0.02	1.53	(1.08, 2.18)
60+*		1			1			1			1	
Years with HIV	<.001			<.001			<.001			<.001		
Test for trend[$]	*<.001*	*1.26*	*(1.18, 1.34)*	*<.001*	*1.25*	*(1.17, 1.33)*	*<.001*	*1.27*	*(1.19, 1.36)*	*<.001*	*1.30*	*(1.31, 1.40)*
0-2*		1			1			1			1	
2-5	0.05	1.31	(1.00, 1.72)	0.20	1.20	(0.91, 1.58)	0.12	1.26	(0.94, 1.67)	0.24	1.22	(0.88, 1.69)
5-10	0.01	1.40	(1.10, 1.79)	0.01	1.43	(1.12, 1.84)	0.02	1.38	(1.06, 1.79)	0.03	1.38	(1.03, 1.85)
10-20	<.001	1.69	(1.33, 2.15)	<.001	1.73	(1.35, 2.21)	<.001	1.83	(1.42, 2.35)	<.001	1.93	(1.45, 2.57)
20+	<.001	3.32	(2.41, 4.57)	<.001	2.76	(2.01, 3.77)	<.001	2.98	(2.17, 4.09)	<.001	2.96	(2.11, 4.17)
Sex	<.001			<.001			0.99			0.01		
MSM*		1			1			1			1	
Hetero male	0.01	0.74	(0.58, 0.94)	0.03	0.76	(0.60, 0.97)	0.89	0.98	(0.77, 1.25)	0.53	0.92	(0.70, 1.20)
female	0.01	1.33	(1.08, 1.63)	<.001	0.63	(0.51, 0.77)	0.91	0.99	(0.80, 1.22)	0.01	1.36	(1.10, 1.69)
Ethnicity Other*		1			1			1			1	
White	0.85	1.02	(0.86, 1.19)	0.003	1.27	(1.08, 1.50)	0.97	1.00	(0.85, 1.18)	0.23	0.90	(0.75, 1.07)

*reference group [$]trend across age groups

3.3.2 **Symptom distress**

Table 9 reports each symptom according to whether they were (i) present and (ii) distressing. At least one symptom was reported as 'distressing' by 55.6% of the population. The mean number of symptoms causing serious distress was 3.2 (S.D.=4.8), the median was 1 out of 26. The most prevalent distressing symptoms were ‘lack of energy’ (25.9%), ‘difficulty sleeping’ (24.4%), ‘feeling drowsy/tired’ (24.2%), ‘muscle aches or joint pains’ (20.8%), and ‘problems with sexual interest/activity’ (19.2%). Although lower in prevalence, 'pain' and 'changes in fat' were also more likely to cause distress when present than other symptoms.

Table 9. **Symptom prevalence and symptom distress (most prevalent in bold).**

Symptom	Present	Distressing[1]	
	N (%)	N (%)	% of
N=3258			‘present’
Lack of energy	***2116(64.9%)***	**844** ***(25.9%)***	39.9
Feeling drowsy/tired	***2105 (64.6%)***	**790** ***(24.2%)***	37.5
Difficulty sleeping	***1890(58.0%)***	**796** ***(24.4%)***	**42.1**
Muscle aches or joint pains	1740 (53.4%)	678 (20.8%)	39.0
Trouble remembering things	1678 (51.4%)	569 (17.5%)	33.9
Problems with sexual interest/activity	1530 (47.0%)	627 (19.2%)	41.0
Difficulty concentrating	1514 (46.5%)	462(14.2%)	30.5
Skin problems (e.g. rash, itching, dryness)	1375 (42.2%)	430 (13.2%)	31.1
Numbness, tingling or pain in hands or feet	1338 (41.1%)	514 (15.8%)	38.4
Headache	1294 (39.7%)	343 (10.5%)	26.5
Pain	1282 (39.3%)	586 (18.0%)	**45.7**
Feeling bloated	1253 (38.5%)	366 (11.2%)	29.2
Diarrhoea	1201 (36.9%)	358 (11.0%)	29.8
Sweats/fever	1192(36.6%)	412 (12.6%)	34.6
Shortness of breath	1056 (32.4%)	340 (10.4%)	32.2
Cough	981 (30.1%)	242 (7.4%)	24.7
Dry mouth	970 (29.8%)	226 (6.9%)	23.3
Dizziness	961 (29.5%)	293 (9.0%)	30.5
Changes in fat in face or body	947 (29.1%)	428 (13.1%)	**45.2**
Nausea	811 (24.9%)	221 (6.8%)	27.3
Lack of appetite	754 (23.1%)	204 (6.3%)	27.1
Constipation	663 (20.3%)	199 (6.1%)	30.0
Changes in way food tastes	564 (17.3%)	159(4.9%)	28.2
Weight loss	543 (16.7%)	191 (5.9%)	35.2
Mouth sores	531 (16.3%)	155 (4.8%)	29.2
Vomiting	392 (12.0%)	125 (3.8%)	21.9
Sleep/energy/tiredness problems*	2556 (78.5%)	1140 (35.0%)	44.6
Memory/concentration problems#	1927 (59.1%)	736 (22.6%)	38.2
Pain/headache$	1746 (53.6%)	688 (21.1%)	39.4
Gastrointestinal symptoms£	1986 (61.0%)	704 (21.6%)	35.4

[1] Symptom causes ‘quite a bit’ or ‘very much’ distress

*Includes ‘lack of energy’; ‘feeling drowsy/tired’; ‘difficulty sleeping’

#Includes ‘trouble remembering things’; ‘difficulty concentrating’

$Includes ‘pain’; ‘headache’, £Includes ‘feeling bloated’; ‘diarrhoea’; ‘nausea’; ‘constipation’; ‘vomiting’

When looking at symptom distress by age group, the mean and median number of distressing symptoms did not appear to deviate with age (*table 10*).

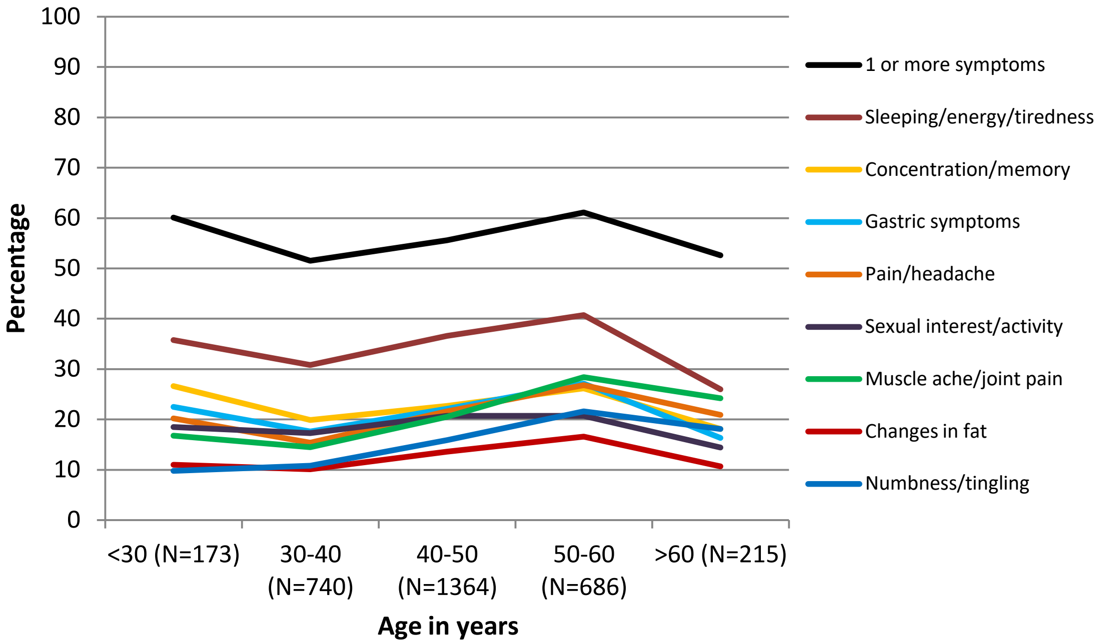
Table 10. **The average number of distressing symptoms present by age group.**

Age in years	**Mean**	**S.D.**	**Median**
<30 (N=173)	3.5	5.00	1
30-40 (N=740)	2.6	4.4	1
40-50 (N=1364)	3.4	4.9	1
50-60 (N=686)	3.9	5.2	1.5
≥60 (N=215)	2.5	3.7	1

The most prevalent distressing symptoms were the same for each of the four age groups under the age of 60 years: 'lack of energy' (22.0% prevalence in participants aged <30 years of age to 30.8% in those aged 50-60), followed by 'feeling drowsy/tired' (20.0-28.3%), and 'difficulty sleeping' (21.9 -26.5%), and the proportion who reported no distressing symptoms ranged from 38.9% to 48.5%. Among participants aged ≥ 60 years the pattern was different: 'muscle ache/joint pains' was the most prevalent distressing symptom (24.2%), followed by 'pain' (18.6%) and 'lack of energy' (18.6%), and 47.4% of participants over the age of 60 reported no distressing symptoms.

Figure 8 shows the prevalence of symptom distress overall and for specific symptom subgroups by age group. As can be seen from the graph, prevalence did not differ much between distressing symptoms, with a large amount of overlap between almost all symptoms except 'sleeping/energy/tiredness' problems, for which prevalence of distressing symptoms was higher. In terms of the pattern of prevalence with age, the frequency of overall symptom distress tended to increase slightly with age over the 30-59 year age range, but decreased in the ≥60 age group in a manner similar to symptom prevalence. Most of the symptom groups followed this pattern, with 'muscle-ache/joint pain' (14.5-28.4%) and 'numbness/tingling in the hands/feet' (9.8-21.6%) having the strongest increases with age. However, sexual interest/activity did not vary by age in unadjusted analysis (p=0.09).

Figure 8. **Prevalence of distressing symptoms (%) by age.**



When looking at symptom distress by time diagnosed with HIV, the mean and median number of distressing symptoms increased with increasing time diagnosed; with the mean number of distressing symptoms doubling (*table 11*). This was a significant increase in unadjusted analysis (χ^2, (N=3258)=37.30, p<.001).

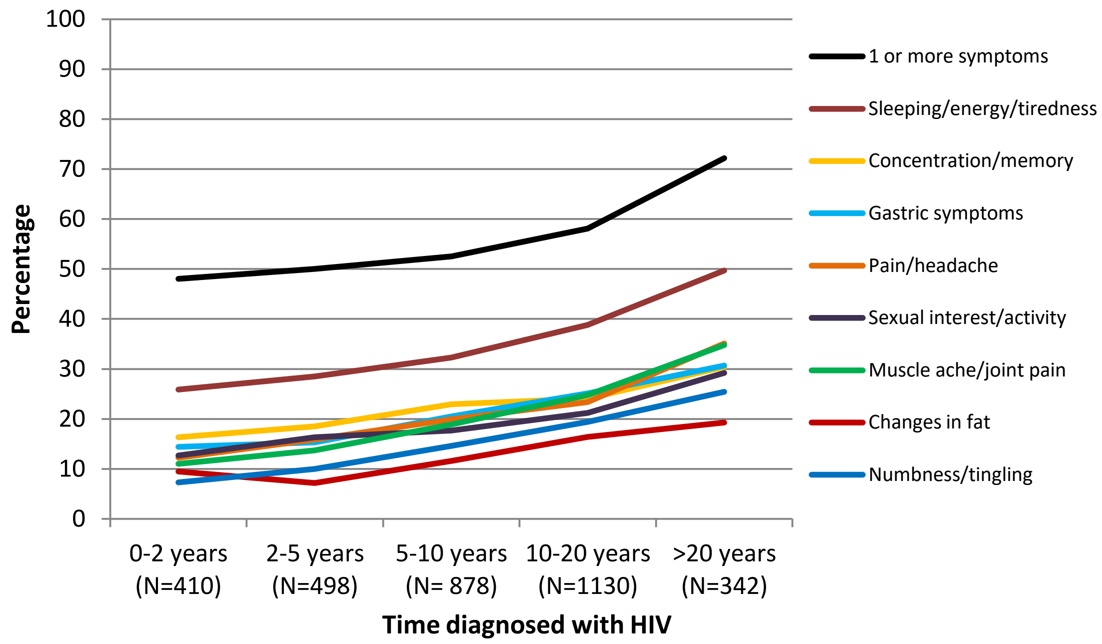
Table 11. **The average number of distressing symptoms present by time diagnosed with HIV.**

Age in years	**Mean**	**S.D.**	**Median**
0-2 years (N=410)	2.3	4.1	0
2-5 years (N=498)	2.4	4.2	0.5
5-10 years (N= 878)	3.0	4.7	1
10-20 years (N=1130)	3.6	5.0	1
>20 years (N=342)	4.9	5.6	3

The most prevalent distressing symptoms were the same for participants diagnosed for between 0 and 20 years: 'lack of energy' (20.2% - 29.8%), followed by 'difficulty sleeping' (15.4% - 25.8%) and 'feeling drowsy/tired' (18.3% - 28.3%). Among participants diagnosed for over twenty years the pattern was different: ‘lack of energy' was still the most prevalent distressing symptom (37.4%), followed by ‘difficulty sleeping’ (35.4%) and ‘muscle ache/joint pains' (34.8%).

Figure 9 shows the prevalence of symptom distress overall and for specific symptom subgroups by time diagnosed with HIV. As can be seen from the graph, prevalence of distressing symptoms increased with increasing time with diagnosed HIV, becoming particularly prevalent in participants diagnosed for over twenty years.

***Figure 9*. Prevalence of distressing symptoms (%) by time diagnosed with HIV.**



The adjusted associations of age and time diagnosed with HIV with symptom distress are presented in *Table 12*. Using the overall symptom distress measure, after adjustment for gender/sexuality and ethnicity, there was no overall trend with age in prevalence of overall symptom distress. However, age-related variation in relation to specific symptoms was identified. For 'pain/headaches', 'numbness/tingling in the hands or feet', and 'muscle ache/joint pain' there was a significant increase in the prevalence of distress with age and for 'sleep/energy/tiredness' and 'sexual interest/activity' the prevalence of distress decreased (test for trend across categories p<0.001). No difference was found with increasing age for 'memory/concentration' problems, 'gastric symptoms' or 'changes in fat'. For almost all symptom subgroups, prevalence of distressing symptoms was lower among those aged ≥60 years than those aged 50-60 years. In fact for most symptom groups, participants aged ≥60 years had the lowest prevalence of distressing symptoms overall.

Time diagnosed with HIV was strongly related to prevalence of overall symptom distress and each symptom subgroup: those diagnosed for longer were more likely to report distressing symptoms (test for trend across categories $p<0.001$ for overall symptom distress and all symptom measures in adjusted models). This relationship was not materially altered when further adjusted for by smoking status, alcohol and drug use and money for basic needs (Odds Ratio=1.25, 95% C.I.=1.16-1.36, p=<.001 for trend across categories of time with diagnosed HIV).

There were also differences in symptom distress by gender/sexuality. For many symptom subgroups the pattern was similar: compared to MSM, prevalence of distressing symptoms tended to be similar (or somewhat lower) among heterosexual men, and higher among women. There were few significant differences according to ethnicity.

Table 12. **Adjusted association of age, time with diagnosed HIV, gender/sexuality and ethnicity with symptom distress prevalence (logistic regression**

(N=3178)	Overall symptom distress[x]			Sleep/energy/tiredness			Memory/concentration			Gastric symptoms			Pain/headache		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	0.02			0.001			0.02			0.004			0.01		
Test for trend[$]	*0.93*	*1.00*	*(0.93, 1.09)*	*0.07*	*0.93*	*(0.85, 1.01)*	*0.43*	*0.96*	*(0.88, 1.06)*	*0.57*	*0.97*	*(0.88, 1.07)*	*0.09*	*1.09*	*(0.99, 1.20)*
<30	0.06	1.52	(0.99, 2.33)	<.001	2.37	(1.50, 3.75)	0.01	2.02	(1.22, 3.36)	0.004	2.20	(1.29, 3.75)	0.35	1.29	(0.76, 2.17)
30-40	0.37	1.16	(0.84, 1.62)	0.004	1.70	(1.18, 2.43)	0.23	1.29	(0.86, 1.93)	0.12	1.41	(0.92, 2.16)	0.40	0.84	(0.56, 1.26)
40-50	0.03	1.40	(1.03, 1.89)	<.001	1.86	(1.33, 2.59)	0.09	1.38	(0.95, 2.01)	0.02	1.58	(1.07, 2.34)	0.59	1.10	(0.77, 1.59)
50-60	0.01	1.53	(1.11, 2.10)	<.001	2.00	(1.42, 2.83)	0.02	1.62	(1.10, 2.38)	0.001	1.92	(1.29, 2.88)	0.08	1.40	(0.96, 2.04)
60+*		1			1			1			1			1	
Years with HIV	<.001			<.001			<.001			<.001			<.001		
Test for trend[$]	*<.001*	*1.31*	*(1.23, 1.40)*	*<.001*	*1.27*	*(1.18, 1.36)*	*<.001*	*1.22*	*(1.12, 1.32)*	*<.001*	*1.28*	*(1.18, 1.39)*	*<.001*	*1.33*	*(1.23, 1.45)*
0-2*		1			1			1			1			1	
2-5	0.57	1.09	(0.82, 1.43)	0.42	1.13	(0.84, 1.53)	0.34	1.19	(0.83, 1.69)	0.56	1.09	(0.75, 1.59)	0.09	1.40	(0.95, 2.06)
5-10	0.03	1.32	(1.03, 1.70)	0.02	1.38	(1.05, 1.80)	0.01	1.55	(1.13, 2.11)	0.01	1.60	(1.15, 2.23)	0.001	1.76	(1.24, 2.49)
10-20	<.001	1.78	(1.39, 2.27)	<.001	1.78	(1.37, 2.32)	0.001	1.69	(1.24, 2.31)	<.001	2.03	(1.47, 2.81)	<.001	2.12	(1.51, 2.98)
20+	<.001	3.36	(2.44, 4.61)	<.001	2.71	(1.96, 3.74)	<.001	2.32	(1.60, 3.35)	<.001	2.50	(1.70, 2.65)	<.001	3.61	(2.45, 5.33)
Sex	0.03			0.05			0.001			0.002			<.001		
MSM*		1			1			1			1			1	
Hetero male	0.01	0.71	(0.56, 0.91)	0.02	0.72	(0.55, 0.94)	0.76	0.96	(0.71, 1.29)	0.003	0.60	(0.43, 0.84)	0.28	0.84	(0.61, 1.15)
female	0.55	0.94	(0.77, 1.15)	0.50	0.93	(0.75, 1.15)	0.001	1.50	(1.19, 1.89)	0.30	1.14	(0.89, 1.45)	<.001	1.53	(1.21, 1.94)
Ethnicity Other*		1			1			1			1.22			1	
White	0.004	1.27	(1.08, 1.49)	0.10	1.15	(0.97, 1.36)	0.69	1.04	(0.86, 1.26)	0.05		(1.01, 1.49)	0.72	0.96	(0.79, 1.18)

[x] Reports one or more distressing symptoms *Reference group [$] Trend across age groups

(N=3178)	Sexual interest/activity			Muscle ache/joint pain			Changes in fat			Numbness/tingling		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	0.05			<.001			0.13			0.002		
Test for trend[$]	*0.02*	*0.88*	*(0.80, 0.98)*	*0.001*	*1.18*	*(1.07, 1.31)*	*0.55*	*1.04*	*(0.92, 1.17)*	*0.001*	*1.21*	*(1.08, 1.35)*
<30	0.01	2.16	(1.23, 3.81)	0.72	0.91	(0.53, 1.55)	0.31	1.42	(0.73, 2.79)	0.25	0.69	(0.36, 1.30)
30-40	0.01	1.74	(1.12, 2.72)	0.04	0.66	(0.45, 0.98)	0.58	1.16	(0.69, 1.93)	0.06	0.66	(0.43, 1.02)
40-50	0.004	1.81	(1.20, 2.73)	0.36	0.85	(0.60, 1.21)	0.20	1.36	(0.85, 2.16)	0.50	0.88	(0.60, 1.29)
50-60	0.03	1.61	(1.05, 2.47)	0.23	1.25	(0.87, 1.79)	0.04	1.66	(1.02, 2.68)	0.30	1.23	(0.83, 1.83)
60+*		1			1			1			1	
Years with HIV	<.001			<.001			<.001			<.001		
Test for trend[$]	*<.001*	*1.28*	*(1.18, 1.39)*	*<.001*	*1.40*	*(1.28, 1.52)*	*<.001*	*1.33*	*(1.20, 1.47)*	*<.001*	*1.38*	*(1.25, 1.52)*
0-2*		1			1			1			1	
2-5	0.15	1.33	(0.9, 1.94)	0.12	1.38	(0.92, 2.09)	0.25	0.75	(0.46, 1.23)	0.14	1.45	(0.89, 2.35)
5-10	0.01	1.55	(1.09, 2.18)	0.001	1.85	(1.29, 2.67)	0.30	1.24	(0.83, 1.85)	0.001	2.05	(1.34, 3.14)
10-20	<.001	1.89	(1.35, 2.65)	<.001	2.61	(1.83, 3.73)	0.001	1.94	(1.32, 2.86)	<.001	2.80	(1.85, 4.24)
20+	<.001	3.01	(2.03, 4.47)	<.001	3.86	(2.58, 5.78)	<.001	2.31	(1.47, 3.63)	<.001	3.66	(2.30, 5.83)
Sex	0.19			<.001			<.001			0.001		
MSM*		1			1			1			1	
Hetero male	0.73	0.95	(0.69, 1.29)	0.13	0.78	(0.57, 1.08)	0.73	0.94	(0.64, 1.37)	0.15	0.77	(0.53, 1.10)
female	0.07	0.78	(0.60, 1.02)	<.001	1.58	(1.24, 2.00)	<.001	1.72	(1.30, 2.27)	0.002	1.52	(1.17, 1.98)
Ethnicity Other*		1			1			1			1	
White	0.09	1.19	(0.97, 1.45)	0.81	0.98	(0.80, 1.19)	0.61	0.94	(0.74, 1.19)	0.53	0.93	(0.75, 1.16)

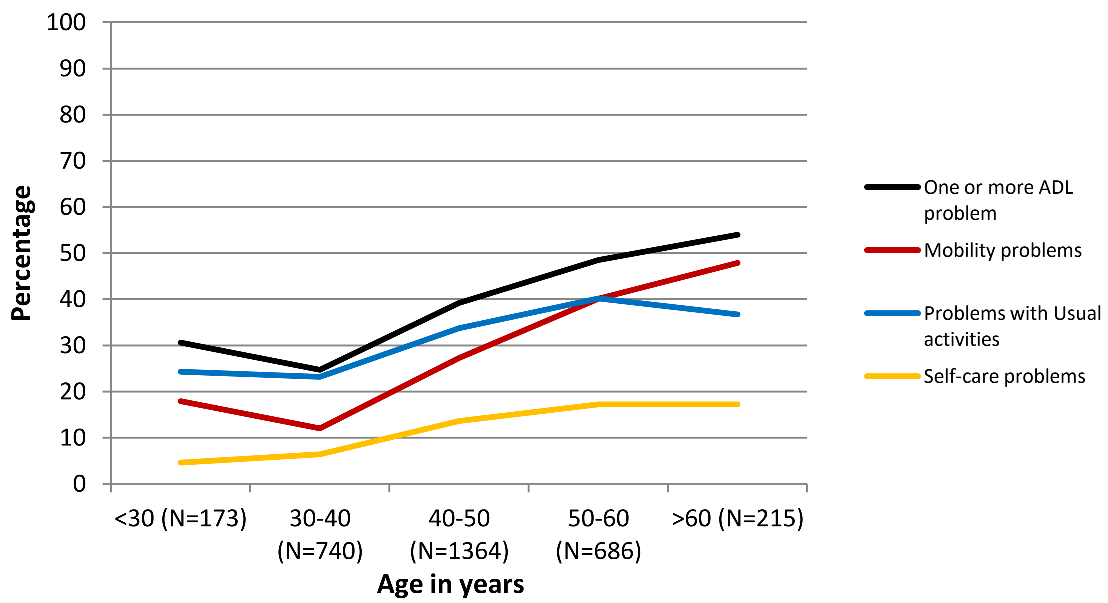
*reference group [$]trend across age groups

3.3.3 Activities of Daily Living

The prevalence of ADL problems was 38.1% overall and prevalence of individual components was as follows: mobility problems (27.6%), self-care problems (12.6%), and problems with daily activity (32.7%). Furthermore, participants reporting ten or more symptoms (65.1% vs. 15.8%, p<.001) or symptom distress (58.4% vs. 12.6% reporting no distress, p<.001) were more likely to report ADL problems.

The prevalence of having one or more ADL problem increased significantly with age (24.7-54.0%) in unadjusted analysis (χ^2, N=3178(4)=115.09, p<.001 for linear trend across age groups). An increase in prevalence with older age was found for all three domains, with mobility problems increasing the most with age (prevalence 12.0 among those <30 years compared to 47.9% among those >=60 years) and self-care the least (corresponding prevalences: 4.6 and17.2% respectively). Interestingly, participants aged <30 still reported more mobility problems than those aged 30-40. These results are depicted in *figure 10*.

***Figure 10*. Prevalence of ADL problems (%) by age.**



The odds of having one or more ADL problem also increased significantly with time diagnosed with HIV (55.6-77.8%) in unadjusted analysis (χ^2, N=3258(4)=72.53, p<.001). The same was found for all three subcategories, with problems with ADLs becoming increasingly prevalent in participants diagnosed for longer than ten years. These results are depicted in *figure 11*.

***Figure 11*. Prevalence of ADL problems (%) by time diagnosed with HIV.**

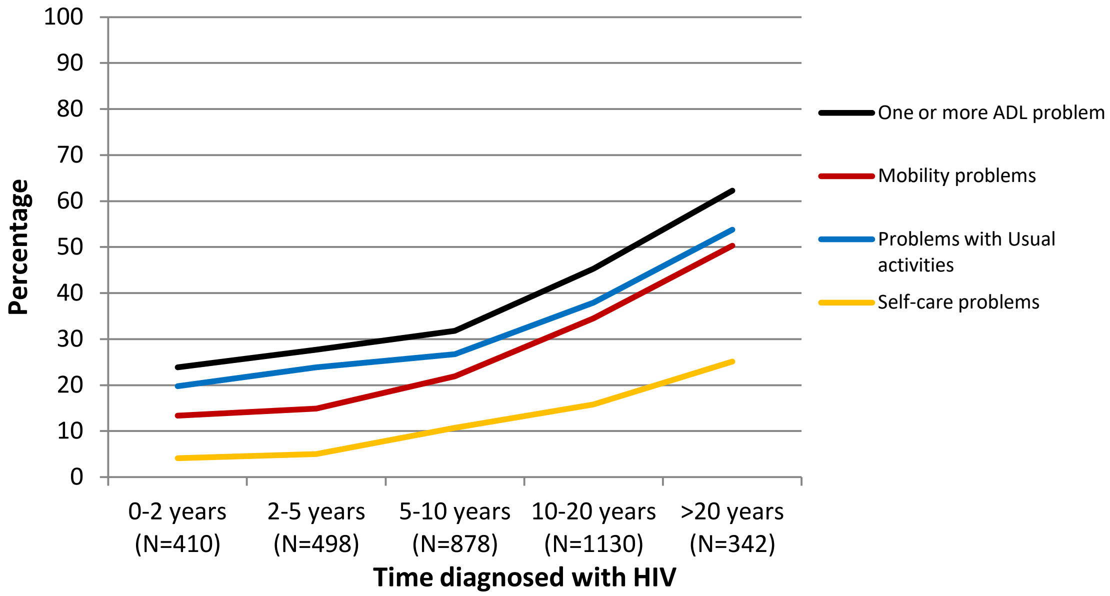


Table 13 shows the adjusted associations of age and time diagnosed with HIV with ADL problems. Using the overall symptom distress measure, after adjustment for gender/sexuality and ethnicity, there was a strong increasing trend in the prevalence of ADL problems with age overall and for each domain. This relationship was not materially altered when further adjusted for by smoking status, alcohol and drug use and money for basic needs (Odds Ratio=1.36, 95% C.I.=1.25-1.49, p<.001 for trend across age groups).

Longer time since HIV diagnosis was also strongly related to higher prevalence of ADL problems. This relationship was not materially altered when further adjusted for by smoking status, alcohol and drug use and money for basic needs (Odds Ratio=1.42, 95% C.I.=1.31-1.55, p=<.001).

In addition, mobility problems were more common among women than MSM and 'problems with usual activities' were more common in White participants than other ethnicities.

Table 13. **Adjusted association of age, time with diagnosed HIV, gender/sexuality and ethnicity with ADL problems prevalence (logistic regression analysis).**

(N=3140)	One or more ADL problem			Mobility problems			Problems with Usual activities			Self-care problems		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	<.001			<.001			0.01			0.002		
Test for trend$^{\$}$	*<.001*	*1.28*	*(1.17, 1.39)*	*<.001*	*1.54*	*(1.40, 1.70)*	*0.02*	*1.11*	*(1.02, 1.22)*	*<.001*	*1.25*	*(1.11, 1.42)*
<30	0.03	0.62	(0.40, 0.97)	<.001	0.41	(0.25, 0.68)	0.78	0.93	(0.59, 1.49)	0.07	0.46	(0.20, 1.06)
30-40	<.001	0.40	(0.29, 0.56)	<.001	0.21	(0.15, 0.31)	0.14	0.77	(0.55, 1.09)	0.01	0.50	(0.31, 0.81)
40-50	0.002	0.62	(0.46, 0.84)	<.001	0.45	(0.33, 0.61)	0.87	1.02	(0.75, 1.40)	0.48	0.87	(0.58, 1.29)
50-60	0.21	0.82	(0.60, 1.12)	0.05	0.73	(0.53, 1.00)	0.27	1.20	(0.87, 1.66)	0.93	1.02	(0.67, 1.54)
60+*		1			1			1			1	
Years with diagnosed HIV	<.001			<.001			<.001			<.001		
Test for trend$^{\$}$	*<.001*	*1.40*	*(1.31, 1.51)*	*<.001*	*1.51*	*(1.39, 1.63)*	*<.001*	*1.39*	*(1.29, 1.49)*	*<.001*	*1.58*	*(1.41, 1.76)*
0-2*		1			1			1			1	
2-5	0.11	1.29	(0.95, 1.74)	0.33	1.21	(0.82, 1.78)	0.10	1.32	(0.95, 1.82)	0.54	1.22	(0.64, 2.31)
5-10	0.01	1.43	(1.09, 1.89)	0.001	1.77	(1.27, 2.47)	0.02	1.40	(1.05, 1.88)	<.001	2.61	(1.53, 4.46)
10-20	<.001	2.35	(1.80, 3.06)	<.001	2.91	(2.11, 4.02)	<.001	2.23	(1.69, 2.96)	<.001	3.64	(2.16, 6.13)
20+	<.001	4.08	(2.94, 5.67)	<.001	4.66	(3.22, 6.76)	<.001	3.92	(2.80, 5.49)	<.001	5.88	(3.36, 10.27)
Sex	0.09			0.01			0.53			0.92		
MSM*		1			1			1			1	
Hetero male	0.53	1.09	(0.84, 1.40)	0.23	1.18	(0.90, 1.56)	0.80	0.97	(0.74, 1.26)	0.68	1.08	(0.75, 1.56)
female	0.03	1.27	(1.03, 1.57)	0.002	1.46	(1.16, 1.85)	0.32	1.12	(0.90, 1.40)	0.92	1.02	(0.74, 1.40)
Ethnicity Other*		1			1			1			1	
White	0.05	1.18	(1.00, 1.40)	0.15	1.15	(0.95, 1.39)	0.01	1.25	(1.05, 1.49)	0.88	1.02	(0.80, 1.30)

* reference group $^{\$}$trend across age groups

3.4 Discussion

The aim of this chapter was to assess the associations of age and time diagnosed with HIV with a) symptom prevalence, b) symptom distress and c) difficulty with ADLs, taking into account demographic factors.

Almost all (92.8%) participants reported experiencing physical symptoms, with the majority reporting nine. The most commonly reported symptoms were fatigue-related across all age groups (which are known to be common in PWH[197-199]), although those over the age of 50 also commonly reported 'muscle-ache/joint pain'. In adjusted analysis there was no trend with age in relation to the majority of symptoms, except that the prevalence of 'gastric symptoms' decreased with age, and the prevalence of 'muscle ache/joint pain' and 'numbness/tingling or pain in hands or feet' increased with age.

Overall, 55.6% of the study population reported distress in relation to their physical symptoms, of which the most distressing symptoms (the symptoms most likely to cause distress, if present) were 'pain', 'changes in fat in face or body', and 'difficulty sleeping'. Older adults did not report more distress - in fact the prevalence of distressing symptoms was generally lowest in participants over the age of 60 than in younger age groups. However, the most common distressing symptoms differed by age group: 'pain/headaches', 'numbness/tingling in the hands or feet', and 'muscle ache/joint pain' increased in prevalence of distress with age while 'sleep/energy/tiredness' and 'sexual interest/activity' decreased. Finally, over a third (38.1%) of the study population reported difficulties with activities of daily living, of which mobility problems were most prevalent (27.6%). This is more than double the reported rates in the general population[176], according to the Office of National Statistics. Problems with ADLs increased with age in all three domains.

Declines in physical health are well documented with age in the general population and are likely due to age-related reductions in immune function[25;52;53;127;173], loss of homeostasis[8], and mitochondrial disfunction[167;168]. This results in fatigue[69;76;174], a poorer response to pathogens[52] and an accumulation of chronic and complex illnesses. Older adults with HIV show similar reductions in physical health with age, but may experience them at a faster rate, which has led researchers to suggest that PWH are at risk of 'accelerated signs of ageing'[47;80;81;167].

3.4.1 **Symptom Prevalence**

Symptom prevalence was extremely high in the ASTRA population, with fatigue-related symptoms being reported most often. The prevalence of fatigue was high across age groups and did not tend to increase with older age, as found in the general ageing population. Gastric symptoms did decrease in prevalence with age, while 'muscle ache/joint pain' and 'numbness/tingling or pain in hands or feet' increased. Gastric symptoms are common in people taking cART[87], but are not particularly related to age. Tingling in hands and feet is often related to nerve damage from viral infections, toxic exposures, and systemic diseases (most often diabetes) while muscle ache and joint pain may be related to osteoarthritis or a rheumatic condition. Diabetes and rheumatic conditions increase with age in the general population[54;69;173] which may explain the difference apparent here, but it is also possible that 'numbness/tingling or pain in hands or feet' is due to prolonged HIV infection or a higher toxicity in response to medication in older adults due to drug-drug interactions[64;128] and/or age-related homeostatic loss[8] reducing the bodies' ability to metabolise the chemicals. Therefore the changes observed with age in this study may be due to onset of age-related illness or age-related changes in HIV or drug toxicity.

In the literature very little evidence was available from the UK in relation to physical well-being in OPWH, so these results are important for understanding the well-being of OPWH in this population. In the global literature, symptom prevalence increased with age which does not correlate with the results presented here. This may be due to the majority of previous papers coming from the US, where physical health has been found to be lower than in the general UK population[194;200]. Alternatively it may be due to the high levels of ART adherence among people with HIV in the UK reducing the risk of 'accelerated signs of ageing' and related symptoms.

3.4.2 **Symptom distress**

While no previous studies were identified which focused on symptom distress in PWH, in interviews OPWH did report high levels of health-related distress due to uncertainty over the meaning and source of illness. They reported concern about a) whether their health challenges were related to ageing or HIV, b) the length of time it took to recover from illness comparative to HIV negative older adults, and c) the future effects of cumulative illnesses[76].

High levels of symptom distress were apparent in the study population, but there was no change in prevalence of overall symptom distress with age. However, the symptoms causing distress did differ with age: younger adults found fatigue symptoms and declines in sexual interest/activity more concerning while older adults were distressed by 'pain/headaches', 'numbness/tingling in the hands or feet', and 'muscle ache/joint pain'. These age differences may be due to "Social comparison". "Social comparison"[201;202] is the process through which individuals identify changes from the norm in themselves by comparing them to those experienced in people with similar demographic factors (e.g. sex, economic status and age) or those identified through popular media[203]. In relation to health, social comparisons are used to identify causes for concern and decide when to seek care[202-204]. When chronic illness is present, social comparisons may become more frequent in order to alleviate stress by accumulating health information[204-206]. Positive health-related social comparisons have previously been identified in older adults coping with chronic illness and/or disability across several countries[207;208]. An example of this present in this study would be fatigue: as fatigue is higher in older adults[69;76;174] it may be less distressing to older PWH because they recognise, through social comparisons, that it is a common function of ageing. Younger adult's social comparisons, on the other hand, would suggest that fatigue is abnormal and therefore more of a cause for concern. There is some evidence for this in the literature also, with one study reported that 30% of OPWH regarded their fatigue to be due to ageing[209].

Another example can be seen in relation to distress with sexual interest. Numerous studies have confirmed that while sexual activity declines with age[93], many adults stay sexually active well past the age of 50[210-214]. In fact, the National Bulletin of the National Advisory Council on Aging reported that in 2002 92% of respondents 60 and over considered sex to be an important part of their lives[212]. Similarly, a community-based study of older women revealed that 98% believed that an active sex life was good for their health and 89% reported that sexual satisfaction was important for life fulfillment[214]. However, social norms encourage the belief that sexual interest/activity should decline with age and so decreases may not be concerning to older adults. In contrast, common media suggests that younger adults are sexually active, which increases concern in younger adults not experiencing these urges. This could also be particularly distressing in adults wanting to procreate, who are likely to be of a younger age. Social comparison could also explain the decreases in overall distress in PWH over the age of 60 who expect to experience age-related reductions in health.

However, the social comparison theory would not explain older adult's concern with 'muscle-ache/joint pain', which commonly increases with age[54;69;173]. That is, unless it is combined with the theory of 'accelerated ageing'. If OPWH consider themselves to have experienced age-related symptoms at a younger age than the general population then social comparisons could increase their distress.

3.4.3 **Activities of Daily Living**

Mobility and physical activity are also generally found to reduce with increasing age[26;55;175 ;]. This is primarily due to increased fatigue[69;76;174] and frailty[55;177] and many older adults subsequently report becoming more selective of their social activities[69;76]. However, the prevalence of problems of ADLs in PWH over the age of 60 was 9% higher than in adults over 65 in the general population[176], suggesting that HIV may have an additional detrimental effect on health. Indeed, a separate analysis of the ASTRA data in comparison to data from the Health Survey for England (HSE) in 2011 (N=7424) also reported more problems with ADLs in the ASTRA population[215]. Frailty[187;188] and difficulties with ADLs[189] become apparent at a younger age in PWH[81] than the general population and have been reported at rates of up to 81% in PWH[192] (Colombian study), with increases with age[193]. In conjunction with previous research, this study reported a prevalence of ADL difficulties of 38.1% of PWH overall, a prevalence which increased with age. Furthermore, these changes with age were not significantly mediated by demographic or risk factors (money for basic needs, alcohol dependency, smoking status, and recreational drug use). This result is therefore likely due to age-related changes in health, as in the general population. However, since the prevalence of problems with ADLs appeared particularly high (over one in three PWH) it is conceivable that 'accelerated signs of ageing' may also be responsible for these statistics. This would mean that OPWH are likely at higher risk of problems with ADLs than age-matched individuals in the general population as well as younger PWH.

3.4.4 Time with diagnosed HIV

With longer time diagnosed with HIV the prevalence and distress caused by all reported symptoms along with the likelihood of problems with ADLs increased. Furthermore, participants who had been diagnosed with HIV for twenty or more years showed even stronger prevalence of physical symptoms and symptom distress. These changes continued to be significant when adjusted for demographic and risk factors associated with growing old with HIV (smoking status, alcohol and drug use and money for basic needs). This ties in with previous theories about changes in physical health in PWH. Namely that HIV, drug toxicity and age-related immunosenescence likely interact to increase symptom prevalence and ADL problems in PWH in a process akin to accelerated signs of ageing.

Symptom distress likely increases with time due to the increase in symptom prevalence which leaves participants with higher levels of stress and fear about the physical effects of their HIV status. Similarly, adults who were diagnosed in the pre-cART era have lived through HIV as a terminal illness and have seen symptom prevalence increase in other PWH in relation to progression to AIDS and eventual death. As such 'social comparison' could be causing them greater levels of distress. This relationship with 'social comparison' may seem arbitrary, especially since the same argument was used to explain decreases in distress in OPWH. For example, one could argue that symptom distress should be lower in PWH diagnosed for longer because compared to the individuals in their symptom group they are better off (i.e. not dead). However, the important distinction here is in relation to the number of symptoms prevalent. Specifically, no difference in prevalence was found by age in relation to the majority of symptoms while symptom prevalence increased dramatically in relation to time with diagnosed HIV. In a situation where physical health remains relatively stable individuals are less likely to consider their health, overall, to be different to the norm and so social comparison can have a positive effect on well-being. Where health declines and many symptoms are apparent -such as in chronic illness - health-related stress increases and individuals are more likely to monitor their symptoms and compare them negatively to adults of the same age, especially if they are concerned about mortality[204;206]. For example, in previous research OPWH expressed fear related to the 'unknown' future of their health and HIV status[106]. If adults living with HIV for a long time are aware of the lack of information available to clinicians on their future health and care - as these participants were - then this could plausibly result in hyper-vigilance and distress in relation to physical health symptoms. This could explain why participants diagnosed for twenty or more years showed even stronger increases in prevalence of physical symptom and distress than participants diagnosed for less time. Alternatively, this could be a result of higher levels of toxicity apparent in early ART medication. These results suggest that both calendar year of diagnosis date and the presence of HIV over time affect physical well-being of PWH. However, it is important to note that all such theories were included post-hoc and are therefore entirely speculative in nature. This occurred for two reasons. Firstly, the nature of epidemiological research is exploratory: this thesis aimed to identify changes in well-being with age, not explain them. Secondly, the lack of literature available which was directly applicable to the research population prohibited the inclusion of directional hypotheses. As such all explanations, while based on the most probable theories available, were not tested directly and should only be used as suggestions for future guided research.

3.4.5 **Limitations**

Several other limitations were apparent in this chapter. As the focus of this research was well-being, rather than biological response to HIV per se, we did not identify comorbidities or take medical history when collecting information - the results here are based solely on self-reported symptoms and their effects on daily function and distress. As such we are unable to say with certainty whether the associations with age and time with diagnosed HIV are due to biological changes in health, only that this seem likely due to the results and literature.

Very few of the ASTRA participants had severe mobility problems. This may be correlated to the ability to travel to the clinic, and so would exclude participants with severe health conditions from the conclusions presented here. As such, symptom prevalence and problems with ADLs may be more prevalent than reported here. Finally, mental, physical and social health are inextricably interlinked, and several symptoms (e.g. fatigue) are related to depression. While we have discussed the possible effects of physical health on the results, it cannot be ruled out that changes in symptom prevalence with age may be mediated by mental health. This will be discussed further in the next chapter.

3.4.6 Conclusions and Implications

Previous UK data on age differences in health in PWH showed increases in mortality and morbidity with age, similar to the global literature. No information was found on age-related differences in mobility, difficulty with ADLs, self-rated health or health-related distress in UK PWH populations, and symptom distress was noticeably lacking from all OPWH literature. The information provided in this chapter makes a contribution towards filling these gaps. It shows that older adults with HIV were not more likely to be symptomatic than younger adults, although some specific symptoms were more likely. They were also no more likely than younger PWH to experience distress at their physical symptoms, although this differed greatly based on the individual symptom. However, OPWH are at greater risk of having problems with ADLs than younger PWH. This suggests that OPWH's well-being is likely to be affected by problems with self-care and that they require a different focus on health care but do not, overall, have worse experience of physical well-being than younger adults. Adults ageing with HIV (those who have lived with HIV for longer), however, show great prevalence of symptoms, problems with ADLs and distress.

It appears possible that the physical health differences apparent by age here may be due to age-related changes in health, coupled with HIV-related changes. Further, it can be suggested that the differences noted in symptom-related distress are due to more positive social comparison in older adults.

Physical function is indispensable in maintaining autonomy and participants in health-care actiities[54]. As such ADLs, while only one of several factors assessed here, are important to consider when assessing well-being in this population and should be managed in age-related interventions. It is also worth noting that physical symptoms differed in prevalence and stress with age and so HIV-related care should be tailored to the age of the patient. However the overall image here is extremely positive in relation to older adult's physical adjustment to HIV and, barring ADLs, physical health should not be the primary focus of further care for OPWH.

Adults ageing with HIV, however, show a high prevalence of symptom distress as well as a high prevalence of physical functional problems and require tailored care.

The next chapter will explore mental health differences with age and their possible effect on well-being.

4 Age, time with diagnosed HIV, and psychological well-being

4.1 Background

Stressors are defined by psychologists as 'events or situations which cause an imbalance between perceived demands and resources'[216]. In chronic illness individuals are faced with a whole new range of demands including symptoms, illness, medication management, behaviour management, and health monitoring which affect their available mental and physical resources[217]. This increase in stressors may tax the individual's current coping strategies and they may need to adjust or replace these strategies to maintain - or regain - their well-being. Most participants with chronic illness do reach a state of good psychological adjustment over time[217] but for some the 'adjustment phase' is prolonged or unsuccessful[217]. In these cases mental health becomes increasingly salient to well-being.

Depression and anxiety are the most common mental disorders in the UK[218], and are often reported in participants with chronic illness (e.g. arthritis, diabetes, cancer, HIV)[63;219]. Indeed, it has been reported that depression was rated as the fourth leading cause of disease burden in the general population in 2000; accounting for 4.4% of disability-adjusted life years[220]. As such, depression and anxiety are the mental health measures which are considered in this study.

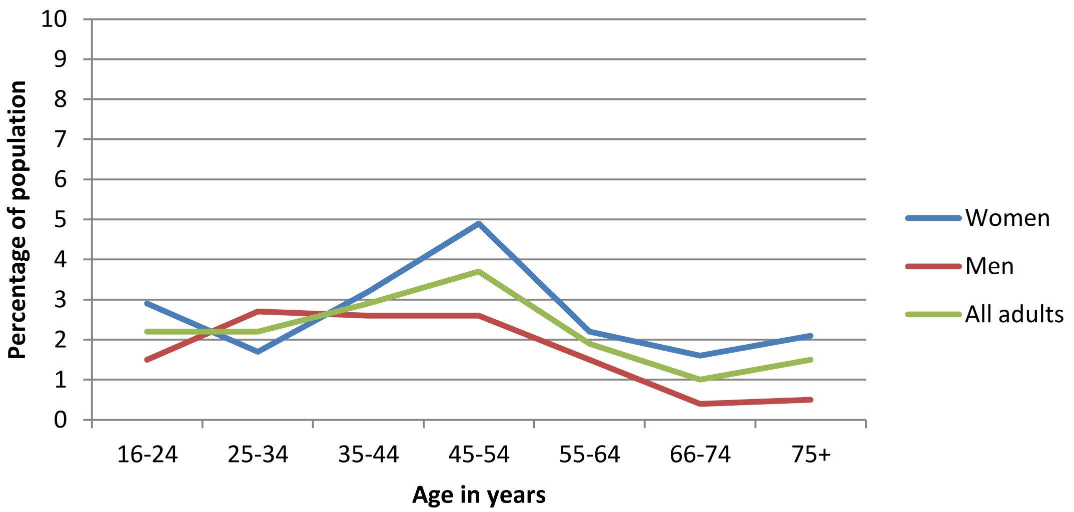
4.1.1 **Depression**

According to the DSM-IV, a major depressive disorder involves depressed mood and loss of interest or pleasure in daily activities for more than two weeks, causing impaired social, occupational and/or educational function. A report by the Office of National Statistics (ONS), states that 2.3% of the general UK population has depression, making it the most common mental illness after anxiety[218]. Depression is also common in chronic illness[58;63;219;221] and older age[56-58]. For example, a longitudinal study by the National Institute of Ageing (N=4,162) found increases in depression prevalence with age across ten-year time points[59]. Similarly, the SHARE study of ten European countries (N=22,777) found increases in depression with increasing age in participants aged 50 and over in nine countries[57], as did the English Longitudinal Study of Ageing (N=11,104)[222]. Depression is associated with increased mortality and physical symptom burden, difficulties with ADLs and decreased health-care use[56;57;200;221;222].

It is thought that depression can be high in older adults due to disengagement with social roles, declining health, bereavement and increased economic strain[57;59;60]. This loss of loved activities and people, and financial and emotional independence, may results in an increased susceptibility to depression. It is likely that depression is high amongst people with chronic illness due to similar processes[63]. However, depression may also increase the risk of chronic illnesses through 'depression-related' behaviours (e.g. over eating, over-sleeping, sedentary behaviour)[60;63;91;222;223]. Several longitudinal studies, for example, have found that major depression is a predictor for heart disease and type 2 diabetes[58;224-226]. A meta-analysis also showed that adults with depression are three times less likely to partake in self-management activities (e.g. diet, exercise) or adhere to medication than those without, which likely causes or exacerbates ill health[227]. This likelihood, in several studies from 2002, includes adherence to ART[228-230]. Finally, depression is shown to increase the number of symptoms experienced in several chronic illnesses (e.g. heart disease[231], COPD[232], diabetes[233], cancer[234;235] and HIV[236]). As such, mental and physical health are strongly and inextricably linked and may reduce overall well-being in older adults.

Data from the ONS, however, show depression prevalence which peak at the ages of 45-54 years and decrease in older adults[218]. As such, older age is not universally reported as a negative psychological life event. *Figure 12* shows the levels of depression reported in the general UK population using data adapted from the ONS (2007)[218].

***Figure 12*. The percentage of the UK population reporting depressive episodes by age and gender[218].**



There is evidence, in relation to other measures of mental well-being, that older adults may have a lower burden of symptoms than younger adults. They have been found, for example, to report fewer negative emotional experiences than younger adults[237-239], greater emotional control[237], and increased positive affect[240]. There are several possibilities given for these improvements in mental well-being despite age-related reductions in health. Cartensen's Socioemotive selective theory[241], for example, suggests that as age increases and mortality becomes more imminent, individuals become more selective of their activities; investing more time and energy into emotionally meaningful - rather than future-oriented – goals and improving their short-term well-being[242;243]. This is thought not only to affect behaviour but also cognitive processing, such that older adults show a selective attention and retention of positive information not present in younger adults[241;244]. This is known as the 'positivity effect' and has been replicated in cognitive[239] and neurological[243] studies. For example, using a reaction time test, older adults (aged 62-94, N=117) were shown to respond faster to happy faces than sad or angry faces, while younger adults showed no attentional bias[239]. In a separate study this was found to be related to lower activation of the amygdala in older adults in response to negative images[245], suggesting a neurological adaptation with age towards positive mental well-being.

This may explain the patterns in depression with age shown in the ONS data, although this would not be consistent with the results found from other countries. Alternatively, since depression is related to chronic illness, it is possible that depression is high in older adults in relation to ill health (which is common in older adults) and therefore that high levels of mental health are possible in older adults only in the absence of illness[246].

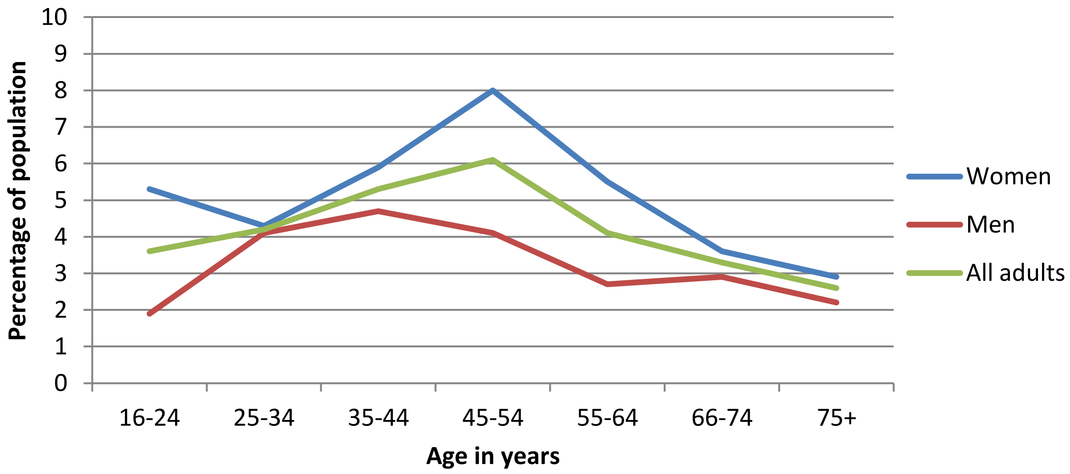
Under this assumption mental health should decline with age in PWH unless a 'selective survival'[247] effect becomes apparent. That is, if strong mental and physical health are strongly correlated, you could expect only physically and mentally fit adults to reach older age, thus skewing the available data towards more healthy older adults. If selective survival occurs in this population, this would likely become apparent through increases in mental health with time diagnosed with HIV.

4.1.2 **Anxiety**

Anxiety is a 'mental response to an irrational fear or situation over which the individual has no control'[248]. Generalised anxiety disorder (GAD) is a disorder in which the individual feels a constant state of high anxiety. According to the DSM-IV, GAD involves 'excessive anxiety and worry which is difficult to control for at least 6 months' and can be related to any aspect of life (e.g. employment, social support, health) or any combination of stressors.

GAD is considered to be the most common anxiety disorder in older adults[249;250]. According to a report by the ONS, 4.4% of the general population has GAD[218] and hospital admissions for anxiety increase in those aged 60 and over[251]. *Figure 13* shows levels of GAD in the general UK population by age group, using data adapted from the ONS in 2007, which shows a peak in anxiety in the 45-54 age group followed by a decrease with age[218]. Therefore, while overall anxiety may be high in older adults, GAD appears to decrease in the UK population.

***Figure 13*. The percentage of the UK population reporting Generalised Anxiety Disorder by age and gender[218].**



Unfortunately, the systematic review (section 1.3.2.3) identified few research papers on age- or chronic illness-related differences in anxiety, and even fewer published since 2000. However, similar to depression, anxiety has been related to the prevalence of chronic illnesses - such as hypertension[252-254] - and to be higher in prevalence in clinical populations[250;255] and in adults with poor health and low social support[249;255]. Unlike depression, anxiety has been related to an increase in health-related behaviours including information-seeking and health-care utilisation[256;257].

4.1.3 Mental health factors related to ageing with HIV

Compared to physical health, mental health is under-researched in OPWH with, on review of the literature, 35 papers focusing on mental health or quality of life (QoL) in older adults with HIV published in the last 15 years (25 papers since 2010). The majority (n=28) of papers were quantitative studies, of which 12 included a control group and validated instruments and were included in the systematic review (section 1.3.2.3). Seven further studies were identified from the systematic review as measuring mental health (primarily depression) as a secondary aim. Of those included in the systematic review, the majority found no difference with age in depression rates[64;120;129;138;145-148] but there was insufficient evidence to conclude upon age-related differences in anxiety, stress, coping mechanisms, resilience, or overall well-being. The remaining papers included three qualitative studies, two summaries, one mathematical model, and one literature review which are detailed below.

Depression is known to be higher in the HIV-positive population than the general population. Indeed, a meta-analysis of the relationship between HIV and depression from 2001 reported that PWH are twice as likely to have depression as those without[84]. More recently, in 2010-2011, an Australian nation-wide study of older (≥40 years, N=1135) MSM found that having HIV increased the likelihood of being treated for a mental health condition by 12%[85], although the causation here was unclear.

The association between HIV and depression has been attributed to multiple factors, including poor physical function[84;85;87;88;258;259], health-induced anxiety[84;89;90], a feeling of lack of control[86;258;260], and social isolation[85;90-92;258;261]. Higher rates of depression, anxiety, and suicidal ideation have also been linked to maladaptive coping strategies (e.g. 'avoidance': ignoring activities related to the stressor, such as doctor visits and/or medication)[89;91], suggesting that it may be related to behaviours with negative health benefits, and higher HIV status disclosure rates[89].

Generally, depression prevalence in OPWH is thought to be around 30%[91]. The Research on Older Adults with HIV (ROAH) study (N=914), in America, reported that 39.1% of OPWH exhibit symptoms of major depression (score of ≥23, CES-D scale)[261], but that younger OPWH (aged 50-55) reported higher levels of depression to older OPWH[261]. This suggests that older adults may cope better as age increases. Other studies have reported depression prevalence ranging from 25%[259] to 39%[261] in OPWH and an American study of PWH over the age of 45 (N=113) found a prevalence of self-reported suicidal tendencies of 27%[89]. These prevalence rates appear to be comparable to those in the HIV-positive population overall, which suggests that older PWH are not at higher risk of depression than younger PWH, but are at considerably higher risk compared to the HIV-negative population (UK percentage of 2.3%), although different scales were used here than in the general population and so the results may not be directly comparable. However, there is another possibility. In a few studies, high rates of suicidal ideation have been reported in PWH who are newly diagnosed[88;89;258]. As only 16% of new diagnoses in the UK are over the age of 50[19], the psychological impact of new diagnoses may disproportionately affect younger PWH, resulting in a higher prevalence of depression among younger than in older PWH. In order to assess this potential confounding it is important for studies to take into account 'time diagnosed with HIV' when assessing mental health by age.

As in the general population, high depression rates and avoidant coping mechanisms in OPWH have been related to low physical function and high levels of distress[38;87;91;258]. Additionally, they have been related to low adherence to ART and low CD4 count[91]. One example of this is an American study of 453 OPWH which reported a relationship between depression and the number of chronic conditions experienced[38]. Another is a study of middle-aged and older MSM with HIV (N=173) which identified a strong association between the number of physical symptoms reported, difficulties with ADLs and the severity of depression irrespective of CD4 count and viral load[87]. This suggests not only a strong relationship between physical function and mental health - as found in the general population - but also that improving clinical status may not necessarily positively impact mental well-being.

In one study, in interviews OPWH also reported distress related to the death of family and friends[86] and feelings that they were ageing prematurely[262]. When HIV-related risks for depression are combined with the age-related reductions in physical and social function this creates a large combination of stressors for OPWH[88]. In theory this might be expected to result in higher levels of depression in OPWH than younger PWH - unless their coping strategies are more advanced, or their coping resources more widespread, than those of younger adults.

In summary, depression and anxiety, in and of themselves, are important factors to address when improving the well-being of PWH, but as they have been related to lower disclosure and ART adherence rates, they are also important to participant care and infection control. Depression rates are high in PWH, but there is evidence that older PWH experience similar depression rates to younger PWH. This appears to occur despite worse physical function and social stress in older PWH, which may be related to more adaptive coping strategies in older adults and/or be an artefact of increased depression rates at HIV diagnosis. Along with these hypotheses, several gaps were identified in the literature which need to be addressed. Specifically, only one 'high-quality' study (systematic review, section 1.3.2.3) was found on age-related differences in mental health in PWH from the UK, meaning that our understanding of this population is limited. Anxiety was also explored in very few studies, preventing conclusions on age differences in PWH from being drawn. Finally, one study reported higher depression rates in younger OPWH (50-55 years of age) than older OPWH (over 55 years of age)[261]. This suggests that depression rates may vary within the OPWH population and so information into mental health is required across the age spectrum in order to identify these differences.

4.1.3.1 Aims

The aim of this chapter is to assess, amongst our ASTRA population, the association of age with a) depression symptoms, b) anxiety symptoms and c) associations between mental and physical symptoms associations between mental and physical symptoms and whether these associations differed according to age, taking into account gender/sexuality and ethnicity.

4.2 Methods

Full details of the study were described in chapter 2. Participants completed a self-administered questionnaire including, in relation to this analysis, questions on depression and anxiety symptoms. These variables are reported in relation to age group and other key socio-demographic characteristics (gender/sexuality, time with diagnosed HIV and ethnicity).

4.2.1 **Symptom measures**

Depression and anxiety were measured via self-report, using the PHQ-9[156] and GAD-7 scales[157]. Both of these scales are validated diagnostic instruments, based on the DSM-IV criteria for depression[156] and GAD[157], for measuring the prevalence and severity of mental health issues (depression and GAD) respectively.

For the purpose of this analysis w the standardised score-based definitions for anxiety and depression were used, comparing participants who reported 'moderate' to 'severe' depression and anxiety (scores ≥10) to those reporting 'mild' or 'no' depression/anxiety. This created the 'overall' depression and anxiety variables. For the individual symptoms that comprise the PHQ-9 and the GAD-7, those reporting the symptom for 'more than half the days' or 'nearly every day' were compared to those reporting the symptom 'not at all' or for 'several days' in the past two weeks. These comparisons were used to identify participants potentially in need for intervention in comparison to those showing no - or mild - distress.

Where participants did not complete the questionnaires, a missing response was analysed as a response of 'not at all' and scored as '0'. As such, it is possible that the results somewhat under-represent the levels of depression and anxiety in this population.

4.2.2 **Statistical analysis**

Age in years was grouped into the following categories: <30, 30-39, 40-49, 50-59, and ≥60 years. Differences in participant characteristics by age were assessed using compared means, chi-squared tests and chi-squared tests for trend.

Depression and anxiety were assessed using raw scores from PHQ-9 (range of 0-27) and GAD-7 (range of 0-21) and the individual components of each measure, as well as by clinical diagnostic group (none, mild, moderate, moderately severe or severe depression/anxiety) and comparing adults with PHQ-9 and GAD-7 scores ≥10 to those without (the 'overall' scores). Statistics were collected for the entire ASTRA population and compared by age group and time with diagnosed HIV group using chi squared test for trend. Logistic regression was used to assess the association of age groups and time with diagnosed HIV groups with the prevalence of each individual symptom (present for at least ‘more than half the days’)and with 'overall' prevalence of depression and anxiety, adjusting for gender/sexuality (MSM, heterosexual man, woman), ethnicity (White, other), and time since diagnosis of HIV (<2 years, 2-5 years, 5-10 years, 10-20 years, >20 years). Age was fitted as a categorical variable in the models, with age>=60 years used as the reference category. In additional models, age was fitted as an ordinal variable with values 1 to 5, rather than defined as categorical and tests for linear trend across age groups were performed. Results are presented as odds ratios with 95% confidence intervals.

Where significant differences in depression or anxiety prevalence were found in relation to age or time with diagnosed HIV, further regression analysis was conducted adjusting for potential confounding or mediating health-related risk factors which had been identified as differing by age or time diagnosed with HIV in Chapter 2: money for basic needs (always/not always), alcohol dependence assessed by CAGE questionnaire (yes/no), recreational drug use in the past three months (yes/no) and smoking status (smoker/non/ex-smoker).

The relationship between depression, anxiety and physical symptom measures (symptom prevalence, distress, problems with ADLs and CD4 count) were also assessed using chi squares tests for trend and logistic regression analysis, adjusted for gender/sexuality (MSM, heterosexual man, woman) and ethnicity (white/non-white). These associations were also analysed as interactions of anxiety and depression adjusted for a) age and b) time diagnosed with HIV as grouped variables in a continuous form, in comparison to physical symptom measures.

4.3 Results

4.3.1 Depression

Out of the study population, 884 (27.1%) had a score of ≥10 on the PHQ-9: indicative of moderate/severe depression. By diagnostic group, 645 (20.3%) of the population showed mild depression, 415 (13.1%) showed moderate depression, 247 (7.8%) showed 'moderately severe' depression and 206 (6.5%) showed severe depression. The mean PHQ-9 score was 6.5 (S.D.=6.8) , indicative of mild depression; the median was 4 out of 27 (no depression). *Table 14* reports the mean and median PHQ-9 scores by age and *Table 15* reports the prevalence of each level of depressive symptoms by age.

***Table 14.* The average depression score (PHQ-9) by age group.**

Age in years	**Mean**	**S.D.**	**Median**
<30 (N=158)	7.6	7.3	5
30-40 (N=676)	5.9	6.4	3
40-50 (N=1261)	6.7	7.0	4
50-60 (N=630)	7.0	7.1	5
≥60 (N=185)	5.0	5.8	3

***Table 15.* Prevalence of levels of depression (PHQ-9 diagnostic group) by age group.**

Age	None	Mild	Moderate	Moderately severe	Severe
<30 (N=173)	80 (46.2%)	33 (19.1%)	27 (15.6%)	19 (11.0%)	14 (8.1%)
30-40 (N=740)	425 (57.4%)	140 (18.9%)	87 (11.8%)	53 (7.2%)	35 (4.7%)
40-50 (N=1364)	695 (51.0%)	274 (20.1%)	184 (13.5%)	114 (8.4%)	97 (7.1%)
50-60 (N=686)	335 (48.8%)	151 (22.0%)	93 (13.6%)	54 (7.9%)	53 (7.7%)
>60 (N=215)	130 (60.5%)	47 (21.9%)	24 (11.2%)	7 (3.3%)	7 (3.3%)

When looking at raw depression scores by age group, the mean and median score was highest in the <30s age group and lowest in those aged 60 and over. In terms of levels of depressive symptoms, however, the majority of participants reported 'none' or 'mild depression' in all groups.

In unadjusted analysis, depression was highest in those aged <30 years and lowest in those 60 and over (χ^2, N=3178)=33.57, p=0.006, test for trend). However, this effect was not linear, as depression prevalence rose somewhat across the middle aged groups (30-60 years), then was lower among those aged ≥60. Next, individual symptoms of depression were explored. These are depicted, by question, in table 16, with prevalences shown for participants reporting symptoms as present for at least ‘more than half the days’.

***Table 16.* Depressive symptoms ordered in relation to prevalence.**

Symptom	Present
N=3178	**N (%)**
Feeling tired or having little energy	1013 (31.9%)
Trouble falling or staying asleep, or sleeping too much	924(29.1%)
Feeling bad about yourself - or that you are a failure or have let yourself or your family down	777 (24.4%)
Feeling down, depressed, or hopeless	731 (23.0%)
Little interest or pleasure in doing things	644 (20.3%)
Poor appetite or overeating	590 (18.6%)
Trouble concentrating on things, such as reading the newspaper or watching television	567 (17.8%)
Thoughts that you would be better off dead, or of hurting yourself in some way	342 (10.8%)
Moving or speaking so slowly that other people could have noticed	227 (7.1%)

Similar to the previous chapter, the most prevalent symptoms were ‘lack of energy’ (31.9%) and ‘Difficulty sleeping' (29.1%). These were followed by 'feeling bad about yourself' (24.4%)

and 'feeling down, depressed, or hopeless (23.0%). In fact, as shown in *Figure 14,* fatigue symptoms were reported at a higher prevalence than depression overall. However, 'trouble concentrating' was far less prevalent (17.8%). The least prevalent depressive symptoms were 'suicidal tendencies' and 'moving/speaking slowly'. This pattern held true for all age groups, but in those aged 60 and over 'feeling bad about self' and 'trouble concentrating' became less prevalent and 'little interest or pleasure in doing things' increased in likelihood.

***Figure 14.* Prevalence of depressive symptoms (% reporting symptom for 'more than half days' or more) by age.**

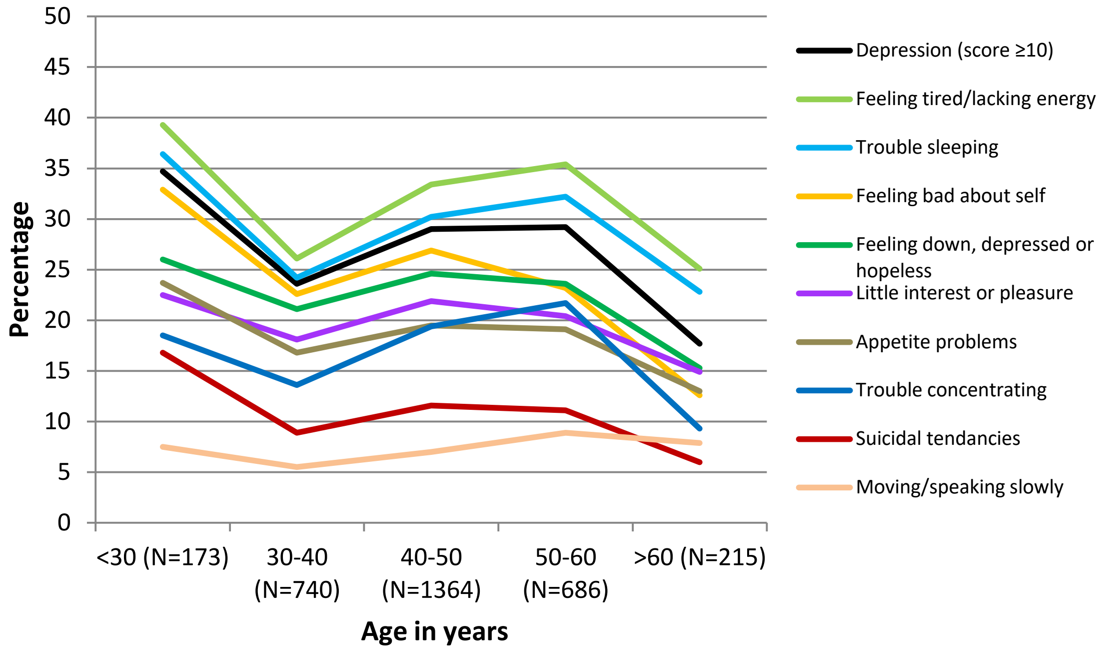


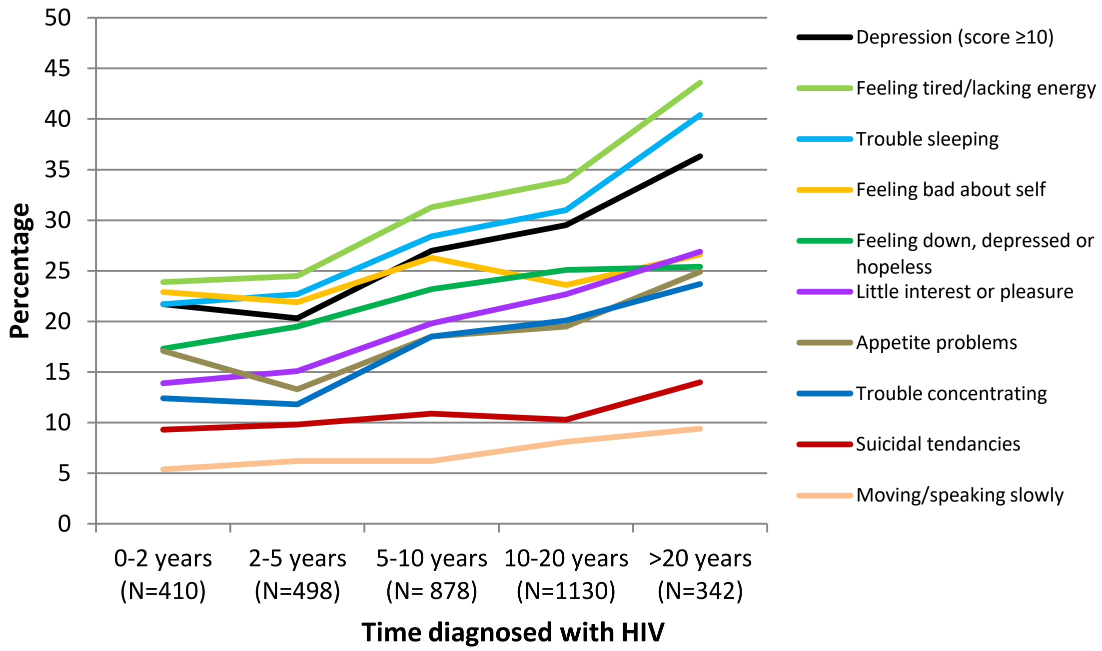
Table 17 reports the mean and median PHQ-9 scores by time diagnosed with HIV. As can be seen, the mean and median depression scores increased with increasing time diagnosed with HIV, with an even greater increase between participants diagnosed for 10-20 years and over 20 years.

***Table 17.* The average depression score (PHQ-9) by time diagnosed with HIV.**

Time diagnosed with HIV	Mean	S.D.	Median
0-2 years (N=410)	5.5	6.4	3
2-5 years (N=498)	5.4	6.3	3
5-10 years (N= 878)	6.4	6.9	4
10-20 years (N=1130)	6.8	6.8	4
>20 years (N=342)	8.1	6.9	7

In unadjusted analysis, this effect was statistically significant (χ^2, N=3258)=35.46, p<.001), with depression symptom prevalence increasing with increasing time diagnosed with HIV. Furthermore, this trend held for the majority of variables, except for 'suicidal tendencies', 'moving/speaking slowly', and 'feeling bad about yourself', for which no significant difference was found in relation to time. This data is depicted in *figure 15*.

***Figure 15.* Prevalence of depressive symptoms (% reporting symptom for 'more than half days' or more) by time diagnosed with HIV.**



The adjusted associations of age and time diagnosed with HIV with symptom prevalence are presented in *Table 18*. Using the overall symptom prevalence measure for depression, after adjustment for gender/sexuality and ethnicity, depression prevalence decreased with age. This trend held true across the majority of individual PHQ-9 symptoms, except 'trouble concentrating', for which there was no overall trend with age. However, when further adjusted for by smoking status, alcohol and drug use, and money for basic needs the linear trend association between age and depression became non-significant (Odds Ratio=0.91, 95% C.I.=0.83-1.00, $p=0.06$ for trend across age groups). This suggests that some of the association between older age and lower depression prevalence was accounted for by differences in socio-economic and/or lifestyle factors.

Longer time diagnosed with HIV, on the other hand, was strongly related to higher prevalence of depression overall, and for each individual PHQ-9 symptom (test for trend across age categories $ps<0.001$). This relationship was not materially altered when further adjusted for by smoking status, alcohol and drug use and money for basic needs (Odds Ratio=1.31, 95% C.I.=1.19-1.44, $p=<.001$ for trend across time with diagnosed HIV groups). In general there was no difference in depression prevalence by gender/sexuality or ethnicity.

Table 18. **Adjusted association of age, time with diagnosed HIV, gender/sexuality and ethnicity with depressive symptom prevalence for the 'overall' measure and individual PHQ-9 symptoms (logistic regression analysis).**

(N=3178)	Overall depression[x]			Feeling tired			Trouble sleeping			Feeling bad about self			Feeling down, depressed		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	<.001			<.001			<.001			<.001			0.02		
Test for trend[$]	*.001*	*0.86*	*(0.79, 0.94)*	*0.07*	*0.92*	*(0.85, 1.01)*	*0.02*	*0.90*	*(0.82, 0.98)*	*.001*	*0.85*	*(0.78, 0.93)*	*0.04*	*0.90*	*(0.82, 0.99)*
<30	<.001	3.47	(2.12, 5.68)	<.001	2.69	(1.70, 4.25)	<.001	2.88	(1.80, 4.61)	<.001	3.64	(2.14, 6.20)	.001	2.35	(1.39, 3.97)
30-40	.004	1.83	(1.22, 2.74)	0.14	1.32	(0.91, 1.90)	0.07	1.43	(0.98, 2.08)	.001	2.10	(2.10, 3.30)	0.02	1.64	(1.07, 2.51)
40-50	<.001	2.07	(1.42, 3.02)	.004	1.63	(1.17, 2.28)	.004	1.66	(1.17, 2.34)	<.001	2.59	(1.69, 2.96)	.003	1.83	(1.23, 2.72)
50-60	.001	1.95	(1.32, 2.88)	.005	1.66	(1.17, 2.35)	0.01	1.65	(1.15, 2.37)	.001	2.12	(1.36, 3.30)	0.01	1.72	(1.14, 2.60)
60+*		1			1			1			1			1	
Years with HIV	<.001			<.001			<.001			0.12			.002		
Test for trend[$]	*<.001*	*1.24*	*(1.15, 1.34)*	*<.001*	*1.24*	*(1.15, 1.33)*	*<.001*	*1.23*	*(1.15, 1.33)*	*0.04*	*1.08*	*(1.00, 1.17)*	*<.001*	*1.18*	*(1.09, 1.27)*
0-2*		1			1			1			1			1	
2-5	0.68	0.93	(0.67, 1.29)	0.78	1.05	(0.77, 1.43)	0.66	1.07	(0.78, 1.48)	0.77	0.95	(0.69, 1.31)	0.37	1.17	(0.83, 1.65)
5-10	0.02	1.40	(1.05, 1.86)	.004	1.50	(1.14, 1.98)	0.01	1.50	(1.13, 1.99)	0.16	1.23	(0.92, 1.63)	0.02	1.46	(1.07, 1.98)
10-20	.001	1.63	(1.23, 2.16)	<.001	1.66	(1.26, 2.17)	<.001	1.66	(1.25, 2.19)	0.36	1.14	(0.86, 1.51)	.001	1.68	(1.24, 2.28)
20+	<.001	2.29	(1.62, 3.22)	<.001	2.44	(1.75, 3.39)	<.001	2.41	(1.72, 3.38)	0.04	1.44	(1.01, 2.04)	.001	1.84	(1.27, 2.67)
Sex	0.47			0.12			0.10			0.01			.001		
MSM*		1			1			1			1			1	
Hetero male	0.96	1.01	(0.77, 1.32)	0.04	0.76	(0.58, 0.99)	0.70	0.77	(0.59, 1.02)	0.03	1.36	(1.04, 1.77)	0.02	1.40	(1.06, 1.84)
female	0.23	1.15	(0.92, 1.43)	0.92	0.99	(0.80, 1.23)	0.12	0.84	(0.67, 1.05)	0.01	1.35	(1.08, 1.69)	.001	1.48	(1.17, 1.86)
Ethnicity Other*		1			1			1			1			1	
White	0.56	1.06	(0.88, 1.26)	0.39	1.08	(0.91, 1.28)	0.03	1.21	(1.01, 1.44)	0.22	0.89	(0.74, 1.07)	0.64	0.96	(0.79, 1.16)

[x]PHQ-9 score of ≥10 *reference group [$]trend across age groups

(N=3178)	Little interest in things			Appetite problems			Trouble concentrating			Suicidal ideation			Moving/speaking slowly		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	0.02			0.01			<.001			.003			0.27		
Test for trend[$]	*0.01*	*0.88*	*(0.80, 0.97)*	*0.01*	*0.87*	*(0.78, 0.96)*	*0.38*	*0.95*	*(0.86, 1.06)*	*0.03*	*0.87*	*(0.76, 0.99)*	*0.15*	*1.12*	*(0.96, 1.31)*
<30	.002	2.36	(1.37, 4.06)	<.001	2.72	(1.56, 4.72)	.001	2.99	(1.61, 5.57)	<.001	3.62	(1.77, 7.39)	0.98	1.01	(0.46, 2.22)
30-40	0.04	1.57	(1.01, 2.42)	0.03	1.66	(1.05, 2.62)	0.02	1.86	(1.11, 3.13)	0.10	1.71	(0.91, 3.22)	0.26	0.70	(0.38, 1.30)
40-50	0.01	1.71	(1.14, 2.56)	0.01	1.76	(1.15, 2.69)	<.001	2.49	(1.53, 4.04)	0.01	2.16	(1.20, 3.90)	0.57	0.85	(0.49, 1.47)
50-60	0.07	1.48	(0.97, 2.26)	0.04	1.60	(1.03, 2.49)	<.001	2.73	(1.66, 4.49)	0.03	1.97	(1.07, 3.64)	0.68	1.13	(0.64, 1.98)
60+*		1			1			1			1			1	
Years with HIV	<.001			<.001			<.001			0.19			0.23		
Test for trend[$]	*<.001*	*1.28*	*(1.17, 1.39)*	*<.001*	*1.17*	*(1.08, 1.28)*	*<.001*	*1.24*	*(1.14, 1.36)*	*0.07*	*1.10*	*(0.99, 1.22)*	*0.03*	*1.15*	*(1.01, 1.30)*
0-2*		1			1			1			1			1	
2-5	0.63	1.10	(0.75, 1.60)	0.11	0.74	(0.51, 1.07)	0.93	0.98	(0.65, 1.47)	0.64	1.11	(0.71, 1.74)	0.50	1.22	(0.69, 2.14)
5-10	0.01	1.55	(1.11, 2.15)	0.42	1.14	(0.83, 1.56)	0.01	1.58	(1.12, 2.24)	0.24	1.27	(0.85, 1.90)	0.63	1.13	(0.68, 1.90)
10-20	<.001	1.94	(1.40, 2.69)	0.16	1.25	(0.92, 1.71)	.001	1.77	(1.26, 2.50)	0.40	1.19	(0.80, 1.79)	0.10	1.51	(0.92, 2.49)
20+	<.001	2.51	(1.71, 3.70)	.004	1.75	(1.20, 2.55)	<.001	2.24	(1.49, 3.35)	0.03	1.72	(1.07, 2.78)	0.07	1.74	(0.97, 3.13)
Sex	0.70			0.72			0.13			0.73			0.06		
MSM*		1			1			1			1			1	
Hetero male	0.62	1.08	(0.80, 1.45)	0.53	0.90	(0.66, 1.24)	0.67	1.07	(0.78, 1.47)	0.48	1.15	(0.79, 1.67)	0.58	1.14	(0.72, 1.79)
female	0.43	1.10	(0.86, 1.41)	0.73	1.05	(0.81, 1.35)	0.05	1.30	(1.01, 1.68)	0.59	1.09	(0.79, 1.50)	0.02	1.55	(1.08, 2.22)
Ethnicity Other*		1			1			1			1			1	
White	0.49	0.93	(0.77, 1.14)	0.42	1.09	(0.89, 1.34)	0.79	1.03	(0.83, 1.27)	0.77	1.04	(0.80, 1.34)	0.21	0.82	(0.60, 1.12)

[x]PHQ-9 score of ≥10 *reference group [$]trend across age groups

4.3.2 **Anxiety**

Of the study population, 715 (21.9%) scored ≥10 on the GAD-7, indicative of moderate/severe anxiety. By diagnostic group, 696 (21.9%) of the population showed mild anxiety, 386 (12.1%) showed moderate anxiety, and 315 (9.9%) showed severe anxiety. The mean GAD-7 score was 12.49 (S.D.=5.9), indicative of moderate anxiety: the median was 11 out of 21, also indicative of moderate anxiety. *Table 19* reports the mean and median GAD-7 scores by age and *Table 20* reports the prevalence of each level of symptoms group by age.

Table 19. **The average anxiety score (GAD-7) by age group.**

Age in years	**Mean**	**S.D.**	**Median**
<30 (N=160)	13.7	6.3	12
30-40 (N=688)	12.0	5.6	10
40-50 (N=1260)	12.7	5.9	11
50-60 (N=633)	12.9	6.2	11
≥60 (N=190)	10.7	4.8	9

Table 20. **Prevalence of levels of anxiety (GAD-7 diagnostic group) by age group.**

Age	**None**	**Mild**	**Moderate**	**Severe**
<30 (N=173)	86 (49.7%)	38 (22.0%)	23 (13.3%)	26 (15.0%)
30-40 (N=740)	432 (58.4%)	163 (22.0%)	83 (11.2%)	62 (8.4%)
40-50 (N=1364)	735 (53.9%)	308 (22.6%)	181 (13.3%)	140 (10.3%)
50-60 (N=686)	379 (55.2%)	147 (21.4%)	80 (11.7%)	80 (11.7%)
>60 (N=215)	149 (69.3%)	40 (18.6%)	19 (8.8%)	7 (3.3%)

When looking at raw anxiety scores by age group, the mean and median score was highest in the <30s age group and lowest in those aged 60 and over, but in all groups the majority of participants reported 'none' or 'mild anxiety'. Therefore this effect was not significant. In unadjusted analysis, anxiety was highest in those aged <30 years and lowest in those 60 and over (χ^2, N=3178)=33.77, p=0.001). Next, individual symptoms of the GAD-7 were explored. These are depicted, by question, in *table 21*.

***Table 21.* Symptoms of anxiety ordered in relation to prevalence.**

Symptom	Present
N=3178	N (%)
Worrying too much about different things	806 (25.4%)
Feeling nervous, anxious or on edge	735 (23.1%)
Becoming easily annoyed or irritable	706 (22.2%)
Trouble relaxing	703 (22.1%)
Not being able to stop or control worrying	690 (21.7%)
Feeling afraid as if something awful might happen	602 (18.9%)
Being so restless that it is hard to sit still	460 (14.5%)

The most prevalent symptoms were 'worrying too much (25.4%), 'feeling nervous' (23.1%), and 'becoming easily annoyed' (22.2%). The least prevalent anxiety symptoms were 'feeling afraid', and 'restlessness'. As depicted in *figure 16*, this pattern held true for all age groups, but in those aged 60 and over 'feeling nervous' became less prevalent and 'lack of control' increased in likelihood. All anxiety symptoms were lowest in those aged 60 and over and highest in those aged <30, with little variation over the middle age ranges (30-60 years).

***Figure 16*. Prevalence of anxiety symptoms (%) by age.**

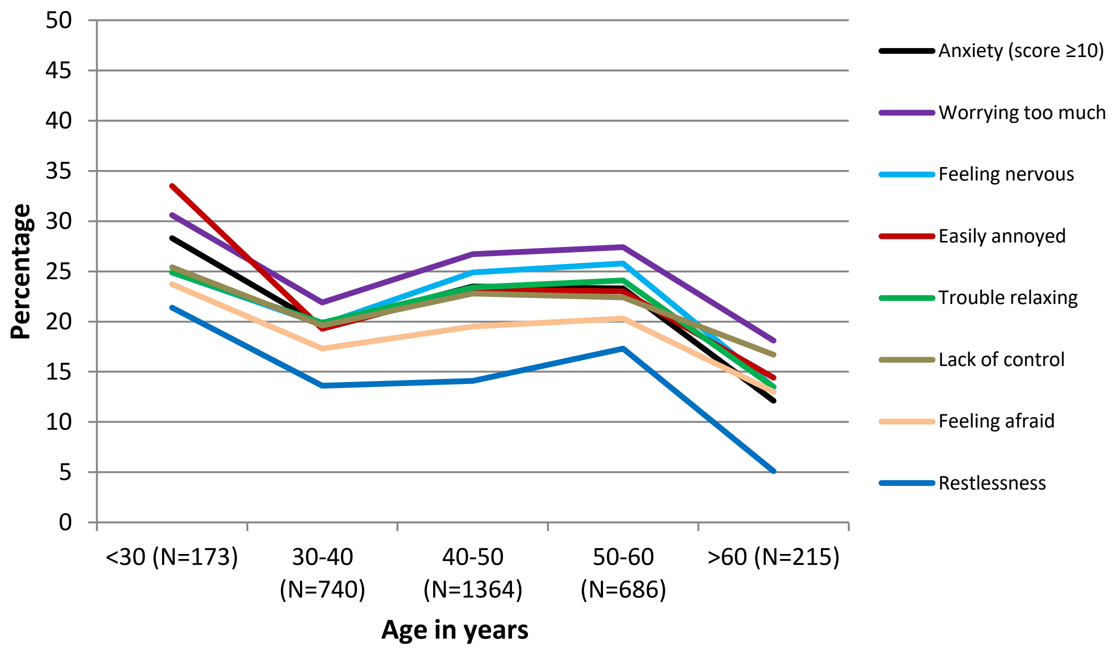


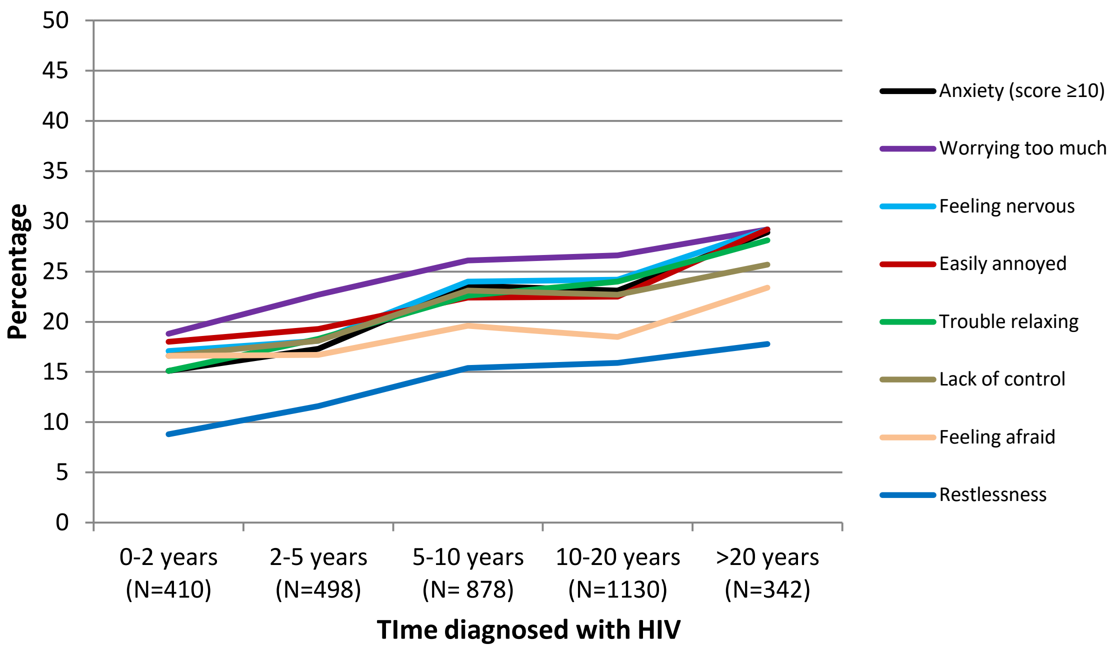
Table 22 reports the mean and median GAD-7 scores by time diagnosed with HIV. Both the mean and median anxiety scores increased with increasing time diagnosed with HIV.

Table 22. **The average anxiety score by time diagnosed with HIV.**

Time diagnosed with HIV	**Mean**	**S.D.**	**Median**
<30 (N=160)	4.4	5.2	3
30-40 (N=688)	4.7	5.4	3
40-50 (N=1260)	5.5	6.0	3
50-60 (N=633)	5.7	5.8	4
≥60 (N=190)	6.4	6.1	5

In unadjusted analysis, this increase in anxiety with increasing time diagnosed with HIV was significant (χ^2, N=3258)=29.53, p<.001). As depicted in *figure 17*, this pattern held true for all variables, except for 'feeling afraid as if something awful might happen' which did not differ significantly with time diagnosed with HIV.

***Figure 17*. Prevalence of anxiety symptoms (%) by time diagnosed with HIV.**



The adjusted associations of age and time diagnosed with HIV with symptom prevalence are presented in *Table 23* for anxiety overall and for individual symptoms of GAD-7. Using the overall symptom prevalence measure, after adjustment for gender/sexuality and ethnicity, anxiety prevalence decreased with age. This trend held true for the symptoms 'easily annoyed/irritable', 'trouble relaxing', and 'restlessness', but no significant trend with age was found for any of the other symptoms. Anxiety was significantly higher in all age groups less than 60 years of age, in comparison to participants aged 60 and over, and highest in those aged under 30, in relation to all symptoms. This relationship was not materially altered when further adjusted for by smoking status, alcohol and drug use and money for basic needs (Odds Ratio=0.89, 95% C.I.=0.80-0.99, p=0.03 for trend across age groups).

Longer time diagnosed with HIV, on the other hand, was strongly related to increases in prevalence of anxiety and each GAD-7 symptom (test for trend across categories ps<0.001). This relationship was not materially altered when further adjusted for by smoking status, alcohol and drug use and money for basic needs (Odds Ratio=1.24, 95% C.I.=1.13-1.37, p=<.001 for trend across age groups). In general there was no difference in anxiety prevalence by gender/sexuality or ethnicity in adjusted models.

Table 23. **Adjusted association of age, time with diagnosed HIV, gender/sexuality and ethnicity with anxiety symptom prevalence for the 'overall' measure and individual GAD-7 symptoms (logistic regression analysis).**

(N=3178)	Overall anxiety[x]			Worrying too much			Feeling nervous			Easily annoyed/irritable		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	<.001			.004			.001			<.001		
Test for trend[$]	*.002*	*0.86*	*(0.78, 0.94)*	*0.35*	*0.96*	*(0.87, 1.05)*	*0.11*	*0.93*	*(0.84, 1.02)*	*.001*	*0.85*	*(0.77, 0.94)*
<30	<.001	3.81	(2.19, 6.60)	.002	2.18	(1.33, 3.59)	<.001	2.66	(1.55, 4.58)	<.001	3.77	(2.24, 6.32)
30-40	.002	2.11	(1.33, 3.35)	0.20	1.31	(0.87, 1.95)	0.01	1.82	(1.17, 2.85)	0.02	1.69	(1.09, 2.61)
40-50	<.001	2.38	(1.54, 3.67)	0.01	1.63	(1.12, 2.36)	<.001	2.24	(1.48, 3.40)	.002	1.92	(1.28, 2.88)
50-60	<.001	2.25	(1.44, 3.52)	0.01	1.70	(1.15, 2.50)	<.001	2.25	(1.47, 3.45)	0.01	1.80	(1.18, 2.75)
60+*		1			1			1			1	
Years with diagnosed HIV	<.001			0.01			<.001			.001		
Test for trend[$]	*<.001*	*1.25*	*(1.15, 1.35)*	*<.001*	*1.15*	*(1.07, 1.24)*	*<.001*	*1.18*	*(1.09, 1.28)*	*<.001*	*1.18*	*(1.09, 1.28)*
0-2*		1			1			1			1	
2-5	0.30	1.21	(0.84, 1.74)	0.09	1.33	(0.96, 1.85)	0.59	1.10	(0.78, 1.56)	0.53	1.12	(0.79, 1.57)
5-10	<.001	1.83	(1.33, 2.52)	.004	1.54	(1.14, 2.07)	.004	1.57	(1.16, 2.14)	0.04	1.40	(1.02, 1.89)
10-20	<.001	1.83	(1.33, 2.53)	.001	1.62	(1.21, 2.17)	.004	1.56	(1.15, 2.12)	0.02	1.46	(1.08, 1.98)
20+	<.001	2.65	(1.81, 3.87)	.001	1.87	(1.31, 2.68)	<.001	2.04	(1.41, 2.93)	<.001	2.13	(1.48, 3.07)
Sex	0.03			<.001			0.29			0.11		
MSM*		1			1			1			1	
Hetero male	0.45	1.12	(0.84, 1.50)	0.88	1.03	(0.77, 1.35)	0.64	0.93	(0.70, 1.25)	0.80	0.96	(0.72, 1.30)
female	0.01	1.38	(1.09, 1.74)	<.001	1.53	(1.23, 1.91)	0.19	1.17	(0.93, 1.48)	0.05	1.26	(1.00, 1.60)
Ethnicity		1			1			1			1	
Other*												
White	0.89	1.01	(0.84, 1.23)	0.46	0.93	(0.78, 1.12)	0.52	1.07	(0.88, 1.29)	0.31	1.11	(0.91, 1.34)

[x]GAD-7 score of ≥10 *reference group [$]trend across age groups

(N=3178)	Trouble relaxing			Lack of control			Feeling afraid			Restlessness		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	.003			0.07			0.05			<.001		
Test for trend[$]	*0.02*	*0.89*	*(0.81, 0.98)*	*0.12*	*0.93*	*(0.84, 1.02)*	*0.35*	*0.95*	*(0.86, 1.05)*	*<.001*	*0.81*	*(0.72, 0.90)*
<30	<.001	2.85	(1.65, 4.91)	0.01	2.03	(1.21, 3.40)	0.01	2.07	(1.19, 3.61)	<.001	7.63	(3.67, 15.86)
30-40	.004	1.93	(1.23, 3.01)	0.16	1.35	(0.89, 2.05)	0.16	1.39	(0.88, 2.19)	<.001	3.74	(1.94, 7.21)
40-50	<.001	2.10	(1.29, 3.19)	0.03	1.52	(1.03, 2.23)	0.03	1.58	(1.04, 2.42)	<.001	3.32	(1.77, 6.23)
50-60	.001	2.05	(1.34, 3.16)	0.07	1.45	(0.97, 2.17)	0.02	1.70	(1.09, 2.64)	<.001	3.99	(2.10, 7.56)
60+*		1			1			1			1	
Years with diagnosed HIV	<.001			.003			0.05			<.001		
Test for trend[$]	*<.001*	*1.21*	*(1.12, 1.31)*	*<.001*	*1.16*	*(1.07, 1.26)*	*0.01*	*1.11*	*(1.03, 1.21)*	*<.001*	*1.26*	*(1.15, 1.39)*
0-2*		1			1			1			1	
2-5	0.19	1.27	(0.89, 1.82)	0.35	1.18	(0.83, 1.68)	0.73	1.07	(0.75, 1.52)	0.15	1.39	(0.89, 2.17)
5-10	.002	1.68	(1.22, 2.32)	0.01	1.57	(1.15, 2.14)	0.14	1.27	(0.93, 1.75)	<.001	2.10	(1.42, 3.13)
10-20	<.001	1.82	(1.33, 2.50)	.004	1.57	(1.15, 2.15)	0.20	1.23	(0.90, 1.69)	<.001	2.26	(1.52, 3.36)
20+	<.001	2.27	(1.55, 3.31)	.001	1.93	(1.32, 2.80)	0.01	1.73	(1.18, 2.54)	<.001	2.62	(1.64, 4.17)
Sex	0.15			0.01			<.001			0.39		
MSM*		1			1			1			1	
Hetero male	0.42	0.88	(0.65, 1.20)	0.15	1.24	(0.93, 1.64)	0.28	1.18	(0.87, 1.59)	0.21	1.24	(0.89, 1.75)
female	0.13	1.20	(0.95, 1.52)	.002	1.45	(1.15, 1.83)	<.001	1.68	(1.32, 2.12)	0.39	1.13	(0.85, 1.51)
Ethnicity		1			1			1			1	
Other*												
White	0.06	1.21	(0.99, 1.47)	0.67	1.04	(0.86, 1.27)	0.03	0.80	(0.65, 0.98)	0.07	1.24	(0.98, 1.55)

[x]GAD-7 score of ≥10 *reference group [$]trend across age groups

4.3.3 The associations between physical and psychological symptoms

Of the whole study population, 598 (18.8%) reported both depression and anxiety. This was equivalent to 68.9% of the participants with depression reporting anxiety and 85.2% of the participants with anxiety reporting depression(p<.001). Using chi squared tests, the association of depression and anxiety with CD4 count, symptom distress, and problems with ADLs were assessed. Both depression (PHQ-9 score ≥10) and anxiety (GAD-7 score ≥10) were related to a higher likelihood of physical symptom prevalence, increasing linearly from 8.2% (depression) and 2.6% (anxiety) among participants reporting no present symptoms to 58.4% and 41.2% reporting ten or more respectively. The same was found for distressing symptoms with prevalence of 12.6% and 3.4% for those reporting no distressing symptoms, compared to 89.9% and 76.9% respectively among those reporting at least one. Finally, both depression and anxiety were also reported to a greater likelihood of reporting problems with ADLs. Neither depression nor anxiety prevalence were related to CD4 count. These associations were not greatly altered after adjustment for age and gender/sexuality. The percentages and p values are reported in *table 24*.

Table 24. **Physical symptom prevalence in relation to anxiety and depression.**

	Anxiety (GAD-7 score of ≥10)			Depression (PHQ-9 score of ≥10)		
	Yes	No	p. value	Yes	No	p. value
10 or more symptoms	606 (84.8%)	865 (34.0%)	<.001	770 (87.1%)	701 (29.5%)	<.001
1 or more distressing symptom	666 (93.1%)	1145 (45.0%)	<.001	830 (93.9%)	981 (41.3%)	<.001
1 or more ADL problem	518 (72.4%)	722 (28.4%)	<.001	671 (75.9%)	569 (24.0%)	<.001
CD4 count >350	573 (80.9%)	2047 (81.6%)	0.37	702 (80.4%)	1918 (81.8%)	0.20

Using a logistic regression model, interactions between a) age and b) time with diagnosed HIV (as grouped variables in a continuous form) with depression and anxiety were assessed in relation to physical health as the dependent variable. The models were adjusted for ethnicity and gender/sexuality. Only one significant interaction was found. The logistic model assessing an interaction between age and anxiety, with ≥10 symptoms as the dependent variable, included the following factors: age (as a grouped variable in a continuous form), depression, time with diagnosed HIV (categorical variable), gender/sexuality, ethnicity, and the interaction between age (grouped variable in a continuous form) and anxiety. This revealed an interaction between age by anxiety, in relation to physical symptom prevalence (Odds Ratio for interaction=1.37, 95% C.I.= 1.07-1.75, p=0.01). *Table 25* shows that the association of anxiety with prevalence of ten or more physical symptoms, while present across all age groups, tended to increase with age.

Table 25. **The relationship between age, anxiety, and physical symptom prevalence.**

Age in years	**Anxiety***	**Physical symptom prevalence**	
		0-9 symptoms	10 or more symptoms
<30	No	85 (68.5%)	39 (31.5%)
	Yes	16 (32.7%)	33 (67.3%)
30-40	No	429 (72.1%)	166 (27.9%)
	Yes	32 (22.1%)	113 (77.9%)
40-50	No	684 (65.6%)	359 (34.4%)
	Yes	39 (12.1%)	282 (87.9%)
50-60	No	311 (59.1%)	215 (40.9%)
	Yes	16 (10.0%)	144 (90.0%)
60+	No	120 (63.5%)	69 (36.5%)
	Yes	3 (11.5%)	23 (88.5%)

*GAD-7 score of ≥10

4.4 Discussion

The aim of this chapter was to assess, amongst the ASTRA population, the association of age with a) depression, b) anxiety, and c) associations between mental and physical symptoms and whether these associations differed according to age or time diagnosed with HIV, taking into account ender/sexuality and ethnicity.

The results showed that 27.1% of the ASTRA population had moderate or severe depression, 21.9% had moderate or severe anxiety, and 18.8% reported both. In adjusted analysis depression and anxiety prevalence there was a significant linear trend of decreasing prevalence with age. The changes with age in anxiety prevalence were not mediated by demographic or risk factors (money for basic needs, alcohol dependency, smoking status, and recreational drug use), but the changes in depression with age neared significance. This suggests that the comparatively high prevalence of depression in younger PWH are to some extent related to lower levels of health-related behaviours, or poorer socio-economic circumstances, among younger compared to older PWH.

Anxiety and depression were both found to be related to an increase in symptom prevalence, symptom distress and problems with ADLs, but not CD4 count. With increasing age the relationship between anxiety and symptom prevalence strengthened, such that older adults with anxiety were more likely to report physical symptoms.

Depression and anxiety are common in chronic illness[58;63;219;221] and older age[56-58] up until the age of 55, where prevalence may decrease again (according to UK statistics)[218]. Similar to the general population, the results showed rates of poor mental health which increased from the ages of 30-60, before decreasing in older age. However, the results also showed evidence that depression prevalence is roughly ten times higher amongst PWH when compared to prevalence found in the general UK population, and anxiety rates four times higher (27.3 vs. 2.3% and 22.1 vs. 4.4% respectively)[263]. This strongly highlights the detrimental effects of HIV on mental health, although it cannot prove causality. The results also underline the need to assess changes in well-being across the entire age spectrum, rather than combining all adults over the age of 50.

In the HIV-specific literature, depression has generally not been found to differ by age group[64;120;129;138;145-148]. This may be due to the high levels of depression identified in PWH of all ages[84;85], which is thought to be related to poorer physical function[84;85;87;88;258;259], health-induced anxiety[84;89;90], feeling a lack of control[86;258;260], social isolation[85;90-92;258;261], and maladaptive coping strategies[89;91]. Strong relationships were apparent between physical function, anxiety, and depression, in line with the first two conclusions. Only one question in the ASTRA study explored feeling of control ("Not being able to stop or control worrying" - GAD-7), which identified that 21.7% of PWH did not feel in control of their anxiety: very similar to the prevalence of overall depression and anxiety. However, as the data presented here is not longitudinal we cannot comment on the direction of these relationships. For example, while it is possible that poor physical function causes distress in PWH, it is also possible that depression causes poorer physical function through over-eating, sedentary behaviour[60;63;91;222;223], and worse adherence to medication and health-management activities[227-230].

Unlike the previous literature, these results identified a decrease in depression and anxiety prevalence with age. As depression and anxiety prevalence increased with time diagnosed with HIV, this suggests that previous results shown in the literature are caused by the amalgamation of these two factors. Specifically, this may in part explain lack of trend with age in previous studies, as decreasing trends with age become more marked once adjusted for time with diagnosed HIV. As such, future studies should adjust for time with HIV when assessing the effects of age. However, the differences between ASTRA - and previous - results may also reflect differences between American and English populations, such as the lessened mental health burden caused by universal healthcare.

Depression was previously thought to be apparent in roughly 30% of OPWH[91], which matched the unadjusted rates identified in the ASTRA participants aged 50-60 years old (29.2%) but not those aged 60 and over (17.7%). Only one previous study reported age-difference in depression in OPWH, which also found that depression became less prevalent in older-OPWH[261]. This suggests that, with age, PWH may develop more adaptive coping methods and that this process may continue into later life.

Anxiety has not been researched much in relation to older age, chronic illness or HIV, meaning that there is little data to compare to the present results. However, anxiety has been found to be higher in adults who report poor overall health[249;255] and/or chronic illness[252-254], which corresponds with the higher prevalence found in this population. Depression and anxiety are thought to be high in older adults in the general population due to disengagement with social roles due to declining health, bereavement, and increased economic strain[57;59;60]. In PWH these stressors are available at most ages so older adults may not be at an increased risk. Previous research also posits that older adults may face fewer high-demand situations due to retirement, leaving increased time and mental reserves for coping with physical distress[264-266].

Older adults have also been found to report fewer negative emotional experiences than younger adults[237-239] and may selectively attend to positive events and situations[241-244]. This may explain the comparatively lower prevalence of depression with increasing age. It would also suggest that Cartensen's Socioemotive selective theory[241] may still be applicable to an HIV-positive population. Alternatively, it is also possible that the results reflect better 'resilience' in older adults[200], developed throughout their lifespan[90;135;152]. However, the age-related differences in depression (if not anxiety) were also mediated by the improved demographic variables in the older population (greater proportion with money for basic needs, lower alcohol dependency etc.), suggesting that age itself is not the only factor that needs to be taken into account when assessing depression in PWH.

In relation to the specific symptoms of depression and anxiety, the most common symptoms were 'feeling tired' (31.9%) and 'trouble sleeping' (29.1%). This correlates with the physical symptom prevalence reported in the last chapter, where the most common symptoms were 'lack of energy' (64.9%), 'feeling drowsy/tired' (64.6%), and 'difficulty sleeping' (58.0%). The fact that the rates were twice as high in the MSAS-SF scale may indicate that participants consider these symptoms to be physical - rather than psychological - in origin. Alternatively this difference may be due to physical symptoms being coded as occurring at all in the past two weeks, while psychological symptoms had to occur for 'more than half the days' in the past two weeks.

4.4.1 **The relationship between mental and physical symptoms**

In the literature, depression has been associated with increased mortality and symptom burden, difficulties with ADLs and decreased health-care use[56;57;200;221;222]. Anxiety has been related to poor overall health[249;255], chronic illness[252-254], and an increase in health-related behaviours[256;257]. With anxiety and depression present, the prevalence and severity of symptoms and likelihood of reporting problems with ADLs increased in the ASTRA population. However, CD4 count did not differ by mental health status in relation to either variable. It can be argued that this occurred for two reasons: firstly a CD4 count of over 350 cells/mm^3 was so prevalent in this sample (81.2%) that no statistical difference was apparent. Secondly, PWH who were highly depressed/anxious to the point of avoidant behaviour are unlikely to come to the clinics for check-up and so were not included in this study. However, the length of the study (two years) may preclude this. It is worth noting, at this point, that while we can accept the association between physical and mental health suggested in the literature due to its correlation to the current results, the association between depression and symptom prevalence can also be explained through methodological similarities: the PHQ-9 includes four questions on symptoms which were also present in the MSAS-SF (tiredness, difficulty concentration, lack of appetite and difficulty sleeping). As this account for 44% of the PHQ-9 symptoms one would expect a high rate of correlation between these two variables.

Some differences in the association between mental and physical health were also observed by age. Specifically, in older PWH anxiety was related more strongly to symptom prevalence than in younger adults. This suggests that declines in physical health are of more concern to OPWH. It is possible that older PWH who report symptom prevalence are more anxious due to feelings of ageing prematurely[262], bereavement[86] and/or a failure to adapt to age-related health limitations[267]. However, in light of the lower symptom distress and lower anxiety reported in older adults than younger adults, it is more likely that the reverse is true: that having anxiety increases the likelihood of reporting symptom prevalence in older adults. This could relate to maladaptive health behaviours, which can cause disproportionately greater ill health in older adults due to immunosenesnce[25;52;53;127;173].

4.4.2 **Time with diagnosed HIV**

With longer time diagnosed with HIV, depression, and anxiety prevalence increased both overall and in relation to each individual symptom. Furthermore, these changes continued to be significant when adjusted for demographic and risk factors associated with growing old with HIV (smoking status, alcohol and drug use, and money for basic needs). This result allows us to exclude the theory that depression is lower in OPWH due to increased depression prevalence at diagnosis. It also makes it likely that the ‘selective surivival’[247] theory of positive mental health in older adults can be excluded from discussion. In other words, based on the strong correlation between good mental and physical health, it is unlikely that this population survived longer with HIV *due to* high prevalence of depression and anxiety.

The few studies identified in the literature which explored time with diagnosed HIV reported that depression is higher in newly diagnosed PWH[88;89;258] and improves as participants develop more effective coping strategies and come to terms with their diagnosis. However the ASTRA results reported the opposite - with particularly high depression rates in PWH diagnosed for over 20 years - which suggests that PWH may not be developing effective coping strategies, or are experiencing too many changes in health-related stress over time to design effectively adaptive strategies.

Alternatively, it is possible that the high rates of depression in participants diagnosed for longer than twenty years is due to the physical symptoms of depression included in the PHQ-9. Namely, the largest increases in prevalence in this group were in relation to 'tiredness/lack of energy' and 'difficulty sleeping', which is a common side-effect of HIV[197-199]. This would not, however, explain the increases in depression and anxiety over time overall, which suggests that mental symptom distress is not wholly related to the trauma of early HIV infection.

These results suggest that adults are likely to cope better with HIV at older ages, but that this does not hold true for adults growing older with HIV. Based on the linear relationship between depression, anxiety and time diagnosed with HIV this does not appear to be related to calendar year of diagnosis, but it more likely a cumulative effect of living with HIV. In other words there is a need to distinguish between people who are diagnosed with HIV at an older age, and those who at a similar age have lived with HIV for many years: the latter are the group at much higher risk for psychological distress. It is possible that the reported increases in symptom prevalence and distress with time diagnosed with HIV leaves this subpopulation at risk of higher levels of HIV- and mortality-related stress. Furthermore, when faced with worse physical stressors, and changing health and mobility, it may be more difficult for these PWH to develop effective coping strategies[217].This would be especially true in the face of reduced social support though bereavement. Indeed, anxiety rates have been related to low social support[249;255], which will be explored in-depth in chapter 5.

4.4.3 **Limitations**

Some limitations have already been mentioned in the discussion but, briefly, there are several main limitations to this analysis. Firstly, mental and physical health are inextricably interlinked, as were the measures used to assess symptom prevalence and depression. The overlap between these two scales may be responsible for the strong link between depression and symptom prevalence. Secondly, where no response was indicated in regards to questions from the PHQ-9 and GAD-7 we recorded the respondent as not feeling the symptom in the past two weeks. As such, the depression and anxiety prevalence reported here may be lower than is prevalent in the HIV-positive population.

As mentioned before, the cross-sectional nature of this data prevents us from defining the direction of the relationship between mental and physical variables. Finally, due to the number of statistical tests run type I errors are a possibility. As such, the interactions between variables should be interpreted with caution. This should also be kept in mind in relation to the interactions presented in Chapter 5.

4.4.4 **Conclusions and Implications**

Previous data on PWH reported no difference in depression rates with age and insufficient data in relation to anxiety. Only one high-quality UK study was identified and the majority of researchers did not explore depression across more than two (<50> years of age) age groups, or the impact of amount of time diagnosed with HIV. The information provided in this chapter begins to address these limitations and suggest that a) depression and anxiety decrease with age in a UK population of PWH, b) that age-related changes in mental health occur beyond the '≥50 years of age' cut-off, and c) that time with diagnosed HIV needs to be taken into account when assessing age-related changes in mental health. More specifically, extremely high depression and anxiety prevalence was identified in the HIV-positive population, which in turn were related to increased physical symptom prevalence, symptom distress and problems with ADLs. The results presented here appear to disprove the theory that low depression prevalence in OPWH is an artefact of increased depression prevalence at HIV diagnosis, as depression and anxiety increased in prevalence with time diagnosed with HIV. Finally, CD4 count was shown to not be an appropriate measure of well-being in PWH, as it was generally unrelated to mental health. It can be suggested that the high prevalence of depression and anxiety in PWH are due to poorer physical function[84;85;87;88;258;259], health-induced anxiety, and feeling a lack of control: as suggested in the literature.

Depression and anxiety may be lower in OPWH due to adaptive coping methods, developed over the lifespan (as found in the general UK population), the 'positivity effect', fewer high-stress demographic characteristics and/or mediating factors such as higher rates of resilience. Once again, time with diagnosed HIV was a much stronger predictor of poor well-being than age, and this did not seem to be related to calendar year of diagnosis before and after effective ART. This should be explored further.

Depression and anxiety are important facets of well-being, both in themselves and in relation to their effects on health. The results so far strongly suggest differences in physical and mental well-being with age, but that older adults do not necessarily have a higher burden of symptoms. Adults ageing with HIV, however, show consistently poorer well-being and are in need of tailored care. In light of the high prevalence of depression and anxiety in the HIV-positive population, however, it can be suggested that coping-improvement programmes are included in interventions to improve the well-being of PWH at all ages. It can also be suggested, in light of the 'time with diagnosed HIV' results, that it is imperative for HIV participant care to continue across a participant's lifespan: even when CD4 count is stable.

5 Age, time with diagnosed HIV, and social well-being

5.1 Background

Social, mental and physical health are strongly and inextricably linked as measures of well-being. From a theoretical perspective, there are several possibilities as to why these relationships might exist. Social relationships might boost feelings of self-worth and self-mastery, which are needed for health maintenance and well-being[65;268]. They may also enable encouragement of health-seeking and health-promoting behaviours - such as adherence to medication - through mimicry and reinforcement[72;166;268;269]. Finally, social relationships may create a buffer to psychological distress and provide physical support in the case of illness[269;270]. In the case of older adults, where chronic health conditions and complex medication management regimens are increasingly likely, social support may be especially important to physical and mental health adjustment.

5.1.1 Social support

Levels of social support are generally found to be lower in older adults than younger adults[64-66]. This difference has been attributed to several factors, including retirement[97], illness[64;97], loss of friends and family through bereavement[64;97;117;271] and reduced mobility[69;76]. As such it has been observed that many older adults tend to focus on maintaining small, highly valued social groups in order to conserve emotional and physical resources, rather than developing a large, diverse, social network (Cartensen's socioemotional selectivity theory)[64;67;68]. An example of this is present in the Louisiana Healthy Aging Study (LHAS), which explored the effects of social support across age group in 364 American participants in 2013[71]. They found that adults aged 60-89 showed lower satisfaction with social support and a lower proportion of time spent in social activities or outside their home compared to those aged 21-59[71]. This illustrates that not only is social support lower in older adults, but that may be affected by reductions in mobility.

The reduction in social network size that may occur in older age does not undermine the importance of these relationships to older adult's mental and physical health. Indeed, social support has been well documented as being associated with health outcomes in later life[70] as mentioned briefly in the previous chapters in relation to PWH. For example, older adults' family's attitudes to exercise have been identified as a barrier to physical fitness[69] and, in return, PWH report becoming more selective of their social activities with age in order to conserve energy[69;76]. Similarly, depression may reduce social function in older PWH through disengagement with social roles[57;59;60], and reduced social health, in turn, increases the risk of depression and anxiety through isolation[85;90-92;258;261] and reduced coping resources (social support)[249;255]. Social isolation has also been associated with increased systolic blood pressure[272] infection[273], depression[274] and mortality[275]. These relationships are especially salient in older adults[72] with recent cross-sectional, longitudinal and qualitative studies showing that increased social support is related to reduced age-related declines in health[71;72;276], increased physical activity[69], decreased mortality risk[73] and lower prevalence of depression[74].

5.1.2 **Partner and Parental status**

Stable, long-term relationships can also promote health in a very similar way to general social support; stable relationships provide emotional and physical care, as well as economic support[270]. The health effects of marital status have been shown to accumulate over time[277], becoming disproportionately large in older adulthood; with one study findings that married individuals show far higher rates of physical health than those without a partner; assuming that the partner is in good health[269]. This may be due to an increase in reliance on partners for social support and physical support with decreasing social circle size[269], as well as the role spouses have as informal care-givers in promoting their partner's well-being and medication management[269]. It is also possible that individuals feel an increased need for self-regulation of health in order to protect their loved ones from bereavement or chronic health care needs[270]. However, it is worth noting that no literature into the health effects of stable, long-term relationship or civil partnerships was found in relation to MSM; barring literature on fidelity and sexual health. While these relationships are likely to have a similar effect across sexualities, the lack of evidence is a limitation when applying these results to an HIV-positive population.

Relative to their married counterparts, unmarried older adults have higher rates of chronic illness[278] and mortality[70]. Furthermore, adults over 50 in self-assessed 'positive' relationships (those where they felt that they could rely on their partner for support) show lower prevalence of anxiety, depression and suicidal ideation than those in 'negative' relationships[74]. However, it is important to note that there is a level of selection in marriage; that is, partners with higher physical, mental, emotional and economic health are considered more desirable and are more likely to attain long-term relationship status[268;279]. Therefore it is possible that marriage itself does not have a large effect on health outcomes, but is simply an outcome of health-related selection bias. For example, a study using data from the 'National Health Interview Survey-Longitudinal Mortality Follow-Up' (1986–2000, N=517,314) found no difference in mortality rates between married and divorced/separated adults, but found that participants who had never married had far higher mortality rates[270]; suggesting a difference in health-related to ability to attain, rather than retain, a partner. They did, however, find an increase in mortality rates in widowed participants[270], suggesting that bereavement can have a large effect on health, which is particularly salient for the HIV-positive population.

In relation to parental status, stress is often higher in adults with young children than those without[280-282]; possibly due to decreased sleep[283-285] and increased responsibility and time-management concerns amongst care-givers[286-289]. Similarly, it has been noted that parents of young children may neglect their own health-related behaviours in favour of child care[290;291]; especially if the child is ill[292;293]. As such, it is possible that the presence of young children may detrimentally affect the medication management and mental health of PWH[294]. Adult children, however, are consistently recognised as important care-givers for elderly parents in terms of financial, physical and emotional care[295-298]. As such, they may be related with better mental and physical health in older PWH.

5.1.3 **Retirement**

Research from the general literature shows competing theories on the effects of retirement on physical and mental health. Compared to continued employment, retirement may improve health through lowered stress[61;299] and increased time for social and physical activity[300;301]. For example, the German Socio-Economic Panel Study (SOEP) (N≈30,000) found that retirement improved self-rated health satisfaction and mental health and reduced the number of hospital visits when compared to employed participants in ages 60-65[301]. In multivariable analysis, higher health satisfaction and mental health in retired participants was related to longer sleep duration ($p<.01$) than in non-retired older adults, regular physical activity ($p<.01$) and longer time spent on home repairs and gardening ($p<.05$), suggesting that health-related behaviours are more frequent in retired adults in this population[301]. Similarly, the Survey of Health, Ageing and Retirement in Europe (SHARE) found that retirement was associated with a 35% decrease in reports of 'fair', 'bad', or 'very bad' health[302] and the English Longitudinal study of ageing reported increases in exercise and leisure time physical activity after retirement[174].

In contrast, where occupation is a core concept of identity, retirement may worsen mental health; especially in those retiring early due to redundancy, ill health or familial health needs[303;304]. It also may reduce financial freedom[305] and opportunities for social engagement[260;306]. A large Australian, cross-sectional, study (N=267,000) of adults over the age of 45 collected in 2006-2008 found that psychological distress was higher in retired adults than those still employed, but lower than in participants who were unemployed or not working due to sickness/disability (p<.001)[301;304]. The Whitehall Study - a longitudinal study of UK civil servants (N=7,584) reported that retirement was related to fewer physical and mental health problems compared to continued employment past that age of 60 unless the retirement was due to ill health, in which case physical and mental health deteriorated after retirement[300]. While it is possible that this is related to distress due to illness rather than retirement, it is also possible that retirement in this situation may have a further deleterious effect on adjustment to older age. This fits with the results of the Australian study[301;304] which seems to suggest adverse psychological consequences for retirement independent of physical health.

5.1.4 **Social factors related to ageing with HIV**

From the systematic review (Section 1.3.2.4) eight papers were found focusing on stigma, disclosure and social support in older adults with HIV. Geographical spread was somewhat skewed, with 19 papers from the USA, two from Africa and four from Canada. None were found using UK populations. No studies were identified relating to the effects of retirement or relationship status on the wellbeing of older PWH, although one study did mention that the fluctuations in health found in HIV make it difficult to maintain employment (published 2012)[96].

Of these eight studies, six studies[93;135;140;144;148;150] assessed differences in social support with age and three[135;150;151] assessed differences in stigma. Overall, no differences were found, in relation to age group, for social isolation[150], interactions[140], support[148] or stigma[135;150;151] but subjective (satisfaction with) support was higher in older adults[148] and disclosure was lower[93]. However, there were a limited number of studies addressing these issues, making conclusions uncertain. As social support is extremely subjective, qualitative work and quantitative studies using non-validated instruments were also explored to identify social issues specific to older PWH. The results are described below.

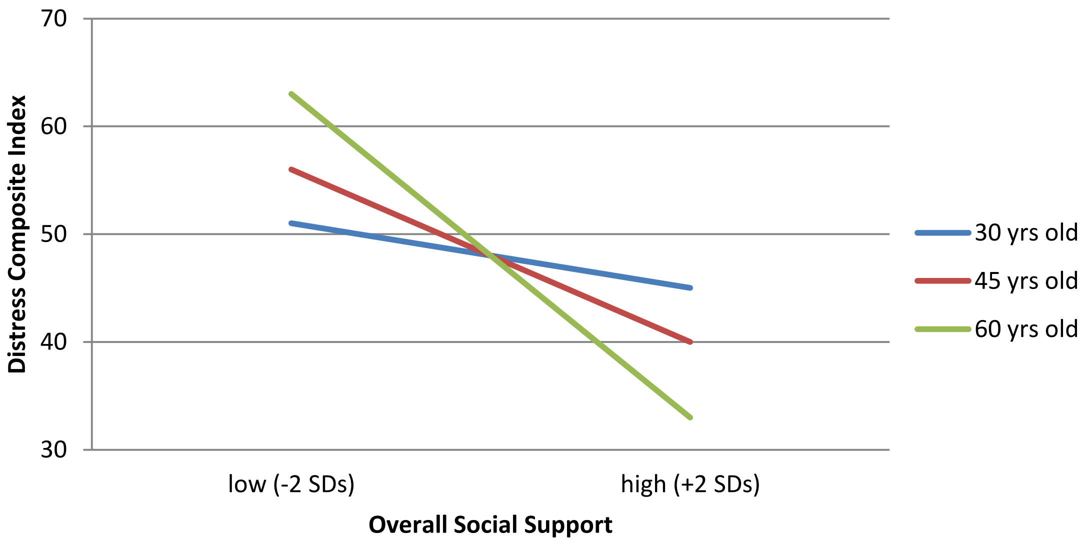
Ten further studies were identified, utilising interviews with PWH, with a total population of 803 (range 15-226) OPWH, all published since 2003. Many participants expressed dissatisfaction with levels of emotional and practical support; especially in relation to friends and family[94;96;307]. Solitude was mentioned specifically as a defining factor of ageing with HIV, due to a loss of friends over time and difficulties in creating new social connections due to old age, HIV-related stigma, fatigue and illness[96;98;99;308;309]. In one study, HIV stigma in particular was considered by participants to be worse in older adults, who have a reduced understanding of the risks of transmission compared to younger family members[96]. However, the majority of reasons given for lack of support were personal, rather than due to HIV stigma. The most common reasons given for lack of support were; (1) nondisclosure of HIV status; (2) others' fear of HIV/AIDS; (3) desire to be self-reliant and independent; (4) not wanting to be a burden[310]; (5) unavailability of family and (6) death of friends to AIDS[307].

The qualitative literature (2008-2015) also identified several themes related to reasons for non-disclosure amongst older adults. These included a) fear of consequences, b) protection of loved ones and c) not knowing how to disclose[94;95;309;311]. Specifically, it was founds that older adults were sometimes afraid of the potential for stigma and discrimination in their social group through direct and indirect (via second party) disclosure and were concerned about a decline in their desirability as a sexual partner[95]. Amongst social groups who were disclosed to, HIV-positive network members were most commonly identified[94-96]; in one case being over 16 times more likely to be disclosed to than HIV-negative social groups[95]. The advantages of this group were that there was less need to monitor disclosure and there were opportunities to gain HIV-related advice and support[94]. The disadvantage was that the group is limited in size and availability due to illness and death[94]. Family were also mentioned as a source of physical and emotional support; especially adult children[94;99;309], but were also reported as a stressor by requiring support from the PWH or rejecting their sexual orientation[97].

These results coincided with those found in quantitative literature on older PWH. Specifically, of 160 PWH over the age of 50 in New York, 79% of participants reported unmet physical support needs and 57% reported unmet emotional support needs[310;312]. Participants were found to rely heavily on HIV positive friends for support[312] and, while 67% had no partner and 71% lived alone, family members were reported as a key source of support[312]. In another qualitative study (N=49) PWH reported their partners as a key source of social support and those without partners were concerned that ageing reduced their opportunity for future intimate relationships[97]. Similar results were found in a study focusing solely on older MSM, of which 65% lived alone but only 20% were receiving informal care from family[313], suggesting that they may be at further risk of isolation.

The Research on Older Adults with HIV (ROAH) study of 914 New York City-based OPWH in 2005 found high levels of loneliness (UCLA Loneliness Scale) and stigma (HIV Stigma Scale) - scores of 43.9 and 88.9 respectively[261]. In relation to health, both stigma and loneliness were related to major depression in multivariable analysis (CES-D, 39.1% prevalence); a one unit increase on either the loneliness or stigma scales being related on average to a 6.4% and 1.3% increase in the odds of major depression respectively[261]. Bivariate analysis of HrQoL (SF-8) found a relationship with increased social support and a negative relationship to limited physical activity ($ps<.05$)[313]. A second American study of 199 MSM with HIV showed, through hierarchical multiple regression analysis, that social support (23-item Social Relationships Scale) was related to a 'Distress Composite Index', including stress, (10-item Perceived Stress Scale) depression (21-item BDI) and negative affect (16-item Affect Balance Scale) regardless of age[308]. While they found no direct relationship between social support and age, the authors did identify an age-by-social support interaction ($B=-.190$, $p<.01$); with lower social support causing more distress for older than younger MSM[308]. This suggests that, with age-related stressors, small changes in social support may cause larger variations in mental health. This is depicted in *Figure 18* below, adapted from the original paper[308].

***Figure 18*. "Social support by age interaction effect on the distress composite index (Regression lines illustrate the interaction effect for three age levels)"[308].**



Finally, and in contrast to the previous literature, the AIDS Community Research Initiative of America (ACRIA) - a 12-year study of 160 PWH in New York published in 2005- reported that satisfaction with emotional support was related to higher levels of comorbid illnesses, HIV-related care needs and higher levels of physical strain ($ps<.05$) when adjusted for age, sex and race[310]. The researchers suggest that this contrary finding relates to individuals' ability to mobilise their support networks more effectively when they have previous experience of illness, leading to higher satisfaction. Alternatively, the increased reliance on formal care systems related to ill health may alleviate their need for informal social support, thus increasing satisfaction with low levels of support[310]. However, I suggest a third option: that with increased support needs comes a more accepting outlook on the limitations of an individual's social system, such that older PWH who are more reliant on their informal care network are more aware of the burden they place on care-givers and so are happier with lower levels of support. This could be further explored using a larger sample size and standardised measures of social support to validate the findings.

It appears that, similar to the general ageing population, social support affects mental and physical health in older PWH, and overall satisfaction with support tends to be low; making it an important factor to consider when measuring well-being in this population. Few of these studies included participants under the age of 50 - so it is unclear whether these findings differ by age group. However, several of the factors studied appear to be related to age: age-related reductions in social support were reported, as were higher levels of HIV stigma in older friends/family and more experience of bereavement. HIV positive support groups also appear to be particularly important to OPWH[94-96] and could be potentially be utilised by clinicians to improve well-being.

Since no difference was found in levels of social support by age in the systematic review, it is possible that overall levels of social support do not differ with age in this population but that the reasons behind isolation and disclosure are age-specific. However, since there were few studies addressing these issues, no UK studies, and the results that were available generally did not include information on retirement or relationship status, this conclusion is tentative and further studies are needed. Similarly, no studies compared social health factors by gender/sexuality, making it unclear whether MSM have unique issues in support and disclosure.

5.1.5 Aims

The current analysis aims to address these issues using the ASTRA[118] study. The aims are as follows: to assess the association of age with a) social support, b) relationship and parental status, c) disclosure of HIV status and d) employment status, taking into account time since HIV diagnosis and other demographic factors. The relationship of each of these social factors with physical and mental symptom symptoms will also be explored individually and as interactions in relation to age and time with diagnosed HIV.

5.2 Methods

As described in chapter 2, section 2.2.3, participants completed a self-administered questionnaire including, in relation to this analysis questions on; their relationship status, relationship length, partner's HIV status, state of disclosure to their partner, family, friends and work colleagues, their current levels of social support (the modified Duke–UNC FSSQ scale)[158] and current occupational status.

5.2.1 **Symptom measures**

Social support was quantified using the modified Duke–UNC FSSQ scale[158], wherein participants were asked five questions relating to their satisfaction with their social support. These questions were: 'I have people who care what happens to me', 'I get love and affection, 'I get chances to talk to someone I trust about my personal problems', 'I get invitations to go out and do things with other people' and 'I get help when I am sick in bed'. Each question was scored from 1-5, with five being 'as much [support] as I would like' and one being 'much less than I would like'. These scores were then amalgamated to create an overall scale of social support, ranging from 5-25. For the purpose of the analysis, social support was classified as 'sufficient' if participants scored ≥20 on the scale, which corresponded with scoring 'almost as much [support] as I would like' on all five questions, or 'as much [support] as I would like' on at least four. Answers to each individual social support question was also assessed, where social support was considered to be present if participants reported having 'almost as much as I would like' or 'as much as I would like' in response to the individual question.

Relationship status was divided into those in a relationship (living, or not living with partner) or not as assessed by the question "Are you currently in an ongoing relationship with a partner (wife/husband or civil partner or girlfriend/boyfriend)?". Length of relationship was divided into ≥10 years or <10 years and, where a partner was identified as being present, partner HIV status was analysed as 'HIV positive/not positive'. Participants were also asked to report whether or not they had children, which was categorised as 'yes' or 'no'.

Disclosure was assessed as a combined measure, defined as responding 'yes' or 'no' to the question "Apart from health care staff, have you told anyone that you have HIV?", and by self-report of disclosing HIV status to 'some' or 'most or all' of individual social groups (partner, family, friends, and colleagues).

Finally, employment status was categorised as 'employed', 'unemployed', 'not working due to sickness/disability' or 'retired'. 'Money for basic needs' was assessed as a binary variable; 'always having money for basic needs' or not (the latter category included ‘mostly’ ‘sometimes’ and not having enough money).

5.2.2 **Statistical analysis**

Age in years was grouped into the following categories: <30, 30-39, 40-49, 50-59, and ≥60 years. Differences in participant characteristics by age were assessed using chi squared tests and chi-squared tests for trend.

Prevalence of social support, relationship status and length, child presence, disclosure, employment status and 'money for basic needs' were calculated overall and according to age group, and differences between age groups were assessed using chi squared tests for trend. Logistic regression was used to assess the association between age group and each of the social measures (dependent variables), adjusting for gender/sexuality (MSM, heterosexual man, woman), ethnicity (White, other) and time since diagnosis of HIV (<2 years, 2-5 years, 5-

10 years, 10-20 years, >20 years). Age was fitted as a categorical variable in the models, with age>=60 years used as the reference category. In additional models, age was fitted as an ordinal variable with values 1 to 5, rather than defined as categorical and tests for linear trend across age groups were performed. Results are presented as odds ratios with 95% confidence intervals.

Where significant differences in symptom prevalence were found in relation to age or time with diagnosed HIV, further regression analysis was conducted. This was adjusted for potential confounding or mediating health-related risk factors which had been identified as differing by age or time diagnosed with HIV in Chapter 2: money for basic needs (always/not always), alcohol dependence assessed by CAGE questionnaire (yes/no), recreational drug use in the past three months (yes/no) and smoking status (smoker/non/ex-smoker). Due to the nature of social measures, the results may also differ by gender/sexuality. As such, associations between age group, time with diagnosed HIV and each social measure are further presented by gender/sexuality group (MSM, heterosexual men, women), and interaction tests were performed between gender/sexuality and (i) age, (ii) time with diagnosed HIV (grouped variables in a continuous form), in relation to each of the social measures as dependent variables, in order to formally assess whether associations differed between the gender/sexuality groups.

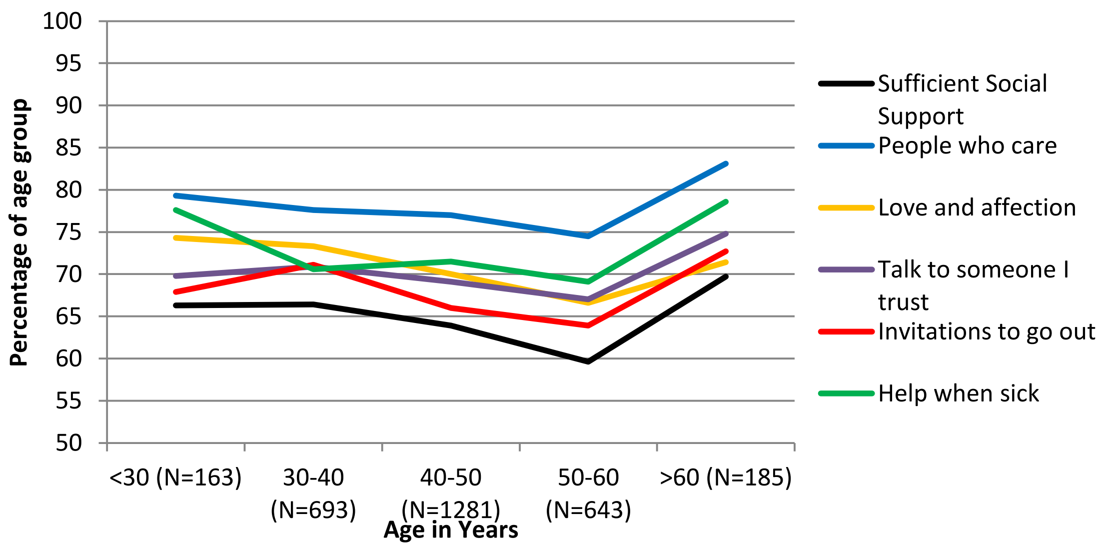
The relationship between psychological (depression and anxiety), physical (symptom prevalence, distress, problems with ADLs and CD4 count), and social (social support, partner and parental status, HIV status disclosure, employment and money for basic needs) symptom measures were assessed using chi squares tests for trend and logistic regression analysis, adjusted for gender/sexuality (MSM; heterosexual man; woman) and ethnicity (white/non-white). These associations were also analysed as interactions of anxiety and depression adjusted for a) age and b) time diagnosed with HIV (grouped variables in a continuous form) in comparison to physical and psychological symptom measures (section 5.3.5).

5.3 Results

5.3.1 Social support

Sufficient social support (assessed by Duke–UNC FSSQ scale) was apparent in 1936 (63.9%) of participants and insufficient social support in 1095 (36.1%). By individual question: 77.0% of participants indicated sufficient support in terms of having people who cared what happened to them, 71.5% got help when sick in bed, 70.2% got sufficient love and affection, 69.2% got chances to talk to someone about personal problems and 67.4% got invitations to go out with other people. *Figure 19* shows the associations with age.

***Figure 19*. Prevalence of sufficient social support (%) by age.**



The prevalence of sufficient social support decreased with age between the years of 40 and 60, being stable beforehand and higher in those aged 60 and over. When adjusted for time with diagnosed HIV, sexuality/gender and ethnicity the overall association between age and sufficient social support became non-significant. However, participants aged 50-60 had significantly lower levels of social support compared to PWH aged 60 and over. Similar results were observed across individual questions, except for 'I get invitations to go out' and 'I get help when sick in bed', where there was stronger evidence for an increasing trend of adequate social support with older age, and almost all age groups reported significantly lower satisfaction with social support than those aged 60 and over.

As shown in *Figure 20*, longer time diagnosed with HIV, on the other hand, was strongly related to decreases in the overall prevalence of adequate social support and each individual component (test for trend across categories, ps<0.001). In general there was no difference in prevalence of adequate social support by gender/sexuality or ethnicity in adjusted analyses. Results are depicted in *Table 26*.

***Figure 20*. Prevalence of sufficient social support (%) by time diagnosed with HIV.**

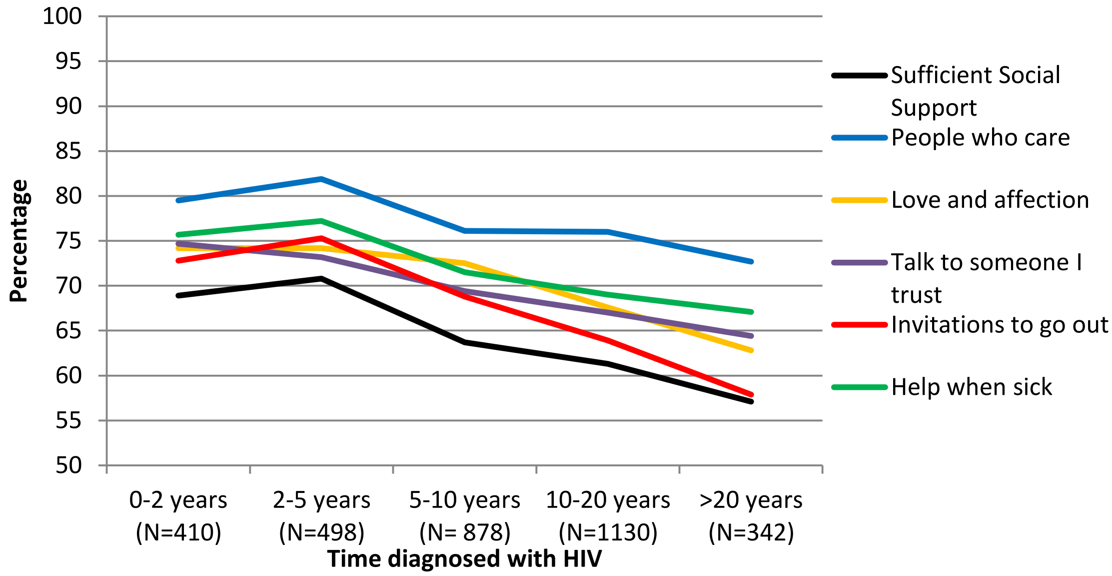


Table 26. **Adjusted association of age, time with diagnosed HIV, gender/sexuality and ethnicity with social support (logistic regression analysis).**

(N=3140)		Sufficient social support[x]			I have people who care for me			I get love and affection			I can talk to someone		
Independent Variable		p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age		0.12			0.16			0.54			0.28		
	Test for trend	*0.98*	*1.00*	*(0.92, 1.09)*	*0.69*	*1.02*	*(0.93, 1.12)*	*0.48*	*0.97*	*(0.89, 1.06)*	*0.30*	*1.05*	*(0.96, 1.14)*
	<30	0.17	0.72	(0.45, 1.15)	0.21	0.71	(0.41, 1.21)	0.82	0.95	(0.59, 1.53)	0.06	0.64	(0.40, 1.02)
	30-40	0.16	0.77	(0.53, 1.11)	0.06	0.67	(0.44, 1.02)	0.76	0.95	(0.66, 1.36)	0.09	0.72	(0.50, 1.05)
	40-50	0.09	0.74	(0.53, 1.05)	0.06	0.68	(0.46, 1.01)	0.47	0.89	(0.64, 1.23)	0.06	0.72	(0.51, 1.02)
	50-60	0.01	0.63	(0.45, 0.90)	0.01	0.60	(0.40, 0.89)	0.18	0.79	(0.56, 1.12)	0.03	0.68	(0.47, 0.97)
	60+*		1			1			1			1	
Years with diagnosed HIV		.001			0.02			0.01			0.01		
	Test for trend	*<.001*	*0.86*	*(0.81, 0.93)*	*.002*	*0.89*	*(0.82, 0.96)*	*.001*	*0.88*	*(0.82, 0.95)*	*<.001*	*0.88*	*(0.82, 0.94)*
	0-2*		1			1			1			1	
	2-5	0.65	1.07	(0.79, 1.45)	0.46	1.14	(0.81, 1.61)	0.96	0.99	(0.73, 1.36)	0.68	0.94	(0.69, 1.28)
	5-10	0.11	0.80	(0.61, 1.05)	0.21	0.82	(0.61, 1.11)	0.60	0.93	(0.70, 1.23)	0.07	0.77	(0.59, 1.02)
	10-20	0.01	0.72	(0.55, 0.93)	0.13	0.79	(0.59, 1.07)	0.04	0.75	(0.57, 0.99)	0.01	0.69	(0.53, 0.91)
	20+	.002	0.59	(0.42, 0.82)	0.02	0.64	(0.44, 0.92)	.004	0.61	(0.44, 0.86)	.003	0.60	(0.43, 0.97)
Sex		0.19			0.59			0.86			0.96		
	MSM*		1			1			1			1	
	Hetero male	0.79	0.97	(0.74, 1.25)	0.43	0.89	(0.67, 1.18)	0.58	1.08	(0.82, 1.42)	0.78	1.04	(0.80, 1.36)
	female	0.07	0.82	(0.66, 1.02)	0.40	0.90	(0.71, 1.14)	0.89	1.02	(0.81, 1.27)	0.85	1.02	(0.82, 1.28)
Ethnicity	Other*		1			1			1			1	
	White	0.19	1.12	(0.95,1.33)	.002	1.35	(1.12, 1.63)	0.95	3.16	(0.84, 1.20)	0.73	1.03	(0.87, 1.23)

[x]Duke–UNC FSSQ scale score of ≥20 * reference group

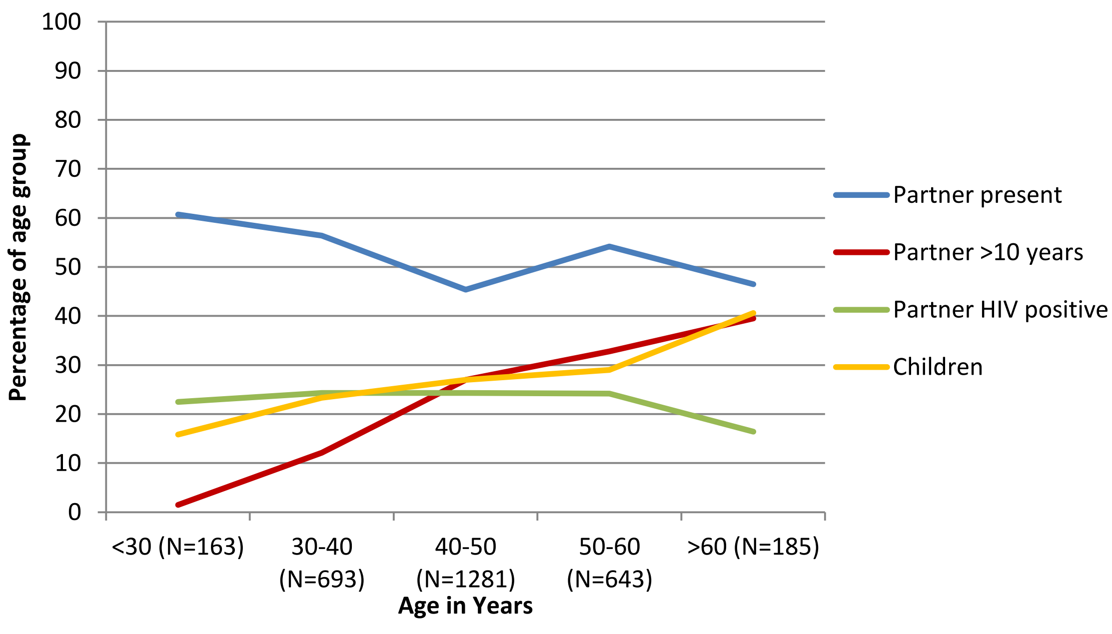
(N=3140)	I get invitations to go out			I get help when sick in bed		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	0.09			0.06		
Test for trend	*0.33*	*1.04*	*(0.96, 1.14)*	*0.49*	*1.03*	*(0.94, 1.13)*
<30	0.03	0.59	(0.37, 0.94)	0.47	0.83	(0.49, 1.39)
30-40	0.11	0.75	(0.52, 1.07)	0.01	0.61	(0.41, 0.91)
40-50	0.02	0.67	(0.48, 0.94)	0.04	0.68	(0.47, 0.99)
50-60	0.02	0.65	(0.46, 0.93)	0.01	0.61	(0.42, 0.90)
60+*		1			1	
Years with diagnosed HIV	<.001			.002		
Test for trend	*<.001*	*0.83*	*(0.77, 0.89)*	*<.001*	*0.87*	*(0.80, 0.93)*
0-2*		1			1	
2-5	0.53	1.11	(0.81, 1.51)	0.59	1.10	(0.79, 1.52)
5-10	0.12	0.80	(0.61, 1.06)	0.18	0.82	(0.61, 1.09)
10-20	.003	0.67	(0.51, 0.87)	0.02	0.71	(0.53, 0.94)
20+	<.001	0.51	(0.36, 0.70)	0.01	0.62	(0.44, 0.88)
Sex	0.62			0.12		
MSM*		1			1	
Hetero male	0.96	0.99	(0.76, 1.29)	0.24	1.19	(0.89, 1.57)
female	0.34	0.90	(0.72, 1.12)	0.19	0.86	(0.69, 1.08)
Ethnicity Other*		1			1	
White	0.49	0.94	(0.79, 1.12)	0.03	1.23	(1.03, 1.47)

* reference group

5.3.2 **Partner status and Parental status**

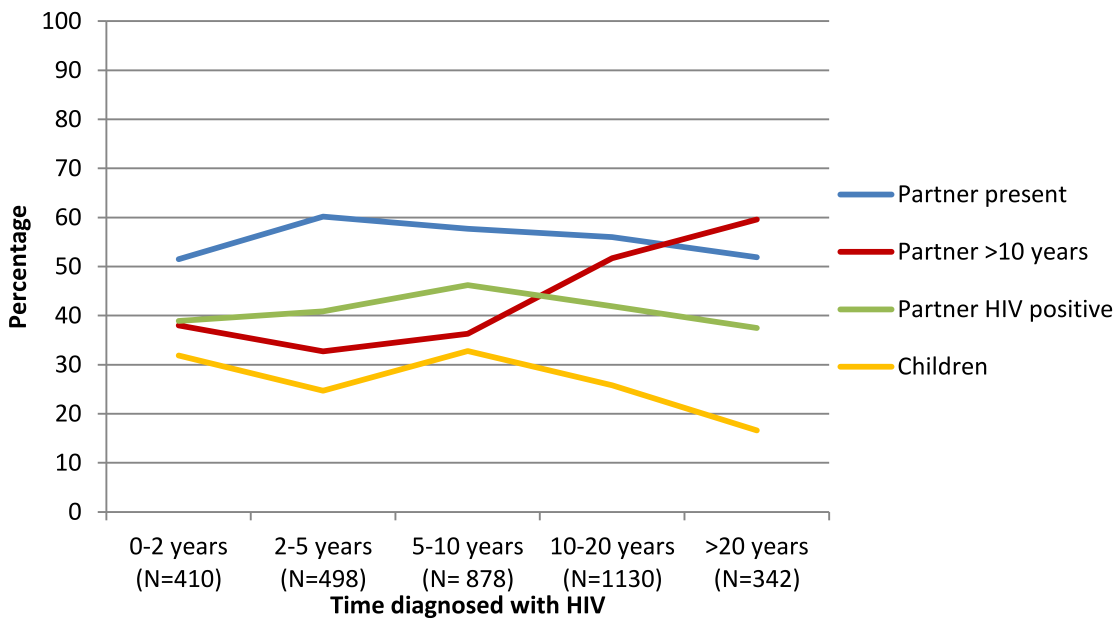
Relationship status was as follows: 1284 (39.4%) participants were living with a partner, 523 (16.1%) had a partner but did not live together and 1420 (43.6%) did not have a long-term partner. Of those that were in a relationship, 707 (21.7%) had been in the same relationship for ten or more years and 765 (23.5%) had partners who were diagnosed with HIV. No association was found between partner's HIV status and relationship length. In regards to parental status, 883 (27.3%) of participants reported having children. Of those with children, 59.6% were in a relationship and 48.2% had been in the relationship for ten or more years. *Figure 21* shows the associations of partner status factors and parental status with age as a percentage of the whole ASTRA population.

***Figure 21*. Prevalence of relationship and parental status' (%) by age.**



Older HIV-diagnosed people were less likely to be in a relationship (46.5% of 60 and over vs. 60.7% of under 30s, p=0.017, chi-squared test for trend across age groups) but, where they were in a relationship, were much more likely to have been in the same relationship for ten or more years (39.5% of >50s vs. 1.5% of <30s, p<.001). With age, PWH became increasingly likely to have children (40.6% of >60s vs. 15.8% of <30s, p<.001). No age difference was found for partner's HIV status in unadjusted analysis.

***Figure 22*. Prevalence of relationship and parental status' (%) by time diagnosed with HIV.**



As shown in *Figure 22*, participants were less likely to be in a relationship with increasing time diagnosed with HIV between 2-5 years of diagnosis and over twenty years (60.2% vs. 51.9%, p=0.03) but, where they were in a relationship, were more likely to have been in the same relationship for ten or more years (32.7% vs. 59.6%, p<.001). With increasing time diagnosed, PWH became less likely to have children (31.9% of participants diagnosed for 0-2 years vs. 16.6% of participants diagnosed for over 0 years, p<.001). No difference was found for partner's HIV status in relation to time diagnosed with HIV in unadjusted analysis.

When adjusted for time with diagnosed HIV, sexuality/gender, and ethnicity, the association between age and relationship status remained, with the odds of being in a relationship decreasing with increasing age. The opposite linear relationship was found for relationships lasting ten or more years, with PWH over the age of 60 being the most likely to be in a long-term relationship, and no relationship was found between partner's HIV status and age. Finally, the likelihood of being a parent increased with age (*table 27*). The relationship between age and relationship status was not materially altered when further adjusted for by smoking status, alcohol and drug use and money for basic needs (Odds Ratio=0.89, 95% C.I.=0.82-0.97, p=0.01, for trend across age group), nor was the relationship between age and relationship length (Odds Ratio=2.00, 95% C.I.=1.75-2.30, p<.001, for trend across age group) or parental status (Odds Ratio=2.24, 95% C.I.=1.94-2.57, p<.001, for trend across age group).

In relation to time diagnosed with HIV, in adjusted analysis the odds of being in a relationship were higher in those who had been diagnosed for 2-20 years than 0-2 years, but no linear trend was apparent in relation to partner status. Participants were more likely to be in a long-term relationship the longer they had been diagnosed with HIV and less likely to be a parent, but no trend was observed in relation to partner's HIV status. In terms of gender/sexuality or ethnicity, few associations were observed, except that heterosexual males were more likely to be in a relationship than MSM or women, women were more likely to have an HIV positive partner and both heterosexual men and women were much more likely to have a child than MSM. Participants of white ethnicity were less likely to have children. The results are depicted in *Table 27*.

When logistic regression analysis was stratified by gender/sexuality, test for trends across age groups and time with diagnosed HIV groups in relation to having a partner present only continued to be significant for women, where the odds of having a partner decreased with age. No significant trend was apparent for the two male groups (MSM and heterosexual men). This interaction between age and gender/sexuality with regard to partner status was significant (Odds Ratio for interaction term for women vs. all men =0.83, 95% C.I.=0.76-0.92, p<.001). Similarly, odds of being in a long-term relationship increased with age in women but decreased with age for MSM and did not change significantly with age for heterosexual men. Parental status increased with age for all three gender/sexualities, with no significant interaction. The number of years diagnosed with HIV was not related to relationship or parental status in any gender/sexuality group individually, except that the odds of being a parent decreased with time diagnosed with HIV in MSM. No interaction tests were significant in relation to time with diagnosed HIV and gender/sexuality. These results are depicted in *Table 28a-c*.

Table 27. **Adjusted association of age, time with diagnosed HIV, gender/sexuality and ethnicity with relationship and parental status (logistic regression analysis).**

(N=3140)		Partner present			Partner for ≥10 years			HIV positive partner			Parental status (child present)		
Independent Variable		p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age		0.03			<.001			0.38			<.001		
	Test for trend	*0.01*	*0.89*	*(0.82, 0.97)*	*<.001*	*2.05*	*(1.79, 2.34)*	*0.47*	*0.96*	*(0.86, 1.07)*	*<.001*	*2.17*	*(1.90, 2.49)*
	<30	.003	1.92	(1.26, 2.94)	<.001	0.02	(.003, 0.07)	0.35	1.33	(0.73, 2.42)	<.001	0.04	(0.02, 0.07)
	30-40	0.01	1.54	(1.12, 2.13)	<.001	0.14	(0.08, 0.24)	0.07	1.55	(0.97, 2.49)	<.001	0.10	(0.06, 0.16)
	40-50	0.01	1.51	(1.12, 2.02)	<.001	0.43	(0.27, 0.69)	0.06	1.52	(0.98, 2.35)	<.001	0.20	(0.13, 0.31)
	50-60	0.04	1.39	(1.02, 1.89)	0.06	0.62	(0.38, 1.01)	0.06	1.54	(0.97, 2.45)	<.001	0.41	(0.26, 0.63)
	60+*		1			1			1			1	
Years with diagnosed HIV		0.05			0.03			0.21			.001		
	Test for trend	*0.50*	*1.02*	*(0.96, 1.09)*	*0.03*	*1.12*	*(1.01, 1.23)*	*0.87*	*0.99*	*(0.91, 1.08)*	*.001*	*0.85*	*(0.77, 0.94)*
	0-2*		1			1			1			1	
	2-5	0.01	1.48	(1.13, 1.93)	0.51	0.86	(0.55, 1.34)	0.42	1.16	(0.81, 1.68)	0.04	0.64	(0.42, 0.97)
	5-10	0.02	1.32	(1.04, 1.69)	0.34	0.82	(0.55, 1.23)	0.07	1.36	(0.97, 1.91)	0.36	0.84	(0.58, 1.22)
	10-20	0.03	1.30	(1.03, 1.66)	0.39	1.18	(0.81, 1.74)	0.47	1.13	(0.81, 1.58)	0.02	0.64	(0.44, 0.93)
	20+	0.37	1.15	(0.85, 1.56)	0.20	1.37	(0.85, 2.20)	0.78	0.94	(0.61, 2.45)	<.001	0.37	(0.22, 0.60)
Sex		<.001			0.36			0.04			<.001		
	MSM*		1			1			1			1	
	Hetero male	<.001	1.97	(1.53, 2.53)	0.16	1.27	(0.91, 1.77)	0.24	1.20	(0.81, 1.68)	<.001	28.06	(20.52, 38.39)
	female	0.89	1.01	(0.83, 1.24)	0.55	1.10	(0.80, 1.51)	0.06	1.77	(0.97, 1.91)	<.001	55.48	(40.71, 75.60)
Ethnicity	Other*		1			1			1			1	
	White	0.10	1.15	(0.98, 1.35)	0.19	1.18	(0.93, 1.50)	0.07	1.23	(0.81, 1.58)	0.03	0.71	(0.54, 0.92)

* reference group

***Table 28a*. Adjusted association of age and time with diagnosed HIV with relationship and parental status in MSM (logistic regression analysis).**

(N=2248)	Partner present			Partner for ≥10 years			Parental status (child present)		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	0.37			0.30			<.001		
Test for trend	*0.76*	*0.99*	*(0.90, 1.08)*	*0.05*	*0.88*	*(0.77, 1.00)*	*<.001*	*2.06*	*(1.70, 2.48)*
<30	0.35	1.28	(0.76, 2.13)	0.09	1.89	(0.90, 3.96)	<.001	0.12	(0.04, 0.33)
30-40	0.20	1.29	(0.88, 1.88)	0.06	1.72	(0.98, 3.02)	<.001	0.08	(0.04, 0.15)
40-50	0.07	1.38	(0.97, 1.95)	0.22	1.38	(0.82, 2.33)	<.001	0.22	(0.13, 0.36)
50-60	0.05	1.44	(1.00, 2.07)	0.25	1.38	(0.80, 2.37)	<.001	0.39	(0.24, 0.64)
60+*		1			1			1	
Years with diagnosed HIV	0.44			0.44			0.62		
Test for trend	*0.87*	*1.01*	*(0..93, 1.09)*	*0.88*	*1.01*	*(0.91, 1.12)*	*0.01*	*0.82*	*(0.71, 0.94)*
0-2*		1			1			1	
2-5	0.16	1.27	(0.91, 1.76)	0.17	1.39	(0.87, 2.20)	0.27	0.69	(0.36, 1.33)
5-10	0.14	1.26	(0.93, 1.70)	0.09	1.44	(0.94, 2.21)	0.28	0.73	(0.41, 1.29)
10-20	0.21	1.21	(0.90, 1.62)	0.27	1.28	(0.84, 1.92)	0.04	0.57	(0.33, 0.99)
20+	0.83	1.04	(0.73, 1.49)	0.67	1.12	(0.67, 1.86)	0.01	0.37	(0.19, 0.74)
Ethnicity Other*		1			1			1	
White	0.47	1.07	(0.89, 1.28)	0.03	1.32	(1.03, 1.70)	0.16	0.77	(0.53, 1.11)

* reference group

***Table 28b*. Adjusted association of age and time with diagnosed HIV with relationship and parental status in heterosexual men (logistic regression analysis).**

(N=373)	Partner present			Partner for ≥10 years			Parental status (child present)		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	0.36			0.14			<.001		
Test for trend	*0.71*	*0.95*	*(0.74, 1.22)*	*0.66*	*0.94*	*(0.70, 1.25)*	*<.001*	*2.00*	*(1.50, 2.66)*
<30	0.29	0.43	(0.09, 2.04)	0.74	0.66	(0.06, 7.45)	<.001	0.02	(.003, 0.14)
30-40	0.98	0.99	(0.39, 2.48)	0.23	2.00	(0.65, 6.21)	.001	0.12	(0.04, 0.40)
40-50	0.92	1.04	(0.47, 2.30)	0.03	3.07	(1.12, 8.39)	.003	0.19	(0.06, 0.58)
50-60	0.28	0.63	(0.27, 1.45)	0.07	2.74	(0.93, 8.12)	0.06	0.32	(0.10, 1.06)
60+*		1			1			1	
Years with diagnosed HIV	0.80			0.89			0.18		
Test for trend	*0.83*	*1.02*	*(0.84, 1.24)*	*0.81*	*1.03*	*(0.82, 1.28)*	*0.34*	*0.90*	*(0.74, 1.11)*
0-2*		1			1			1	
2-5	1.00	1.00	(0.47, 2.14)	0.92	1.05	(0.43, 2.55)	0.03	0.41	(0.18, 0.93)
5-10	0.48	1.29	(0.64, 2.59)	0.60	1.24	(0.56, 2.71)	0.43	0.74	(0.34, 1.58)
10-20	0.82	0.93	(0.47, 1.80)	0.89	0.95	(0.43, 2.09)	0.22	0.62	(0.29, 1.33)
20+	0.50	1.46	(0.49, 4.38)	0.50	1.53	(0.45, 5.16)	0.10	0.39	(0.13, 1.19)
Ethnicity Other*		1			1			1	
White	0.08	0.62	(0.37, 1.06)	0.54	0.82	(0.43, 1.56)	0.01	0.46	(0.27, 0.81)

* reference group

***Table 28c*. Adjusted association of age and time with diagnosed HIV with relationship and parental status in women (logistic regression analysis).**

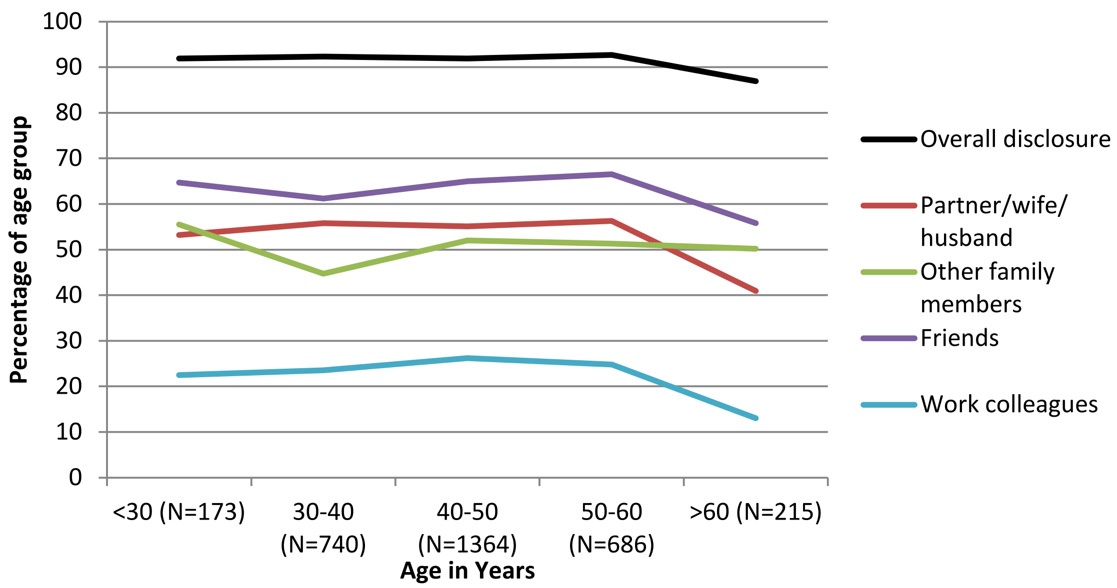
(N=637)	**Partner present**			**Partner for ≥10 years**			**Parental status (child present)**		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	<.001			0.10			<.001		
Test for trend	*<.001*	*0.60*	*(0.49, 0.73)*	*0.01*	*1.48*	*(1.12, 1.96)*	*<.001*	*2.61*	*(2.01, 3.40)*
<30	<.001	12.54	(3.70, 42.57)	0.05	0.09	(0.01, 0.96)	.001	0.02	(.003, 0.20)
30-40	.002	5.49	(1.89, 15.99)	0.09	0.14	(0.01, 1.32)	0.02	0.09	(0.01, 0.71)
40-50	0.01	4.12	(1.45, 11.74)	0.14	0.19	(0.02, 1.76)	0.09	0.17	(0.02, 1.32)
50-60	0.14	2.30	(0.76, 6.92)	0.27	0.28	(0.03, 2.77)	0.75	0.70	(0.08, 6.21)
60+*		1			1			1	
Years with diagnosed HIV	0.01			0.24			0.06		
Test for trend	*0.85*	*0.99*	*(0.84, 1.16)*	*0.52*	*0.93*	*(0.74, 1.17)*	*0.13*	*0.86*	*(0.71, 1.05)*
0-2*		1			1			1	
2-5	.002	2.85	(1.47, 5.51)	0.48	0.73	(0.30, 1.77)	0.72	0.88	(0.42, 1.82)
5-10	0.21	1.42	(0.82, 2.47)	0.76	1.14	(0.50, 2.57)	0.71	1.13	(0.59, 2.19)
10-20	0.07	1.69	(0.95, 3.01)	0.81	0.90	(0.38, 2.12)	0.56	0.81	(0.40, 1.63)
20+	0.68	0.84	(0.36, 1.94)	0.08	0.26	(0.06, 1.15)	0.02	0.32	(0.12, 0.81)
Ethnicity Other*		1			1			1	
White	<.001	2.91	(1.67, 5.07)	0.28	1.42	(0.75, 2.68)	0.89	0.96	(0.52, 1.76)

* reference group

5.3.3 **Disclosure**

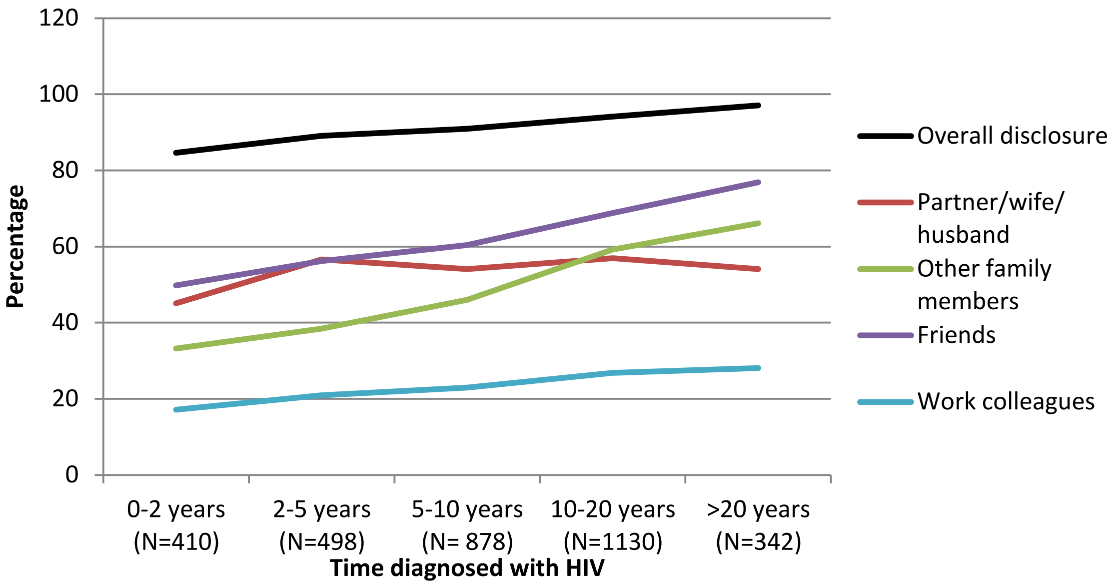
Self-report of disclosure of HIV status to persons other than health-care staff was reported by 2962 (91.6%) of participants. Of these, 1770 (59.8%) had told their partner/wife/husband, 1626 (49.9%) had told some family members, 2055 (63.1%) had told some friends and 774 (23.8%) had told work colleagues. *Figure 23* shows the associations with age.

***Figure 23*. Prevalence of HIV status disclosure (%) by age.**



Disclosure of HIV status to friends was high across all age groups, followed in prevalence by disclosure to a partner or family member. In unadjusted analysis prevalence of disclosure remained relatively constant between the ages of 30 and 60, but decreased significantly in those aged 60 and over (ps<0.01, for trend across age groups). This occurred in all disclosure sub-groups except family members, which was similar across age group, but lower in participants aged 30-40 compared to other age groups (p<0.03).

***Figure 24*. Prevalence of HIV status disclosure (%) by time diagnosed with HIV.**



Disclosure of HIV status increased with increasing time diagnosed with HIV, especially in relation to disclosure to friends and family (ps<.001). This occurred in all disclosure sub-groups (*figure 24*).

In adjusted analysis the relationship between age and disclosure of HIV status became more significant, with odds of disclosure decreasing with older age for the overall disclosure measure and each individual subcategory. This relationship was not materially altered, but was somewhat attenuated, when further adjusted for by smoking status, alcohol and drug use and money for basic needs (Odds Ratio=0.80, 95% C.I.=0.67-0.94, p=0.01 for trend across age groups).

Time with diagnosed HIV was also related to disclosure prevalence overall and in each social group in adjusted analyses, with increased time with diagnosed HIV relating to higher levels of disclosure (ps≤.001 for trends across categories for all). Compared to MSM, heterosexual men were less likely to have disclosed overall or to friends or work colleagues (ps<.001) but more likely to have disclosed to a partner (p=0.001). Women were also less likely to have disclosed overall or to friends or colleagues but were also less likely than MSM to have disclosed to their partner and more likely to have disclosed to family (ps≤0.01). Participants who were white were more likely to have disclosed to someone other than health care professionals and more likely to have disclosed to family, friends and work colleagues (ps≤.001) than other ethnicities. These results are depicted in *Table 29*.

As gender/sexuality differences were apparent in the regression analysis, disclosure associations were also assessed within gender/sexuality group. Overall disclosure rates were highest in MSM (95%) and lowest in heterosexual men (84.3%) and women (83.4%). Heterosexual men were most likely to have disclosed to their partner (62.2%), followed by MSM (55.1%) and women (47.1%) but women were most likely to have disclosed to other family members (52.1%; MSM=50.2%, het. men=44.2%). MSM were far more likely to have disclosed their status to their friends (76.3%) than women (36.9%) or heterosexual men (28.2%), as well as to have disclosed to work colleagues (31.1%; heterosexual men=8.8%, women = 6.6%).

When logistic regression analysis was stratified by gender/sexuality, test for trends across age and time with diagnosed HIV remained significant, with increasing age associated with lower odds of disclosure, and increasing time diagnosed with HIV associated with higher odds of disclosure within each gender/sexuality group. Trends of decreasing disclosure with increasing age were similar across groups (although not significant among heterosexual men), with no significant interaction between gender/sexuality and age (Odds Ratio=1.08, 95% C.I.= 0.93-.125, p=0.31, odds ratio for interaction). Similarly, 'years diagnosed with HIV' was only related to disclosure to friends and colleagues; which increased with time diagnosed with HIV in interaction tests. However, it is possible that the lack of significant differences is due to the comparatively small number of heterosexual male participants (n=373). These results are depicted in *Table 30a-c*.

***Table 29.* Adjusted association of age, time with diagnosed HIV, gender/sexuality and ethnicity with disclosure (logistic regression analysis).**

(N=3140)	Disclosed to someone			Disclosed to partner			Disclosed to family			Disclosed to friends			Disclosed to colleagues		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	<.001			<.001			<.001			<.001			<.001		
Test for trend	*<.001*	*0.73*	*(0.63-0.84)*	*.001*	*0.87*	*(0.80, 0.94)*	*<.001*	*0.85*	*(0.79, 0.93)*	*<.001*	*0.82*	*(0.75, 0.90)*	*<.001*	*0.81*	*(0.74, 0.89)*
<30	<.001	3.94	(1.91, 8.12)	<.001	2.18	(1.43, 3.33)	<.001	2.50	(1.63, 3.85)	<.001	3.04	(1.90, 4.88)	<.001	3.27	(1.85, 5.78)
30-40	<.001	3.41	(2.02, 5.78)	<.001	2.15	(1.55, 2.97)	0.12	1.29	(0.93, 1.79)	<.001	2.07	(1.45, 2.96)	<.001	2.86	(1.81, 4.51)
40-50	<.001	2.33	(1.45, 3.73)	<.001	1.91	(1.42, 2.57)	0.12	1.27	(0.94, 1.72)	<.001	1.95	(1.40, 2.72)	<.001	2.83	(1.84, 4.33)
50-60	0.01	2.06	(1.23, 3.46)	<.001	1.93	(1.41, 2.64)	0.67	1.07	(0.78, 1.47)	.003	1.69	(1.19, 2.40)	<.001	2.27	(1.46, 3.54)
60+*		1			1			1			1			1	
Years with diagnosed HIV	<.001			<.001			<.001			<.001			.003		
Test for trend	*<.001*	*1.50*	*(1.34, 1.69)*	*.001*	*1.11*	*(1.04, 1.19)*	*<.001*	*1.52*	*(1.42, 1.63)*	*<.001*	*1.34*	*(1.25, 1.44)*	*<.001*	*1.17*	*(1.08, 1.27)*
0-2*		1			1			1			1			1	
2-5	0.08	1.44	(0.96, 2.18)	<.001	1.62	(1.24, 2.12)	0.11	1.26	(0.95, 1.67)	0.13	1.26	(0.94, 1.69)	0.21	1.25	(0.88, 1.78)
5-10	<.001	1.99	(1.37, 2.90)	.002	1.48	(1.16, 1.88)	<.001	1.79	(1.39, 2.30)	<.001	1.75	(1.34, 2.29)	0.01	1.53	(1.11, 2.10)
10-20	<.001	3.30	(2.22, 4.91)	<.001	1.70	(1.34, 2.17)	<.001	3.39	(2.63, 4.36)	<.001	2.34	(1.80, 3.06)	.001	1.74	(1.27, 2.37)
20+	<.001	5.96	(2.94, 12.10)	.004	1.57	(1.16, 2.14)	<.001	4.57	(3.31, 6.31)	<.001	3.14	(2.20, 4.49)	.002	1.83	(1.26, 2.68)
Sex	<.001			<.001			.002			<.001			<.001		
MSM*		1			1			1			1			1	
Hetero male	<.001	0.42	(0.29, 0.60)	.001	1.50	(1.18, 1.92)	0.56	1.08	(0.84, 1.37)	<.001	0.16	(0.12, 0.20)	<.001	0.27	(0.19, 0.40)
female	<.001	0.39	(0.28, 0.55)	0.01	0.76	(0.62, 0.93)	<.001	1.46	(1.18, 1.79)	<.001	0.23	(0.19, 0.29)	<.001	0.19	(0.14, 0.27)
Ethnicity Other*		1			1			1			1			1	
White	<.001	2.02	(1.46, 2.80)	0.19	1.11	(0.95, 1.31)	<.001	1.43	(1.21, 1.68)	<.001	1.60	(1.33, 1.91)	<.001	1.40	(1.16, 1.69)

* reference group

***Table 30a*. Adjusted association of age and time with diagnosed HIV with disclosure in MSM (logistic regression analysis).**

(N=2248)		Disclosed to someone			Disclosed to partner			Disclosed to family			Disclosed to friends			Disclosed to colleagues		
Independent Variable		p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age		<.001			.002			.003			0.03			<.001		
	Test for trend	*<.001*	*0.65*	*(0.53, 0.81)*	*0.09*	*0.92*	*(0.84, 1.01)*	*.001*	*0.84*	*(0.76, 0.93)*	*.002*	*0.84*	*(0.75, 0.94)*	*<.001*	*0.79*	*(0.71, 0.87)*
	<30	.002	4.80	(1.80, 12.80)	0.02	1.85	(1.10, 3.11)	.001	2.49	(1.47, 4.22)	.004	2.40	(1.31, 4.38)	<.001	3.90	(2.09, 7.26)
	30-40	<.001	6.36	(3.00, 13.46)	<.001	2.02	(1.37, 2.97)	0.13	1.36	(0.92, 2.00)	0.01	1.74	(1.13, 2.67)	<.001	3.32	(2.01, 5.46)
	40-50	<.001	3.12	(1.66, 5.84)	<.001	1.98	(1.39, 2.82)	0.11	1.34	(0.94, 1.92)	0.02	1.58	(1.07, 2.34)	<.001	3.15	(1.97, 5.04)
	50-60	.001	3.15	(1.56, 6.35)	<.001	2.16	(1.49, 3.13)	0.77	1.06	(0.73, 1.54)	0.15	1.35	(0.90, 2.03)	<.001	2.52	(1.55, 4.08)
	60+*		1			1			1			1			1	
Years with diagnosed HIV		<.001			0.02			<.001			<.001			0.02		
	Test for trend	*<.001*	*1.58*	*(1.35, 1.87)*	*0.04*	*1.08*	*(1.00, 1.17)*	*<.001*	*1.60*	*(1.48, 1.74)*	*<.001*	*1.24*	*(1.14, 1.36)*	*.001*	*1.15*	*(1.06, 1.25)*
	0-2*		1			1			1			1			1	
	2-5	0.28	1.39	(0.77, 2.52)	0.02	1.49	(1.07, 2.07)	0.03	1.48	(1.04, 2.11)	0.50	1.13	(0.79, 1.62)	0.19	1.28	(0.88, 1.87)
	5-10	0.01	2.08	(1.17, 3.71)	0.01	1.47	(1.09, 1.99)	<.001	2.22	(1.60, 3.07)	0.01	1.59	(1.14, 2.23)	0.01	1.59	(1.13, 2.24)
	10-20	<.001	4.16	(2.28, 7.58)	.001	1.64	(1.22, 2.20)	<.001	4.25	(3.09, 5.85)	<.001	1.99	(1.43, 2.76)	.003	1.68	(1.20, 2.35)
	20+	<.001	5.58	(2.37, 13.12)	0.10	1.35	(0.94, 1.94)	<.001	5.65	(3.83, 8.34)	<.001	2.11	(1.40, 3.20)	0.01	1.77	(1.18, 2.65)
Ethnicity	Other*		1			1			1			1			1	
	White	<.001	2.13	(2.37, 13.12)	0.88	0.99	(0.82, 1.18)	.002	1.34	(1.11, 1.62)	<.001	1.50	(1.22, 1.85)	.002	1.37	(1.13, 1.68)

* reference group

Table 30b. **Adjusted association of age and time with diagnosed HIV with disclosure in heterosexual men (logistic regression analysis).**

(N=373)		Disclosed to someone			Disclosed to partner			Disclosed to family			Disclosed to friends			Disclosed to colleagues		
Independent Variable		p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age		0.71			0.32			0.26			0.09			0.51		
	Test for trend	*0.32*	*0.85*	*(0.62, 1.17)*	*0.68*	*1.05*	*(0.83 1.34)*	*0.03*	*0.76*	*(0.60, 0.97)*	*0.09*	*0.79*	*(0.60, 1.04)*	*0.44*	*0.85*	*(0.57, 1.28)*
	<30	0.69	1.60	(0.16, 16.48)	0.18	0.34	(0.07, 1.62)	0.21	2.68	(0.57, 12.53)	0.88	1.20	(0.11, 13.45)			
	30-40	0.24	2.03	(0.62, 6.63)	0.88	1.07	(0.43, 2.67)	0.06	2.32	(0.96, 5.59)	0.01	4.66	(1.47, 14.76)	0.12	5.98	(0.63, 56.84)
	40-50	0.88	1.07	(0.42, 2.77)	0.25	0.63	(0.29, 1.38)	0.29	1.52	(0.71, 3.25)	0.02	3.63	(1.27, 10.30)	0.10	5.90	(0.73, 47.57)
	50-60	0.78	1.16	(0.41, 3.24)	0.52	0.76	(0.33, 1.75)	0.65	1.21	(0.53, 2.74)	0.02	3.69	(1.24, 10.97)	0.07	7.09	(0.85, 59.23)
	60+*		1			1			1			1			1	
Years with diagnosed HIV		0.52			0.62			0.11			.003			0.20		
	Test for trend	*0.13*	*1.20*	*(0.95, 1.53)*	*0.24*	*1.12*	*(0.93, 1.34)*	*0.07*	*1.19*	*(0.99, 1.43)*	*<.001*	*1.56*	*(1.25, 1.94)*	*0.04*	*1.43*	*(1.02, 2.00)*
	0-2*		1			1			1			1			1	
	2-5	0.52	1.36	(0.54, 3.43)	0.32	1.45	(0.70, 2.99)	0.66	0.85	(0.41, 1.76)	0.20	1.84	(0.72, 4.67)	0.32	2.12	(0.49, 9.13)
	5-10	0.30	1.55	(0.67, 3.59)	0.31	1.40	(0.73, 2.70)	0.52	0.81	(0.42, 1.56)	0.03	1.07	(1.07, 5.84)	0.66	1.38	(0.33, 5.86)
	10-20	0.35	1.47	(0.66, 3.29)	0.38	1.33	(0.70, 2.52)	0.17	1.57	(0.83, 2.98)	.002	1.62	(1.62, 8.53)	0.09	3.19	(0.85, 11.94)
	20+	0.10	5.78	(0.70, 47.52)	0.14	2.29	(0.77, 6.76)	0.23	1.87	(0.67, 5.17)	.001	2.37	(2.37, 23.75)	0.06	4.85	(0.94, 25.07)
Ethnicity	Other*	0.76	1			1			1			1			1	
	White	0.06	1.11	(0.56, 2.21)	0.46	0.82	(0.49, 1.38)	0.01	2.03	(1.21, 3.41)	0.01	1.22	(1.22, 3.73)	0.01	3.01	(1.39, 6.52)

* reference group

Table 30c. **Adjusted association of age and time with diagnosed HIV with disclosure in heterosexual women (logistic regression analysis).**

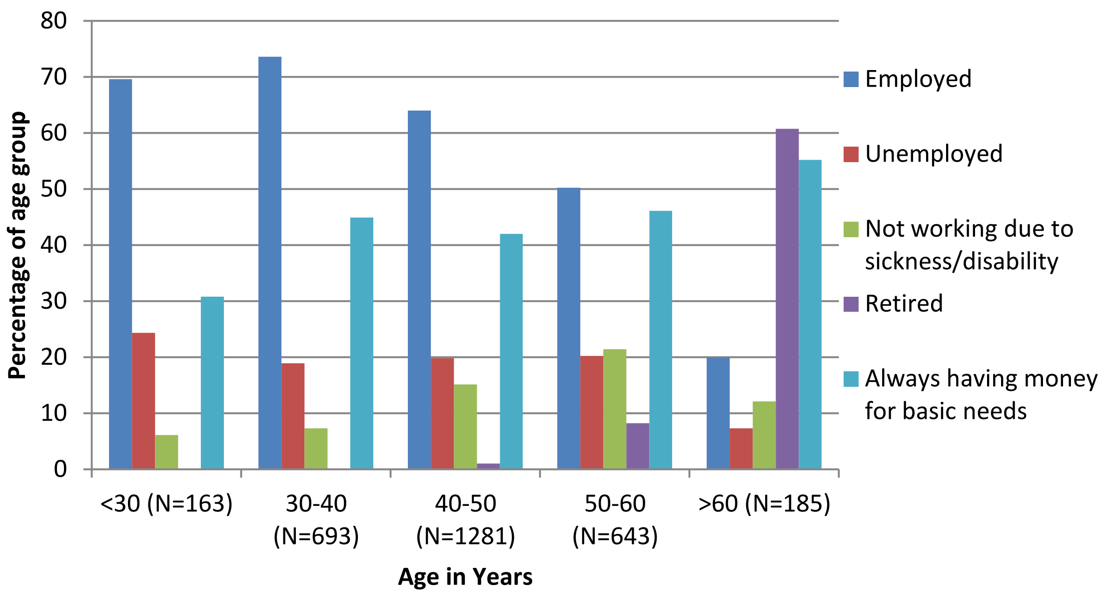
(N=637)		Disclosed to someone			Disclosed to partner			Disclosed to family			Disclosed to friends			Disclosed to colleagues		
Independent Variable		p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age		0.24			<.001			0.03			0.05			0.40		
	Test for trend	*0.04*	*0.77*	*(0.61, 0.99)*	<.001	*0.65*	*(0.54, 0.79)*	*0.32*	*0.91*	*(0.76, 1.09)*	*0.03*	*0.81*	*(0.67, 0.98)*	*0.45*	*1.15*	*(0.80, 1.64)*
	<30	0.08	3.40	(0.78, 13.29)	<.001	12.08	(3.09, 47.28)	0.12	2.26	(0.81, 6.33)	.004	5.55	(1.70, 18.11)	0.35	0.46	(0.09, 2.34)
	30-40	0.30	1.79	(0.59, 5.47)	.001	8.87	(2.47, 31.81)	0.55	0.76	(0.31, 1.86)	0.08	2.64	(0.90, 7.80)	0.08	0.31	(0.08, 1.14)
	40-50	0.28	1.84	(0.61, 5.51)	.002	7.36	(2.09, 25.92)	0.68	0.83	(0.35, 2.00)	0.05	2.88	(1.00, 8.28)	0.20	0.47	(0.14, 1.51)
	50-60	0.84	1.13	(0.35, 3.68)	0.04	3.94	(1.07, 14.56)	1.00	1.00	(0.39, 2.57)	0.08	2.70	(0.89, 8.24)	0.09	0.29	(0.07, 1.19)
	60+*		1			1			1			1			1	
Years with diagnosed HIV		.001			0.13			<.001			<.001			0.20		
	Test for trend	*<.001*	*1.60*	*(1.29, 1.98)*	*0.07*	*1.16*	*(0.99, 1.36)*	*<.001*	*1.53*	*(1.30, 1.80)*	*<.001*	*1.64*	*(1.37, 1.95)*	*0.04*	*1.42*	*(1.02, 1.98)*
	0-2*		1			1			1			1			1	
	2-5	0.24	1.56	(0.75, 3.23)	0.18	2.01	(1.07, 3.79)	0.88	1.05	(0.56, 1.97)	0.27	1.50	(0.73, 3.07)	0.31	0.41	(0.07, 2.29)
	5-10	0.02	2.09	(1.11, 3.93)	0.03	1.47	(0.84, 2.56)	0.06	1.71	(0.99, 2.95)	0.01	2.27	(1.21, 4.27)	0.81	1.15	(0.36, 3.68)
	10-20	<.001	3.99	(1.93, 8.27)	0.07	1.92	(1.07, 3.44)	<.001	3.19	(1.79, 5.66)	<.001	3.49	(1.82, 6.69)	0.26	1.95	(0.62, 6.18)
	20+	0.02	12.89	(1.63, 102.29)	<.001	2.16	(0.94, 4.94)	.001	4.66	(1.93, 11.26)	<.001	10.52	(4.08, 25.74)	0.23	2.40	(0.57, 10.07)
Ethnicity	Other*		1			1			1			1			1	
	White	0.01	3.78	(1.32, 10.88)	<.001	2.78	(1.64, 4.70)	0.17	1.44	(0.86, 2.41)	0.08	1.57	(0.95, 2.61)	0.83	0.90	(0.35, 2.33)

* reference group

5.3.4 **Employment and Retirement**

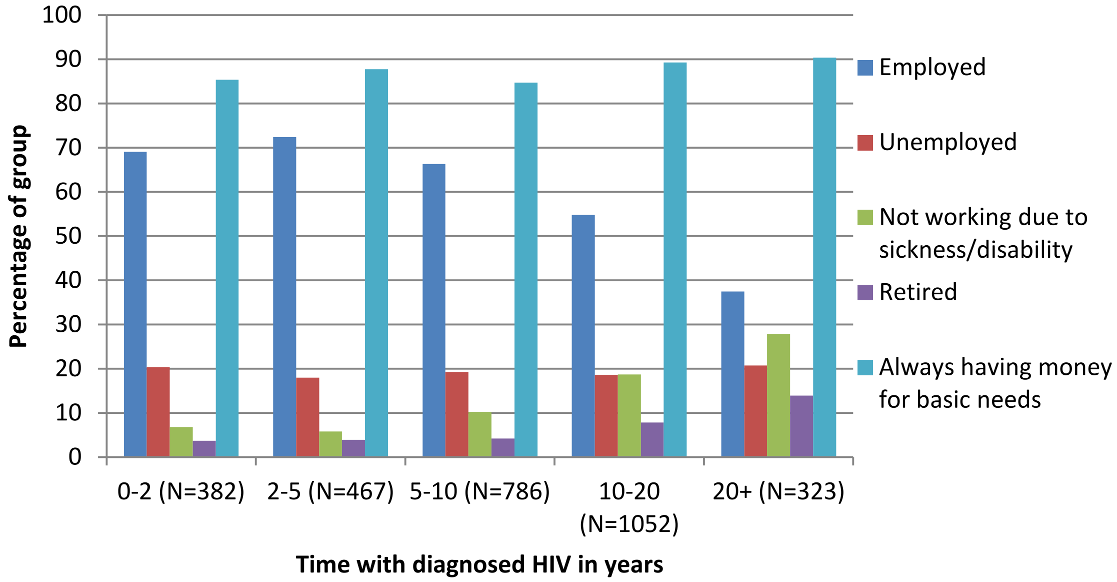
Many of the participants (N=1821; 49.3%) were employed, 577 (17.7%) were unemployed, 420 (12.9%) were not working due to sickness/disability, 192 (5.9%) were retired, 99 (3.0%) were students, and 37 (1.1%) took care of the home. Overall, less than half (1392; 42.7%) of participants reported that they had enough money for basic needs all the time, while 400 (12.4%) reported never having enough money for basic needs. *Figure 25* shows the associations with age.

***Figure 25*. Employment and money for basic needs (%) by age.**



While 'money for basic needs' increased (30.8% - 55.2% prevalence) with older age, being in employment decreased with age; and unemployment and not being in work due to sickness/disability increased in prevalence from the ages of 30-60 (ps<.001, for trend across age groups for employment status and money for basic needs). The prevalence of employment, unemployment and not working due to sickness/disability all decreased in participants over the age of 60 compared to younger age groups; as retirement became highly prevalent. *Figure 26* shows the associations with time diagnosed with HIV.

Figure 26. **Employment and money for basic needs (%) by time diagnosed with HIV.**

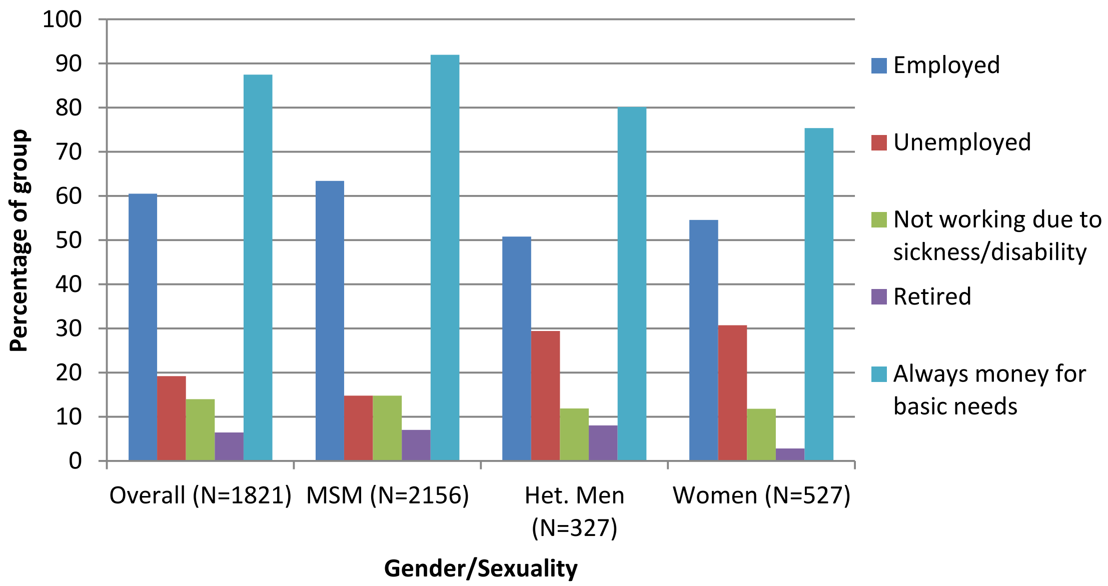


'Money for basic needs' remained stable across time with diagnosed HIV groups. However, employment was shown to decrease with increasing time with diagnosed HIV; and not working due to sickness/disability increased (ps<.001). Retirement was also found to increase with increasing time with diagnosed HIV.

Adjusted analyses were conducted for 'money for basic needs'. In adjusted analysis the association between age and 'money for basic needs' was significant, but there was no overall trend with age. The main difference was that adults aged 50-60 were significantly less likely to have money for basic needs than those aged 60 and over. There was also a nonsignificant association between with diagnosed HIV and 'money for basic needs' in adjusted analysis. This is depicted in *Table 31*.

When analysed by separate gender/sexuality subgroup, employment was highest in MSM (81.1%) compared to heterosexual men (63.4%) and women (64.0%), as was money for basic needs (92.0%; heterosexual men = 80.2%, women = 75.4%). This trend held true in PWH over the age of 50, with employment highest in MSM (43.3%) compared to heterosexual men (31.7%) and women (33.9%). However, comparatively more MSM over the age of 50 were also retired (21.0%; het. men = 20.3%, women =12.2%) and fewer were unemployed (13.7%; het. men = 22.0%, women =23.5%). Finally, older women were most likely to report being sick/disabled (20.0%; MSM = 18.3%, het. men = 15.4%). The results are depicted in *Figure 27*.

***Figure 27*. Employment and money for basic needs (%) by gender/sexuality.**



When logistic regression analysis for money for basic needs was stratified by gender/sexuality, test for trends across age and time with diagnosed HIV remained nonsignificant, with neither increasing age nor increasing time diagnosed with HIV associated with higher odds of having money for basic needs within each gender/sexuality group. No significant interaction was identified between gender/sexuality and age. These results are depicted in *Table 31.*

Table 31. **Adjusted association of age, time with diagnosed HIV, gender/sexuality and ethnicity with money for basic needs (logistic regression analysis).**

		No money for basic needs [a] Overall (N=3258)			No money for basic needs [a] MSM (N=2248)			No money for basic needs [a] Het. men (N=373)			No money for basic needs [a] Women (N=637)		
Independent Variable		p. value	Odd ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age		0.01			0.11			0.15			0.02		
	Test for trend	*0.62*	*1.03*	*(0.91, 1.17)*	*0.91*	*0.99*	*(0.83, 1.18)*	*0.53*	*0.91*	*(0.67, 1.23)*	*0.18*	*1.16*	*(0.94, 1.42)*
	<30	0.09	1.90	(0.91, 3.94)	0.15	2.54	(0.72, 8.92)	0.19	3.59	(0.54, 23.75)	0.97	1.02	(0.33, 3.19)
	30-40	0.09	1.70	(0.91, 3.18)	0.09	2.52	(0.86, 7.36)	0.15	2.71	(0.70, 10.46)	0.77	0.86	(0.31, 2.36)
	40-50	0.07	1.73	(0.95, 3.15)	0.02	3.36	(1.21, 9.37)	0.49	1.57	(0.44, 5.65)	0.54	0.73	(0.27, 1.98)
	50-60	.002	2.62	(1.42, 4.84)	0.02	3.54	(1.25, 10.01)	0.09	3.15	(0.85, 11.64)	0.22	1.94	(0.68, 5.57)
	60+*		1			1			1			1	
Years with HIV diagnosed		0.17			0.86			0.86			0.09		
	Test for trend	*0.15*	*0.93*	*(0.84, 1.03)*	*0.78*	*0.98*	*(0.85, 1.13)*	*0.50*	*0.92*	*(0.73, 1.16)*	*0.12*	*0.87*	*(0.72, 1.04)*
	0-2*		1			1			1			1	
	2-5	0.38	0.84	(0.56, 1.25)	0.29	0.72	(0.39, 1.33)	0.61	0.79	(0.32, 1.96)	0.78	1.11	(0.55, 2.24)
	5-10	0.83	1.04	(0.73, 1.48)	0.67	0.89	(0.52, 1.52)	0.97	1.02	(0.46, 2.25)	0.43	1.28	(0.70, 2.34)
	10-20	0.12	0.75	(0.52, 1.07)	0.45	0.82	(0.49, 1.38)	0.41	0.71	(0.32, 1.61)	0.18	0.63	(0.32, 1.24)
	20+	0.28	0.77	(0.47, 1.24)	0.66	0.86	(0.45, 1.64)	0.63	0.73	(0.20, 2.62)	0.41	0.64	(0.22, 1.84)
Sex		<.001											
	MSM*		1										
	Hetero male	<.001	2.23	(1.60, 3.10)									
	female	<.001	2.86	(2.17, 3.76)									
Ethnicity	Other*		1			1			1			1	
	White	<.001	0.59	(0.46, 0.77)	0.06	0.73	(0.53, 1.01)	0.04	0.44	(0.20, 0.95)	.002	0.32	(0.16, 0.67)

[x] participants over the age of 50 only [a] money for basic needs less than 'always' * reference group

5.3.5 The associations between physical, psychological and social factors of well-being

Using chi squared analysis, the associations between the social health measures and depression, anxiety, CD4 count, symptom prevalence and distress and problems with ADLs were assessed.

5.3.5.1 Social support

Social support, both overall and across all components of the social support questionnaire, was related to a decreased likelihood of symptom prevalence and distress (34.5% prevalence of symptom prevalence in adults with sufficient social support overall vs. 67.0% prevalence with insufficient social support, and 44.0% prevalence of distressing symptoms vs. 77.4% respectively). Social support was also related to roughly a 50% reduction in prevalence of participants reporting difficulties with ADLs (27.0% prevalence of ADLs in participants with sufficient social support vs. 59.3% in those without) and a 75% reduction in the odds of having clinically significant depression (13.4% prevalence of depression vs. 52.6%) or anxiety (10.6% vs. 43.1%). No association was found between social support and CD4 cell count. These associations were not greatly altered after adjustment for age and gender/sexuality. The percentages and p values are reported in *Table 32*.

Using a logistic regression model, interactions between a) age and b) time with diagnosed HIV as grouped variables in a continuous form with social support were assessed in relation to physical health as the dependent variables. The models were adjusted for ethnicity and gender/sexuality. No significant interactions were found.

Table 32. **CD4 count and physical and mental symptom prevalence in relation to social support.**

N=3258	Sufficient social support			People who care			Love and affection			Talk to someone			Invitations to go out			Help when sick		
	Yes	No	p. value	Yes	No	p. value	Yes	No	p. value	Yes	No	p. value	Yes	No	p. value	Yes	No	p. value
≥10 symptoms	668 34.5%	734 67.0%	<.001	954 39.2%	494 68.0%	<.001	812 36.7%	632 67.4%	<.001	826 37.8%	619 63.7%	<.001	756 35.6%	684 66.6%	<.001	825 37.4%	600 68.3%	<.001
≥1 distressing symptom	852 44.0%	847 77.4%	<.001	1192 49.0%	574 79.0%	<.001	1040 47.0%	720 76.8%	<.001	1040 47.6%	723 74.5%	<.001	963 45.3%	794 77.3%	<.001	1048 47.5%	686 78.1%	<.001
1 or more ADL problem	523 27.0%	649 59.3%	<.001	786 32.3%	430 59.1%	<.001	669 30.2%	539 57.5%	<.001	675 30.9%	538 55.4%	<.001	601 28.3%	609 59.3%	<.001	665 30.1%	535 60.9%	<.001
Depression*	259 13.4%	576 52.6%	<.001	461 18.9%	405 55.7%	<.001	370 16.7%	495 52.8%	<.001	381 17.4%	482 49.6%	<.001	330 15.5%	529 51.5%	<.001	391 17.7%	465 53.0%	<.001
Anxiety ˣ	205 10.6%	472 43.1%	<.001	364 15.0%	338 46.5%	<.001	304 13.7%	396 42.2%	<.001	298 13.6%	403 41.5%	<.001	252 11.9%	442 43.0%	<.001	315 14.3%	378 43.1%	<.001
CD4 count >350	1564 81.7%	887 82.2%	0.39	1960 81.6%	586 81.6%	0.51	1792 82.0%	750 81.1%	0.29	1764 81.7%	780 81.4%	0.44	1717 81.6%	820 81.3%	0.44	1772 81.4%	713 82.1%	0.33

*PHQ-9 score ≥10, ˣ GAD-7 score ≥10

5.3.5.2 Relationship status

Having a partner present was strongly related to having sufficient social support - prevalence of sufficient social support was 69.0% for those with a partner vs. 35.2% for those without ($p<.001$), while amongst participants with a partner, having an HIV positive partner was negatively related to social support (41.2% reporting sufficient social support and an HIV positive partner vs. 46.5% with an HIV negative partner, $p=0.04$). Having a child was related to lower levels of social support (24.8% with a child and sufficient social support, vs. 27.8% respectively, $p=0.04$).

Having a partner present was also strongly related to all physical and mental health factors. More specifically, having a partner present was related to a significantly prevalence of participants having a CD4 count >350 cells/mm^3 (82.5% for partner vs. 78.8% where no partner was reported), and lower physical symptom prevalence (40.6% reporting physical symptom prevalence vs. 50.9% respectively) or distress (50.6% vs. 61.8%), problems with ADLs (31.9% vs. 45.9%), depression (20.0% vs. 36.3%) or anxiety (17.1% vs. 28.1%). Being in a long-term relationship was associated with a lower prevalence of depression (16.7% vs. 22.3%) and anxiety (13.0% vs. 19.9%). However, having a partner who is HIV positive was associated with an increase in prevalence of symptom distress (53.3% vs. 48.6%) and no other measures. Having a child was associated with a lower CD4 count (77.3% vs. 83.2%) and an increase in anxiety (24.3% vs. 21.1%). These associations were not greatly altered after adjustment for age and gender/sexuality. The percentages and p values are reported in *Table 33*.

Using a logistic regression model, interactions between a) age and b) time with diagnosed HIV (grouped variables in a continuous form) with partner and parental status compared to physical and mental health were explored, adjusted for ethnicity and gender/sexuality. No significant interactions were found in relation to age.

When adjusted for time diagnosed with HIV, three significant interactions were found. The logistic model assessing an interaction between time with diagnosed HIV and relationship status, with a Duke–UNC FSSQ scale score of ≥20 as the dependent variable, included the following factors: time with diagnosed HIV (as a grouped variable in a continuous form), relationship status, age (categorical variable), gender/sexuality, ethnicity, and the interaction between time with diagnosed HIV (as a grouped variable in a continuous form) and relationship status. This revealed an interaction between time with diagnosed HIV and relationship status, in relation to social support (Odds Ratio for interaction=1.16, 95% C.I.= 1.01-1.33, p=0.04). *Table 34* shows that the association of not having a partner with sufficient social support, tended to decrease with time diagnosed with HIV.

The logistic model assessing an interaction between time with diagnosed HIV and parental status, with GAD-7 score of ≥10 as the dependent variable revealed an interaction between time diagnosed with HIV by parental status, in relation to anxiety (Odds Ratio for interaction =0.74, 95% C.I.= 0.59-0.94, p=0.01). *Table 35* shows that the association of not having a child present with anxiety symptom prevalence tended to increase with increasing time diagnosed with HIV. Finally, the logistic model assessing an interaction between time with diagnosed HIV and relationship length, with 'having a partner with a positive HIV status' as the dependent variable revealed an interaction between time diagnosed with HIV by relationship length, in relation to partner's HIV status (Odds Ratio for interaction =1.27, 95% C.I.=1.06-1.53, p=0.01). *Table 36* shows that the association of partner's HIV-positive status with relationship length tended to increase with increasing time diagnosed with HIV.

Table 33. **CD4 count and physical and mental symptom prevalence in relation to relationship and parental status.**

N=3258	Partner present			Partner for ≥10 years			Partner HIV positive			Child present		
	Yes	No	p. value	Yes	No	p. value	Yes	No	p. value	Yes	No	p. value
≥10 symptoms	736 (40.6%)	723 (50.9%)	<.001	288 (40.7%)	361 (39.7%)	0.36	320 (41.8%)	416 (39.7%)	0.19	370 (41.9%)	1093 (46.5%)	0.01
≥1 distressing symptom	918 (50.6%)	878 (61.8%)	<.001	341 (48.2%)	469 (51.6%)	0.10	408 (53.3%)	510 (48.6%)	0.03	481 (54.5%)	1213 (55.9%)	0.25
1 or more ADL problem	578 (31.9%)	652 (45.9%)	<.001	240 (33.9%)	277 (30.5%)	0.08	249 (32.5%)	329 (31.4%)	0.31	346 (39.2%)	884 (37.6%)	0.22
Depression[x]	362 (20.0%)	516 (36.3%)	<.001	118 (16.7%)	203 (22.3%)	.003	146 (19.1%)	216 (20.6%)	0.23	245 (27.7%)	632 (26.9%)	0.33
Anxiety[x]	311 (17.1%)	399 (28.1%)	<.001	92 (13.0%)	181 (19.9%)	<.001	131 (17.1%)	180 (17.2%)	0.52	215 (24.3%)	495 (21.1%)	0.03
CD4 count >350	1498 (82.5%)	1103 (78.8%)	.001	591 (84.1%)	751 (83.6%)	0.43	628 (83.0%)	870 (83.8%)	0.34	674 (77.3%)	1930 (83.2%)	<.001

*PHQ-9 score ≥10, [x] GAD-7 score ≥10

***Table 34*. The relationship between time with diagnosed HIV, relationship status and social support prevalence.**

Time in years	Relationship status	Sufficient social support present*	
		No	Yes
0-2	No partner	78 (45.6%)	93 (54.4%)
	Partner	34 (18.1%)	154 (81.9%)
2-5	No partner	76 (42.7%)	102 (57.3%)
	Partner	60 (21.1%)	224 (78.9%)
5-10	No partner	186 (55.4%)	150 (44.6%)
	Partner	108 (22.6%)	370 (77.4%)
10-20	No partner	261 (56.7%)	199 (43.3%)
	Partner	146 (24.6%)	447 (75.4%)
≥20	No partner	104 (66.2%)	53 (33.8%)
	Partner	34 (20.6%)	131 (79.4%)

*Duke–UNC FSSQ scale score of ≥20

***Table 35*. The relationship between time with diagnosed HIV, parental status and anxiety symptoms.**

Time in years	Child present	Anxiety symptoms present*	
		No	Yes
0-2	No	241 (87.3%)	35 (12.7%)
	Yes	103 (79.8%)	26 (20.2%)
2-5	No	310 (83.3%)	62 (16.7%)
	Yes	99 (81.1%)	23 (18.9%)
5-10	No	454 (77.5%)	132 (22.5%)
	Yes	212 (74.1%)	74 (25.9%)
10-20	No	649 (77.9%)	184 (22.1%)
	Yes	215 (74.1%)	75 (25.9%)
≥20	No	200 (70.9%)	82 (29.1%)
	Yes	39 (69.6%)	17 (30.4%)

*GAD-7 score ≥10

***Table 36*. The relationship between time with diagnosed HIV, partner's HIV status and relationship length.**

Time in years	Partner's HIV status	Relationship length	
		0-9 years	≥10 years
0-2	HIV negative	59 (57.3%)	44 (42.7%)
	HIV positive	47 (70.1%)	20 (29.9%)
2-5	HIV negative	98 (64.9%)	53 (35.1%)
	HIV positive	77 (70.6%)	32 (29.4%)
5-10	HIV negative	145 (62.5%)	87 (37.5%)
	HIV positive	138 (65.1%)	74 (34.9%)
10-20	HIV negative	169 (51.8%)	157 (48.2%)
	HIV positive	108 (43.4%)	141 (56.6%)
≥20	HIV negative	42 (42.9%)	56 (57.1%)
	HIV positive	23 (37.1%)	39 (62.9%)

5.3.5.3 Disclosure

Disclosure of HIV status to one or more persons other than health-care staff was positively associated with social support rates (94.0% reporting sufficient support in disclosed participants vs. 89.7% in non-disclosed, p<.001) and reports of having a partner present (58.3% vs. 34.2%, p<.001). Having a child was related to lower disclosure rates (25.1% of participants who had disclosed vs. 50.2% of those who hadn't, p<.001).

Disclosure was related to a higher chance of participants having a CD4 count >350 cells/mm^3 (82.1% vs. 74.2%) and a greater likelihood of reporting symptom prevalence (46.0% vs. 37.3%) and distress (56.3% vs. 47.6%). Disclosure of HIV status to a partner was related to greater likelihood of CD4 count >350 cells/mm^3 (83.8% vs. 78.6%) and a decrease in reports of symptom prevalence (42.0% vs. 48.9%), symptom distress (52.4% vs. 59.3%), difficulty with ADLs (33.4% vs. 43.5%), depression (22.0% vs. 33.2%) or anxiety (18.5% vs. 26.1%). However, disclosure to family members was also related to an increase in reports of symptom prevalence (49.6% vs. 40.7%) and distress (60.8% vs. 50.4%), problems with ADLs (44.1%vs. 32.0%), depression (30.0% vs. 24.3%) and anxiety (24.0% vs. 19.9%). Similarly, disclosure to friends was related with higher symptom prevalence and distress and problems with ADLs -

but not depression or anxiety - and disclosure to colleagues was related to higher symptom prevalence and distress but lower prevalence of depression and anxiety. These associations were not greatly altered after adjustment for age and gender/sexuality. The percentages and p values are reported in *Table 37*.

Using a logistic regression model, interactions between a) age and b) time with diagnosed HIV (grouped variables in a continuous form), with HIV status disclosure were assessed in relation to physical and mental health as the dependent variables. The models were adjusted for ethnicity and gender/sexuality. Only two significant interactions were found. The logistic model assessing an interaction between age and disclosure, with ≥10 physical symptoms as the dependent variable, included the following factors: age (as a grouped variable in a continuous form), disclosure to one or more persons, time with diagnosed HIV (categorical variable), gender/sexuality, ethnicity, and the interaction between age (as a grouped variable in a continuous form) and disclosure. This revealed an interaction between age by disclosure, in relation to physical symptom prevalence (Odds Ratio for interaction=1.35, 95% C.I.= 1.03-1.75, p=0.03). *Table 38* shows that the association of disclosure with prevalence of ten or more physical symptoms, while present across all age groups, tended to be lower in participants aged 30-40 than other age groups.

The logistic model assessing an interaction between time with diagnosed HIV and disclosure, with a Duke–UNC FSSQ scale score of ≥20 as the dependent variable revealed an interaction between time diagnosed with HIV by disclosure, in relation to social support (Odds Ratio interaction =0.77, 95% C.I.= 0.61-0.98, p=0.04). *Table 39* shows that the association of disclosure with sufficient social support, while present across all time with diagnosed HIV groups, tended to decrease with increased time diagnosed with HIV.

Table 37. **Physical and mental symptom prevalence in relation to disclosure.**

N=3258	Disclosed to someone			Partner			Family			Friends			Colleagues		
	Yes	No	p. value	Yes	No	p. value	Yes	No	p. value	Yes	No	p. value	Yes	No	p. value
≥10 symptoms	1363 (46.0%)	101 (37.3%)	.003	744 (42.0%)	727 (48.9%)	<.001	806 (49.6%)	665 (40.7%)	<.001	1003 (48.8%)	468 (28.9%)	<.001	380 (49.1%)	1091 (43.9%)	0.01
≥1 distressing symptom	1668 (56.3%)	129 (47.6%)	.004	928 (52.4%)	883 (59.3%)	<.001	989 (60.8%)	822 (50.4%)	<.001	1203 (58.5%)	608 (50.5%)	<.001	456 (58.9%)	1355 (54.5%)	0.02
1 or more ADL problem	1135 (38.3%)	91 (33.6%)	0.07	592 (33.4%)	648 (43.5%)	<.001	717 (44.1%)	523 (32.0%)	<.001	822 (40.0%)	418 (34.7%)	.002	285 (36.8%)	955 (38.4%)	0.22
Depression*	803 (27.1%)	73 (26.9%)	0.51	390 (22.0%)	494 (33.2%)	<.001	488 (30.0%)	396 (24.3%)	<.001	569 (27.7%)	315 (26.2%)	0.19	185 (23.9%)	699 (28.1%)	0.01
Anxiety[x]	647 (21.8%)	64 (23.6%)	0.27	327 (18.5%)	388 (26.1%)	<.001	390 (24.0%)	325 (19.9%)	.003	445 (21.7%)	270 (22.4%)	0.31	131 (16.9%)	584 (23.5%)	<.001
CD4 count >350	2404 (82.1%)	198 (74.2%)	.001	1465 (83.8%)	1155 (78.6%)	<.001	1311 (81.8%)	1309 (81.1%)	0.31	1694 (83.6%)	926 (77.7%)	<.001	639 (84.0%)	1981 (80.6%)	0.02

*PHQ-9 score ≥10, [x] GAD-7 score ≥10

***Table 38*. The relationship between age, disclosure, and physical symptom prevalence.**

Age in years	**Disclosure***	**Physical symptom prevalence**	
		0-9 symptoms	10 or more symptoms
<30	No	8 (57.1%)	6 (42.9%)
	Yes	92 (58.2%)	66 (41.8%)
30-40	No	32 (56.1%)	25 (43.9%)
	Yes	428 (63.0%)	251 (37.0%)
40-50	No	68 (61.8%)	42 (38.2%)
	Yes	645 (51.9%)	598 (48.1%)
50-60	No	31 (62.0%)	19 (38.0%)
	Yes	294 (46.6%)	337 (53.4%)
60+	No	21 (75.0%)	7 (25.0%)
	Yes	101 (54.3%)	85 (45.7%)

* Disclosed to one or more person other than healthcare staff

***Table 39*. The relationship between time diagnosed with HIV, disclosure and social support.**

Time in years	**Disclosure**	**Social Support**	
		Less than desired	Acceptable level*
0-2	No	25 (54.3%)	21 (45.7%)
	Yes	85 (27.2%)	227 (72.8%)
2-5	No	17 (37.8%)	28 (62.2%)
	Yes	119 (28.4%)	300 (71.6%)
5-10	No	38 (53.5%)	33 (46.5%)
	Yes	258 (34.5%)	490 (65.5%)
10-20	No	29 (50.9%)	28 (49.1%)
	Yes	380 (38.0%)	620 (62.0%)
20+	No	3 (37.5%)	5 (62.5%)
	Yes	134 (42.7%)	180 (57.3%)

*Duke–UNC FSSQ scale score of ≥20

5.3.5.4 Employment and money for basic needs

Social support was higher in adults who were employed, rather than unemployed (73.1% reporting sufficient social support in employed participants vs. 49.2% in unemployed, p<.001), and in those who always had money for basic needs (67.2% reporting sufficient social support vs. 38.3% respectively, p<.001). Having a partner was also associated with higher rates of employment (62.3% with a partner vs. 37.7% without, p<.001), as was having a child (37.2% with a child vs. 21.8% without, p<.001). Employment was positively associated with always having money for basic needs (90.0% employed with money for basic needs vs. 84.2% unemployed, p<.001), but having a child was negatively associated (23.9% with a child and money for basic needs vs. 48.6% without, p<.001). Finally, disclosure was also positively related to having money for basic needs (88.6% disclosed vs. 76.4% undisclosed, p<.001).

In PWH over the age of 50, being unemployed was related to the highest levels of anxiety (28%) and depression (44%) and the lowest satisfaction with social support (48% with sufficient social support) compared to all other employment groups (ps<.01). Retired OPWH showed the highest physical symptom distress and second highest rates of depression and anxiety, compared to other employment groups (employed, unemployed, unemployed due to sickness/disability) but the second lowest reports of social support. Employment was still related to low levels of depression, anxiety and physical symptom distress and high social support when compared to other employment groups.

CD4 count was high across employment groups, but was highest in those employed (83.2%) and retired (83.2%) and lowest in those who were sick/disabled (77.3%). This difference was statistically significant. Symptom prevalence was lowest in the employed group (32.7%) and highest in the sick/disabled group (81.2%), as were symptom distress (44.4% and 88.1% respectively), problems with ADLs (19.7% and 87.9%), depression (14.9% and 59.5%) and anxiety (12.4% and 45.0%).

Compared to unemployed PWH, employed PWH were more likely to have a high CD4 count and less likely to show symptom prevalence, distress, depression, anxiety or problems with ADLs. Similar results were found for 'money for basic needs', with those 'always having money for basic needs' showing higher CD4 count and lower odds of symptom prevalence, distress, mental illness and ADL problems. In OPWH, being employed was related to lower odds of physical and mental symptoms, but no difference in CD4 count when compared to unemployment. In comparison to retirement, employed OPWH were less likely to report symptom prevalence, distress, depression or problems with ADLs. Unemployed OPWH were more likely than retired OPWH to report physical and mental problems. These associations were not greatly altered after adjustment for age and gender/sexuality. The percentages and p values are reported in *Table 40a-b*.

Using a logistic regression model, interactions between a) age and b) time with diagnosed HIV (grouped variables in a continuous form) with employment status were assessed in relation to physical and mental health as the dependent variables. The models were adjusted for ethnicity and gender/sexuality. Only one significant interaction was found in relation to money for basic needs. The logistic model assessing an interaction between time with diagnosed HIV and money or basic needs, with a GAD-7 score of ≥10 as the dependent variable, included the following factors: time with diagnosed HIV (as a grouped variable in a continuous form), money for basic needs, age (categorical variable), gender/sexuality, ethnicity, and the interaction between time with diagnosed HIV (as a grouped variable in a continuous form), and money for basic needs. This revealed an interaction between time with diagnosed HIV by money for basic needs, in relation to anxiety (Odds Ratio for interaction =1.25, 95% C.I.= 1.02-1.52, p=0.03) which increased in strength with increasing time.

However, employment - compared to any other employment status – did show interactional differences in relation to age and time with diagnosed HIV. Specifically, the logistic models assessing an interaction between age and employment revealed interactions between age by employment, in relation to anxiety (Odds Ratio for interaction =1.27, 95% C.I.= 1.04-1.55, p=0.02), which increased in strength with increasing age as did the relationship to having a child present (Odds Ratio for interaction=1.36, 95% C.I.= 1.14-1.61, p=0.001), while the relationship to relationship length weakened (Odds Ratio for interaction =0.68, 95% C.I.= 0.52-0.88, p=0.003). The logistic models assessing an interaction between time with diagnosed HIV and employment revealed interactions between 'time with diagnosed HIV by employment', in relation to physical symptom prevalence, which became weaker (Odds Ratio for interaction =0.72, 95% C.I.= 0.63-0.82, p<.001). The relationship to symptom distress also became weaker (Odds Ratio for interaction =0.77, 95% C.I.= 0.67-0.88, p<.001), as did the relationship to problems with ADLs (Odds Ratio for interaction =0.75, 95% C.I.= 0.65-0.86, p<.001), depression (Odds Ratio for interaction =0.77, 95% C.I.= 0.66-0.90, p=0.001), and disclosure of HIV status (Odds Ratio for interaction =0.78, 95% C.I.= 0.62-0.98, p=0.03). The relationship to ‘having a child present’ became stronger (Odds Ratio for interaction =1.17, 95% C.I.= 1.01-1.35, p=0.04).

Table 40a. **CD4 count, physical, and mental symptom prevalence in relation to employment status.**

	Employment status					Employed vs. unemployed	Money for basic needs		
	Employed	Unemployed	Retired	Sick/ Disabled	p. value	p. value	Yes	No	p. value
≥10 symptoms	595 (32.7%)	336 (58.2%)	94 (49.0%)	341 (81.2%)	<.001	<.001	1189 (42.6%)	256 (64.0%)	<.001
≥1 distressing symptom	808 (44.4%)	394 (68.3%)	108 (56.3%)	370 (88.1%)	<.001	<.001	1469 (52.6%)	314 (78.5%)	<.001
1 or more ADL problem	359 (19.7%)	312 (54.1%)	109 (56.8%)	369 (87.9%)	<.001	<.001	965 (34.6%)	252 (63.0%)	<.001
Depression*	271 (14.9%)	251 (43.5%)	46 (24.0%)	250 (59.5%)	<.001	<.001	653 (23.4%)	218 (54.5%)	<.001
Anxiety ˣ	225 (12.4%)	211 (36.6%)	30 (15.6%)	189 (45.0%)	<.001	<.001	522 (18.7%)	184 (46.0%)	<.001
CD4 count >350	1497 (83.2%)	449 (79.2%)	158 (83.2%)	321 (77.3%)	0.03	0.02	2274 (82.4%)	295 (75.1%)	<.001

*PHQ-9 score ≥10, ˣ GAD-7 score ≥10

Table 40b. **CD4 count, physical, and mental symptom prevalence in relation to employment status in adults over the age of 50.**

	Employment status			Employed vs. unemployed	Employed vs. retired	Unemployed vs. retired
	Employed	Unemployed	Retired	p. value	p. value	p. value
≥10 symptoms	123 (33.7%)	88 (60.7%)	85 (47.8%)	<.001	.002	<.001
≥1 distressing symptom	153 (41.9%)	109 (75.2%)	99 (55.6%)	<.001	.003	<.001
1 or more ADL problem	92 (25.2%)	98 (67.6%)	100 (56.2%)	<.001	<.001	<.001
Depression*	46 (12.6%)	62 (42.8%)	40 (22.5%)	<.001	.004	<.001
Anxiety ˣ	41 (11.2%)	48 (33.1%)	26 (14.6%)	<.001	0.18	<.001
CD4 count >350	296 (81.3%)	112 (78.3%)	145 (82.4%)	0.26	0.46	0.20

*PHQ-9 score ≥10, ˣ GAD-7 score ≥10

5.4 Discussion

The aim of this chapter was to assess the association of age with a) social support, b) relationship and parental status, c) disclosure and d) employment and financial hardship, taking into account time since HIV diagnosis and other demographic factors. It also explored the relationship between these social factors and CD4 count, physical and mental symptom distress.

Insufficient social support was apparent in 36.1% of the ASTRA population: that is, they reported moderately less support than desired on one or more of the Duke–UNC FSSQ domains. In adjusted analysis, the number of participants with sufficient social support decreased with age until the 50-60 year age group, becoming lowest in participants aged 50-60 and then increasing slightly in the 60 and over age group. However, the declining trend with age was not statistically significant. OPWH were found to be less likely to be in a relationship, but where they were they were more likely to have been in the relationship for ten or more years. Older OPWH were also more likely to be a parent and less likely to have disclosed their HIV status to their partner, family, friends or work colleagues.

Good social support has previously been found to be related to better physical and mental health in the general population[272-274] and older adults[70;72**18;20**74], strongly suggesting that social engagement is an important determinant of health and well-being. These results are reiterated here. Sufficient social support was related to lower levels of depression, anxiety and physical symptom distress. Disclosure of HIV status and being in a relationship were also associated with higher levels of overall social support. These associations did not differ greatly between age groups. Finally, rates of unemployment and 'not working due to sickness/disability' increased with age and, in comparison to participants over the age of 60 who were employed, retired OPWH showed higher physical symptom distress, depression and anxiety and lower levels of social support.

5.4.1 **Social Support**

In older adults, levels of social support are generally found to be lower than in younger adults[64-66], due to retirement, illness, loss of friends and family through bereavement[64;97;117;271]. As physical health declines with age, it is likely that social support becomes an increasingly important factor in the maintenance of physical and mental health and the possibility of 'successful ageing'. In older adults with HIV, social support may be doubly important; both to maintain acceptable levels of health and medication adherence and to buffer against stigma. However, very few quantitative studies have explored social support in this population, fewer still have made age comparisons and none have utilised UK populations. Previously, no difference has been found in social support by age in relation to PWH[148], but dissatisfaction with levels of support were commonly identified in older PWH[94;96;307;310;312], as was social isolation due to a loss of friends over time and difficulties in creating new social connections due to old age, HIV-related stigma, fatigue and illness[96;98;99;261;308;309]. This social isolation was, in turn, related to increased prevalence of depression[261;308] and illness[310], with one study reporting a stronger relationship between social support and distress with increasing age[308]. However, in the present HIV-positive population the association between social support and physical and mental health did not differ with age. This suggests that, for PWH, social support does not become increasingly important with age. This could be due to the relatively low levels of social support reported in all PWH, or possibly due to illness burden and medication management causing variations in health regardless of social support.

Other than this, the presented results mirror those of the international literature; social support decreased (nonsignificantly) with age in PWH, and higher levels of social support were related to lower probabilities of depression, anxiety and physical symptom distress. This suggests that PWH overall may not be receiving the levels of informal support that they require to maintain their overall well-being.

The association between low social support and poorer mental health among PWH may affect mental health by limiting the self-worth available to them through friendship which, in turn, reduces wellbeing and health maintenance[65;268]. Lower social support may also affect physical health directly by preventing the development of health-seeking behaviours, such as exercise and medication adherence[72;268;269]. In PWH 'HIV health maintenance' - the action of monitoring ill health, creating and keeping hospital appointments and adhering to medication - is especially important for physical health and to prevent virological failure of ART and, ultimately, progression to AIDS. Without acceptable levels of social support, PWH may not receive the levels of psychological and physical support[269;270] required to maintain these health behaviours, or to respond appropriately to ill health and medication side-effects.

5.4.2 Relationship and parental status

Partners are often reported as a source of emotional and physical support; with the benefits accumulating with increasing length of relationship[277]. Relative to their unmarried counterparts, married older adults often have lower rates of chronic illness[278] and mortality[70] and those in 'positive' relationships show low levels of anxiety and depression[74]. In the ASTRA population almost half of the participants did not have a partner, with the likelihood of being single increasing with age in women and relationship length decreasing with age in MSM. Being in a relationship was found to be related to sufficient social support, which may explain the lower levels of social support reported in older adults. However, unlike social support, relationship status and length were not found to be strongly associated with mental or physical health. It is possible that, as found in the qualitative literature, the feelings of being a burden to loved ones[310] may decrease mental health and balance out the positive effects of long-term relationships . Alternatively, the stress and anxieties related to preventing the transmission of HIV to their partner may create an HIV-specific effect wherein being in a relationship causes as much physical and mental stress as it removes. This may be especially true in cases where the partner has not been disclosed to. Finally, it is possible that being in a long-term MSM relationship brings its own challenges which reduce the positive effects of having a partner present. Gender/sexuality-based differences in relationship status were not explored, but such differences are worthy of investigation in other studies; especially in relation to recent legislative changes in relation to same-sex marriage.

Interestingly, having a child was related to lower levels of social support and disclosure, regardless of participant age. In other words, older PWH do appear to disclose their HIV status to their children, but may not rely on adult children for support. This would cut older PWH off from a very important line of financial, emotional and physical support, which is commonly utilised in older adults in the general population[295-298;314], and may detrimentally affect their ability to cope with age-related changes in physical well-being.

5.4.3 **Disclosure**

Disclosure prevalence was very high in the study population overall, with over 90% having disclosed their HIV status to someone other than health-care staff. Friends were the most likely group to have been disclosed to across all ages and, while the HIV status of adults disclosed to was not measured, it seems likely from the literature that that a significant number of confidants may also be HIV positive[94;96;315] due to the lower levels of expected stigma from other HIV positive adults and the ability to share HIV-specific stories, advice and emotions[94].

Disclosure prevalence decreased with age both overall and within each individual social group (partner, family, friends, colleagues). In agreement with a previous study, disclosure was related to increased social support[307], and this may at least partially explain the reduction in social support identified amongst older population study participants. Previous qualitative work has identified that older PWH are hindered in disclosing their HIV status for three primary reasons: a) fear of consequences, b) protection of loved ones and c) not knowing how to disclose their status[94;95;309;311]. As, with older age, HIV-positive friends decline in numbers due to illness and reduced mobility[94] the 'friends' available for disclosure and social support also decrease. If older adults feel the need to protect younger family members from their illness and/or are not equipped with the necessary skills to broach the subject of HIV then the likelihood of disclosure will decrease; as will the available social support. Furthermore, disclosure was found to be increasingly strongly related to physical symptom prevalence with age, which suggests that family members may have a positive effect on health-related behaviours when disclosed to. However, this could equally suggest that PWH do not disclose their status until forced to by ill health. Either way, disclosure appears to be important to well-being in PWH and, since the prevalence decreased with age, is of concern for OPWH.

5.4.4 **Retirement**

In the study population overall, retirement was found to be related to higher prevalence of depression, anxiety, physical distress and insufficient social support when compared to employment, but the prevalence of these symptoms was lower among retired participants than among those who were unemployment or not working due to sickness/disability. An identical pattern was found when looking at adults over the age of 50 only and, when adjusted for age, the relationships between employment and mental and physical health became stronger. This suggests that employment is as central to identity in older adults as younger adults. It also implies that, for PWH, retirement may well be forced by ill health, and is related to overall well-being.

In the literature, it has been suggested that retirement causes positive effects on mental and physical health through lowered stress[61;316] and increased time for social and physical activity[300;301] unless it is forced due to ill health[300;303;304]. In ASTRA the reasons behind retirement were not collected, but it seems possible that ill health and fear of HIV stigma may dampen the positive effects of retirement by reducing opportunities for social or physical activity - thus causing the apparent negative effects of retirement on health measures shown in this analysis. It also seems possible that, on average, people with HIV may take retirement earlier than planned due to ill health or as a care-giver for family members and therefore feel 'cheated' of the sense of achievement attained through work. This is partially supported by the average age of the 'retired' group, which was 62.3 years; meaning that many PWH retired early (assuming a traditional retirement age of 65). However, the information necessary to confirm this is not available.

While retirement was related to worse overall well-being in comparison to employment, retirement was related to improved well-being compared to unemployment and those not working due to sickness/disability; both overall and in participants over the age of 50s only. As such, it does appear possible that retirement does have some positive effects on levels of stress and physical health (as found in the gerontological literature)when compared to adults who cannot afford to stop working, despite physical illness. This is supported by the evidence that not having 'money for basic needs' was strongly related to lower levels of physical and mental well-being.

5.4.5 **Time with diagnosed HIV**

With longer time diagnosed with HIV, social support decreased and disclosure prevalence increased. It is not surprising that prevalence of disclosure increased with longer time HIV since diagnosis, but the steady increase in prevalence across the time since diagnosis categories suggests that many PWH take a number of years to disclose their status to another person. In addition, disclosure may be higher with longer time since diagnosis through necessity; in previous qualitative analysis PWH mentioned disclosing their HIV status due to a need for support and an inability to hide their status because of ill health and medication[317]. For PWH who have lived through a time when the outcome of HIV was far less certain, moreover, it is likely that family or friends were necessary for emotional and physical support, and so non-disclosure was less available. This is corroborated by the finding that, with increasing time with diagnosed HIV, the relationship between social support and having a partner increased, as did the relationship between being in a long-term relationship and reporting fewer problems with ADLs.

Relationship status did not differ by time diagnosed with HIV. The implication of this is unclear, but as low prevalence of relationships were reported in the participants aged under 30 years, it is possible that this reflects a difficulty in maintaining or starting a relationship in individuals with a positive diagnosed HIV status; meaning that the odds of being in a relationship remain relatively low across the HIV lifespan. This is especially problematic in light of the strengthened relationship between relationship status and social support with longer time diagnosed with HIV. Furthermore, with increasing time diagnosed with HIV, being in a long-term relationship was more strongly related to having an HIV positive partner. This may limit the support possible from partners in this sub-population due to their partner's own limited health[277] and increased care needs and contribute to the lower levels of social support reported with increased time diagnosed.

The fact that low levels of social support were reported, despite the positive association previously found between disclosure and social support, suggests that bereavement of HIV-positive friends and partners from earlier in the epidemic may cause a retraction in available social support over time, even with disclosure. This would also explain why, with increasing time diagnosed with HIV, social support became less related to disclosure. However, the evidence may not support this, as the decrease in social support was continuous across time and did not show particular prevalence in participants who were diagnosed early in the epidemic. As such, it is also possible that the decline in satisfactory social support with increasing time diagnosed with HIV is related to decreased physical and mental health. More specifically, it is possible that as physical and mental health declines the need for social support increases[318] and the ability to engage in social situations declines[319], leading PWH to be less satisfied with the levels that they receive. Therefore, PWH who have been diagnosed with HIV for longer may be at an even greater disadvantage when it comes to informal care-givers, and overall physical and mental support.

Due to the absence of available literature on ageing with HIV, the meanings behind these results can only be surmised, based on overall OPWH literature and the information gathered in the previous chapters of this thesis. As such, the information provided here, while a broad image of the social impact of ageing with HIV, is scarce in regards to the factors driving these changes. Further research needs to be developed to explore the causes and effects of lower social support with time diagnosed with HIV.

5.4.6 **Limitations**

As previously mentioned, mental, physical and social health are inextricably interlinked. Due to the cross-sectional nature of the ASTRA study it is not possible to attribute any causation between the social support measures and mental and physical distress (e.g. whether lower social support causes depression or vice versa) and it is likely that the correlations observed are bi-directional. The reasons suggested for the links between the variables examined in this chapter are based on the evidence available from the HIV-positive and ageing literature but do not exclude the possibility of other explanations.

Satisfaction with social support was measured, but not the size of social networks or the isolation experienced by the participants; although it is assumed that they are related. As such it is not possible to say with certainty whether the observed reductions in prevalence of satisfaction with social support and of disclosure with older age are related to decreasing social network size; only that this appears likely from the limited literature. Similarly, we can only make conjecture on HIV-related ill health being the cause of lower mental health in retired older PWH. However, the conclusions are informed by the ageing literature from the general population and the conclusions remain justifiable.

5.4.7 **Conclusions and Implications**

Our results reveal that in a UK HIV-positive population rates of 'sufficient' social support appeared low and tended to decrease with increasing time with diagnosed HIV; making it an important factor to consider when measuring well-being in older adults with HIV. Sufficient social support was, further, related to lower levels of depression, anxiety and physical symptom distress; making social support an important factor for development of well-being in OPWH. Relationship status and disclosure were both found to be related to the level of social support available, and both reduced with age suggesting that they may in part be responsible for the low levels of social support available to OPWH. Finally, unlike much gerontological literature, retirement was also found to be related to a decrease in mental and physical health and social support in the ageing HIV-positive population. This may be due to HIV-related illness reducing the availability of the social and physical leisure usually associated with retirement.

Support groups appear to be particularly important to OPWH and could be utilised by clinicians to improve well-being, by increasing the availability of age-matched HIV-positive networks. Similarly, sessions into counteracting HIV stigma or 'ways to disclose' to family members appear likely to be beneficial in improving the social support available to this population, as well as support in coping with feelings of 'being a burden'.

However, while social support alone is a factor of well-being worthy of intervention, it is worth noting that in the previous chapter no significant difference was found in relation to overall physical symptom distress was found with age, and there was a decrease with age in the prevalence of depression and anxiety. It appears that despite the potential detrimental effects of lower prevalence of having a current partner, higher prevalence of HIV status non-disclosure, and retirement among older adults with HIV, they manage to maintain positive physical and mental health in comparison to younger PWH; if not in comparison to the general population. It is likely that resilience is responsible for these improvements in well-being; especially as the results in this chapter do not suggest that improved 'social support' is responsible. This will be explored further in the following chapters.

6 The Resilience study - Methodology

6.1 Background

Resilience is a multidimensional concept which seeks to explain how some individuals can achieve, maintain or regain well-being in the face of hardship[111]. It encompasses an individual's current coping mechanisms in response to stressors and their ability to adapt these mechanisms to combat new stressful situations[320-324]. More specifically, Vance and colleagues' review identified that individuals with high resilience were likely to use problem-focused coping mechanisms - transforming stressors into experiences to be overcome, while those with low resilience tend towards distancing coping mechanisms such as withdrawal, repression and denial[152]. Often, definitions of resilience also rely on the premise that the individual has experienced stressful life events before and can utilise these life experiences to effectively adapt their behaviours[325-327].

This would suggest that resilience can be learnt in response to adversity, should the individual be in a position to accept the possibility of behavioural change. Therefore, such behavioural change could be the focus of interventions to improve well-being. However, achieving high levels of resilience is likely reliant on several intrinsic and extrinsic factors. Commonly, resilience is broken down into five intrinsic characteristics: purpose/meaning in life[112;328-331], perseverance[328], equanimity (balance in life)[328;329], self-reliance[111;112;328;329;332] and 'authenticity' (self-acceptance, autonomy)[112]. Extrinsic factors related to resilience include hardship experience[112;333], access to care[112;328] and social support from professionals, the community and family/friends[112;328;329;333;334]. As such, the definition could be amended to: 'resilience is a series of responses to adversity which can, in the presence of an acceptable support network, be learnt in response to repeated stressful circumstances'. As the importance of social support was discussed in Chapter 5, the resilience study will focused on the intrinsic characteristics of resilience.

6.1.1 The relationship between resilience and health

Resilience has been consistently linked to mental and physical health in the general population. This has been found in relation to chronic illness, health-care behaviours and disability. For example, a study of 185 Native Americans over the age of 55 found, using the Connor-Davidson Resilience Scale (CD-RISC[335]), that low levels of resilience were associated with low mental health (Mental health Component Summary (MCS-8) scores of the SF-36[336]) and physical health (Physical Component Summary (PCS-8) scores of the SF-36[336]) as well as higher prevalence of depression and chronic pain[337]. A small, cross-sectional, Argentinean study (N=53) also reported higher risk of hypertension in adults with low resilience (CD-RISC scale)[338].

In relation to health-care behaviour, a cross-sectional Taiwanese study found that high resilience (using the RS scale) was related to an increase in health-promoting behaviours and lower risk of end-stage renal disease in 150 participants with kidney disease ($p<.001$)[339]. Finally, 3,942 people over the age of 65 were studied in Germany in 2012[340]. Using the RS scale the researchers found that highly resilient participants were more likely to consume five or more servings of fruit or vegetables each day and to perform physical activity than participants with low resilience[340]. This occurred irrespective of socioeconomic status[340]. Since no studies were identified showing improved health or health-related behaviours in participants with lower resilience scores, these results suggest a strong relationship between high levels of resilience and favourable health behaviour outcomes.

While these associations are interesting, where relationships are found in cross-sectional studies it is difficult to rule out reverse causality. For example, it is possible that low levels of health decrease an individual's ability to develop or maintain resilience, rather than low resilience resulting in poorer health outcomes. As such, evidence from longitudinal data were also explored in order to suggest causal evidence for the relationship between resilience and health.

A longitudinal study from China (2002-2005) of adults over 65 years old (N=11,112) related higher resilience at base-line to a lower risk of developing ADL disabilities at three-year follow-up, independent of sociodemographic factors, family support, and base-line health[341]. A similarly large American longitudinal study (the Health and Retirement Study, N=10,753) of adults aged over 50 from 2006-2010 reported that high resilience at baseline - assessed via the RS - was a protective factor against the development of problems with ADLs, chronic illness and subsequent disability[342]. A smaller (N=1,594) longitudinal American study of disabled adults reported that greater baseline resilience (CD-RISC scale) predicted decreases in depressive symptoms and increases in social functioning three years later[113]. A 2008 prospective American study of 111 people with diabetes found that low resilience at base-line was associated with fewer self-care behaviours (Pearson's correlation coefficient r= -0.55), high levels of diabetes-related emotional distress, and worsening blood sugar levels at one-year follow-up (r = 0.57 and r= 0.56, respectively)[343]. Finally, two American studies (Ns=1,150 and 1,238) explored 'purpose in life' specifically. They found that higher purpose in life at base-line was related to a substantially reduced risk of developing disability (Hazard ratio = 0.61, 95% Confidence Interval = 0.44, 0.84) or problems with ADLs (HR= 0.60, 95% CI= 0.45, 0.81) in older adults[344] and lower mortality rates at five-year follow-up (Hazard ratio = 0.60, 95% CI = 0.42, 0.87) when adjusted for age, sex, education, and race - although not to pre-existing poor health[345].

This information provides evidence that resilience is related to better mental and physical health and may be a protective factor against health decline. The consistent results across different study populations suggest that this effect operates across the lifespan, irrespective of original health status (e.g. disability[113]), sociodemographic characteristics or geographical location. A possible reason for this is that resilient individuals are more 'self-reliant'[111;112;328;329;332] and perseverant[328] and may be more likely to engage in health-promoting behaviours such as healthy eating and exercise[340] which, in turn, improves overall mental and physical health. However, it is also possible that improved access to care and social support are related to the improvements in health regardless of levels of resilience. It is also worth noting that many of these studies focused on individuals with chronic illness and found both high and low resilience in these populations. This implies that it is possible to develop or maintain resilience despite a reduced health status.

6.1.2 The relationship between resilience and age

As people age, purpose in life changes[260], especially in relation to retirement and adult children, and the opportunities for self-reliance may increase while social support may decrease[260]. However, for similar reasons, the opportunity for leisure activities and equanimity may increase. Resilience may be especially important to older adults as it may allow for psychosocial adjustment in compensation for physical decline[51].

The majority of resilience research has focused on the development of children[111;333], but recently the field has begun to evolve and acknowledge age-related changes in adults. Overall, current research suggests that resilience may be higher in older – than younger - adults[112-114;346;347]. This was found, for example, in a comparative study of 60 older (>64) and 60 younger (<26) adults in the UK in 2011[347]. The British Household Panel Survey (N=3581) also found that resilience continued to increase with age amongst older adults[346], as did an American study of adults over and under the age of 65 years (N=1,594)[113], and one of disabled adults (N=1,862)[114].

However, a longitudinal study in China (CLHLS, 1998-2009, N=1,528) reported increases in resilience with age up until the age of 65, after which resilience began to decrease[348]. Similarly, the KORA-Age study (Germany, N=3,942) reported that high resilience was more prevalent in participants under the age of 75 than those over this age (35.8 vs. 27.9%)[340] and a five-year longitudinal American study (N=1,238) exploring 'purpose in life' (Ryff scale) reported a negative correlation with age ($r = -0.34$, $p < .001$)[345]. This highlights, again, the importance of studying changing patterns with age across the full older age range when assessing age associations.

The evidence for an increase in resilience with age may be due to accrued experiences with adversity in older adults - such as bereavement, physical changes and adaptive life roles[115] - giving them an effective skill-set for dealing with hardship. It is also possible, however, that these changes are responsible for the reduction in 'purpose in life' in older age, found in the American study[345]. Interestingly, in the one study that explored disability, the duration of disability was not associated with resilience scores[114]. This suggests that resilience may be more related to lifespan development than the length of experience with a single stressor.

6.1.3 **The relationship between resilience and HIV**

Only two quantitative studies were identified in relation to HIV and resilience, and neither looked at age-related differences. The first compared resilience in people with and without HIV (N=60) using the CD-RISC scale[349]. They found a near significant decrease in resilience in PWH when compared to the controls (mean score = 27.0 v.31.0, $p = 0.06$)[349]. The second included 138 women with HIV on ART in the USA, and found that high resilience was associated with an increase in cART adherence and a greater likelihood of undetectable viral load ($p<.05$), when controlled for age, race, income, substance use, and depressive symptoms[350].

As previously mentioned, high levels of resilience have been identified in chronically ill populations, suggesting that resilience is also likely to be possible in relation to HIV. However, the effects of time with chronic illness have not been explored. It is possible that, with time with diagnosed HIV, adults learn and hone coping strategies such that resilience is able to increase. It is also possible that, while some individuals may maintain or develop resilience, unrelenting illness-related stress reduces the population’s potential for high resilience overall.

For example, similar to the model of toxic stress in children[351], prolonged stress and illness may inhibit the time and resources necessary for positive mental development.

As such, very little is known about the relationship of resilience with physical, psychological or social health in PWH and the existing studies are greatly limited by small sample sizes. It could be hypothesised that resilience in PWH is associated with improved biopsychosocial health, as found in other populations, but no studies have looked at changes in resilience with age or time diagnosed with HIV in HIV positive adults. Vance, Struzick and Masten[152] do note, however, that due to the continued hardship of living with HIV for a comparatively long time, older adults with HIV may develop higher resilience than HIV-negative individuals.

The resilience study was conceived, developed and conducted specifically as part of this PhD and is novel in regards to the population, geographical origin and factors studied. The study methodology and results are described in this and the next chapter. This chapter (Chapter 6) will cover the development and methodology of the study and present the demographics of the study sample. Chapter 7 will describe the measures utilised to analyse the effects of resilience on mental and physical health, present the results of these analyses and draw conclusions.

6.1.4 **Aims of the resilience study**

The resilience study was an exploratory study which was designed to assess differences in levels of resilience between older and younger adults with and without HIV, and to assess the association between resilience and time with diagnosed HIV, mental, and physical health. It was a cross sectional self-administered questionnaire study that included an HIV-positive sample and an HIV-negative sample. The resilience study questions were an addition to a larger questionnaire which aimed to investigate smoking and respiratory health in HIV-positive and negative populations. The questionnaire therefore included inquiry on smoking habits and lung health and participants were also asked to complete spirometry readings. Only the information relevant to the resilience study is detailed below.

The primary aims of this study were:

1. To assess age-related differences in resilience in adults with and without HIV.

2. To assess 'time with diagnosed HIV'-related differences in resilience in adults with HIV.

3. To assess the association of resilience, if any, with depression, anxiety, problems with ADLs and physical activity in adults with and without HIV.

Secondary aims involved comparison of prevalence of depression, anxiety, problems with ADLs and physical activity in adults with and without HIV. This allows us to build on the ASTRA data further by assessing whether age associations with well-being differ among those with and without HIV.

6.2 Data collection and management

6.2.1 **Development of study questionnaire**

An initial draft questionnaire and other participant documents (information sheet, consent form) were produced. Following feedback from research staff, a small number of minor revisions were made to the questionnaire, the participant information sheet and consent form (Appendix B). These changes were submitted as amendments for ethical approval and were incorporated into the final versions employed during the main recruitment period, which commenced in March 2015. The final questionnaire consisted of a printed A5 booklet, with two versions available: one for HIV-positive and one for HIV-negative participants. The questions included in each version were identical, except that HIV positive participants were asked whether they were currently taking HIV treatment and their date of HIV diagnosis. The HIV positive booklet is available in Appendix C.

6.2.2 **Study recruitment**

Patients attending out-patient appointments or accessing the drop-in service at the Ian Charleson Centre (ICC) HIV clinic or Marlborough Sexual Health Clinic in Hampstead were invited to participate on arrival between March 2015 and August 2015. Both clinics are situated at the Royal Free London NHS Foundation Trust in London. The Ian Charleson Centre was selected for recruitment of the HIV-diagnosed sample based on previously successful research collaborations with UCL, while the Marlborough Sexual Health Clinic was chosen for recruitment of HIV-negative participants due to its geographical similarity to the Ian Charleson Centre.

A sexual health clinic was chosen for recruitment of the HIV-negative sample as it was considered to include a population with similar risk characteristics (e.g. smoking rates, sexual behaviour) to those of an HIV clinic, which was beneficial for the smoking study occurring in tandem, and would include individuals from the major demographic groups affected by HIV, therefore providing a suitable control group. A six-month time period was used for recruitment as the majority of participants at the HIV clinic had an appointment scheduled every six months or less, meaning that this was the shortest amount of time in which the majority of the clinic population would be seen in the clinic and would potentially be eligible to be recruited into the study.

The recruitment team involved two doctoral students who had undertaken General Clinical Practise training and the clinic nurses. The recruitment schedule was based on the clinic times, identified by the nursing staff, in which the most patients would be available to discuss participation. The recruitment team then contacted participants while they were waiting for their appointments. Specifically, in the Ian Charleson Centre, participants were approached during blood pressure recordings. This area was chosen to maintain privacy, but participants were also made aware that they could ask for a private area if necessary. In the Marlborough clinic the reception staff asked participants whether they would like to participate on entry to the clinic. With confirmation, patients were directed to a private room where the study was explained to them in more detail. At each site, participants were given details of the study (including a patient information sheet) and those agreeing to participate completed a patient consent form. As part of the main consent process, participants were given the option to allow us access to their clinical information. Individuals were allowed to be involved in the study regardless of consent to view clinical data. They were told that the research team would use this information to confirm their HIV status and age.

6.2.3 **Sample size**

The aim was to recruit 165 HIV-positive and 165 HIV-negative participants, giving a total of 330 participants. This was based on a power calculation from the co-occurring smoking study in order to compare the health of adults with and without HIV. Specifically, based on an 80% power, and two-sided 5% significance level, to detect the minimal clinically important difference (4 points on the SGRQ scale) between these two groups, a samples size of 165 individuals per group was required. It was calculated that a total sample size of 330 participants was needed to detect a moderate difference (0.3 of a standard deviation) in resilience between older and younger PWH, using a two-sided 5% significance level. As such this sample was expected to include a large enough percentage of older adults to form a statistically meaningful comparison between older and younger PWH.

6.2.4 **Participant eligibility and recruitment process**

Patients were eligible if they met the inclusion criteria. In order to participate individuals were to: a) be over 18 years of age, b) have sufficient English fluency to be able to understand the information sheet, questionnaire and provide informed consent and c) not too ill or distressed to participate, as judged by the clinic staff. In addition to this, as the HIV-negative group was expected to be younger than the HIV positive group, HIV-negative participants were further required to be a) aged 30 or over, to allow for more direct age comparisons with the HIV positive population, and b) not known to be HIV positive.

Participants were asked their diagnosed HIV status at enrolment and given the appropriate questionnaire. Participants' HIV status was based on self-report, where no clinical data was available. Where permission to view clinical records was given, HIV status was checked during data cleaning and participants moved group accordingly.

Participants who were eligible and expressed interest were given a participant information sheet that contained full details of the research project, including contact details for the research team (Appendix B). The research staff explained the purpose of the study and its potential benefits and answered any questions or concerns. Participants were told that the self-completed questionnaire would take between ten and 20 minutes to complete. If the participant agreed to participate they were required to sign the study consent form (Appendix B). Recruiters kept a log of the number of patients approached who declined to participate such that a response rate could be calculated.

Participants completed the self-administered pen-and-paper questionnaire on a range of demographic, health, and lifestyle issues. They were encouraged to complete the questionnaire at the clinic (either before or after their appointment, or while waiting for tests or prescriptions), but were also allowed to take the questionnaires home and bring them back to the clinic and a time convenient to them. Names and clinic numbers were not recorded on the questionnaire. Completed questionnaires were collected in the clinic, directly from the participants, and transferred regularly to the study management centre, where they were kept locked in a secure area. During the questionnaire, participants were asked for their height and weight. If they were unsure then they were offered a measurement within the clinic. This data was using to create a Body Mass Index (BMI).

Details of all the clinic attendees approached for the study were collected in a study log which was maintained securely and updated at the study management centre at UCL. The study log contained study numbers, clinic identifiers and details of consent status for all participants who agreed to participate in the study. A checking process using clinical data identified four cases where participants filled out a questionnaire more than once. In these cases only the first completed questionnaire was included in the analysis. All the questionnaires which were returned to the researchers were digitised by the recruitment team through manual data entry, with each booklet being entered once and checked once, each time by different researcher.

During the study period, 439 participants were invited to take part in the study, of which 327 completed the questionnaire; a response rate of 74.5% invited participants. In regards to HIV status, the response rate was 75.5% for HIV positive patients and 73% for HIV negative patients.

6.2.5 **Ethics statement**

The research protocol and all versions of the study documents (information sheet, consent form and questionnaire) were approved by the local Ethics Committee and Hospital R&D department (ref 14.LO.1646, NRES committee London, Camden & Islington). The study is sponsored by University College London (UCL Sponsor reference 13/0639). A summary of the measures taken to ensure the confidentiality and security of participant information is as follows:

1. Care was taken to ensure the privacy of participants during questionnaire completion.
2. Participants were assured, via the information sheet, that their questionnaire responses would not be seen by clinic staff or recorded in clinic notes.
3. The participant information sheet made participants aware that they could withdraw at any stage without affecting their care.
4. The participant information sheet informed participants that their data would be kept anonymous.
5. The questionnaire noted that participants could leave out any of the questions.
6. Paper copies of participant responses were kept in a secure area of the hospital, inside a locked room and cabinet. Questionnaires were identified only by a unique study number and were not linked to clinic number on any document.
7. Where clinical data was taken, this data was linked to the survey responses using only a personalised study ID. No personal information (names, address, and clinic number) was kept in the database.
8. Data were stored on a secure database. It was anonymised at data entry and files kept in an encrypted form on computers at the Royal Free Hospital and University College London (Royal Free Campus).
9. Data was identified only by an anonymous study number and did not contain sufficient detail to allow personal identification of responses during the data processing stage.

6.3 Subject characteristics

6.3.1 Statistical methods

In this chapter subject characteristics and health-related behaviours are compared across HIV status group using demographic data. The relationships between age group and demographic and health-related factors are then assessed separately amongst HIV positive and HIV negative groups. Due to the small number of older adults in the HIV negative sample, participants aged over 50 years were grouped together. The differences in demographic data by HIV status group are then given.

6.3.2 **Demographic variables by HIV status**

The final HIV positive sample included 195 participants. The HIV negative sample included 126 participants. In the HIV positive population, the mean age was 48 years (SD=10.5, range=19-82 years), with 40 (20.5%) participants aged under 40, 72 (36.9%) aged 40-50, 61 (31.3%) aged 50-60 and 22 (11.3%) aged 60 and over. The mean age for the HIV negative population was 42 (SD=11.2, range=19-81), with 68 (54.0%) participants aged under 40, 31 (24.6%) aged 40-50, 17 (13.5%) aged 50-60 and 10 (7.9%) aged 60 and over. As such, the HIV positive population was significantly older than the HIV negative population, despite the recruitment measures used.

There were more HIV-positive MSM (66.5% vs. 24.2%) than HIV negative MSM, and fewer HIV-positive than HIV-negative heterosexual men (13.7% vs. 46.8%) and women (19.8% vs. 29.0%). PWH were more likely to be Black African (16.3% vs. 6.3%) than HIV negative participants, but there was no significant difference in the likelihood of being UK born (61.7% vs. 56.7%). No difference was observed in terms of levels of education, with a similar proportion of HIV-positive and negative participants attaining a university qualification (54.4% vs. 60.7%) and no qualification (12.3% vs. 11.5%). However, PWH were less likely to be employed (58.1% vs. 81.6%), and more likely to be retired (9.2% vs. 3.2%) or sick/disabled (14.2% vs. 4.0%) than HIV-negative participants. Despite this there was no substantial difference in the number of participants who always had money for basic needs (57.9% vs. 66.4%).

There was also no significant difference between the HIV-positive and HIV-negative samples in relation to recreational drug use (29.6% vs. 21.5% respectively) or smoking habits in relation to current smokers (30.1% vs. 36.0%), ex-smokers (28.1% vs. 18.4%) or non-smokers (41.7% vs. 45.6%). These differences are shown in *table 41* below.

Of the participants with HIV only, the mean time since diagnosis was 14 years (S.D.=8.6, range=0-32 years). By group, 32 (18.1%) participants had been diagnosed with HIV for 0-5 years, 32 (18.1%) for 5-10 years, 61 (34.5%) for 10-20 years and 52 (29.4%) for more than 20 years. The majority of HIV-positive participants were currently on ART (N=171, 94.5%).

***Table 41*. Demographic and health-related risk factors in the HIV positive and negative samples (n & percentage of group).**

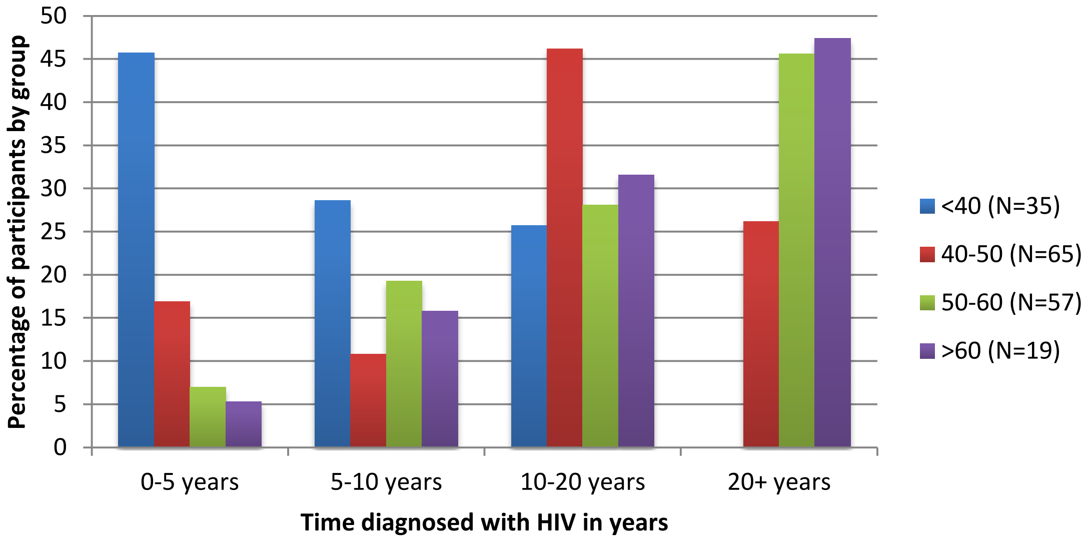
Characteristics	HIV positive population (N=195)	HIV negative population (N=126)
Age		
<40	40 (20.5%)	68 (54.0%)
40-50	72 (36.9%)	31 (24.6%)
50-60	61 (31.3%)	17 (13.5%)
60+	22 (11.3%)	10 (7.9%)
Gender/Sexuality		
MSM	131 (66.5%)	30 (24.2%)
Het. Male	27 (13.7%)	58 (46.8%)
Female	39 (19.8%)	36 (29.0%)
Ethnicity		
Born in the UK	121 (61.7%)	72 (56.7%)
White British	106 (54.1%)	49 (38.9%)
Black African	32 (16.3%)	8 (6.3%)
Work status		
Employed	114 (58.1%)	102 (81.6%)
Unemployed	25 (12.8%)	5 (4.0%)
Sick/disabled	28 (14.2%)	5 (4.0%)
Retired	18 (9.2%)	4 (3.2%)
Highest education level		
University or above	106 (54.4%)	74 (60.7%)
A levels	31 (15.9%)	18 (14.8%)
GCSE/O-level	28 (14.4%)	11 (9.0%)
None	24 (12.3%)	14 (11.5%)
Money for basic needs		
Always	114 (57.9%)	83 (66.4%)
Never	16 (8.1%)	3 (2.4%)
Smoking status		
Current	58 (30.2%)	45 (36.0%)
Ex-smoker	54 (28.1%)	23 (18.4%)
Non-smoker	80 (41.7%)	57 (45.6%)
Recreational drug use	58 (29.6%)	26 (21.5%)

Next, age-related differences in demographic factors were assessed.

6.3.3 Age-related demographic differences: HIV positive population sample

Demographic differences by age group were assessed. Unsurprisingly, as age increased so did time with diagnosed HIV (χ^2, N=176 (9)=46.21, p<.001, test for trend). As shown in *figure 28* below, adults under the age of 40 had primarily been diagnosed for less than five years, with none diagnosed for more than twenty years; while participants aged 40-50 were diagnosed for ten or more years. The proportion of adult diagnosed for ten or more years was greatest for those aged 50 and over.

***Figure 28*. Time with diagnosed HIV by age group (N=176).**



In terms of ethnicity/country of origin, the number of participants born in the UK increased with age (52.5% vs. 72.7%). For gender/sexuality, MSM were more likely to be older (52.5% of MSM under the age of 40 vs. 86.4% over the age of 60) and heterosexual men and women were more likely to be younger (22.5% aged <40 vs. 4.5% aged >60, and 25.0% vs. 9.1% respectively). This is shown in *table 42.*

Levels of education were similar across all ages, with 55.0% aged <40 - 63.6% aged >60 being university educated. Employment was highest among participants aged <40 and 50-50 years, while unemployment was highest in the < 40s group and decreased with age (15.0% aged <40 - 4.5% aged >60). The proportion of people who were not working due to sickness/disability was highest in the 40-50 years age group while retirement was highest in those 60 and over years of age (54.5%). Always having money for basic needs was highest in the >60s age group (81.8%) and lowest between ages 40-50 (50.0%).

Recreational drug use decreased with age (45.0% aged <40 - 4.5% aged >60), but the prevalence of being overweight, as specified by a BMI score of >25kg/m^3, increased with age (40.6-61.5% respectively). The proportion of current smokers decreased with age (42.5% - 13.6%), as the proportion of non-smokers (52.5% - 45.5%) while the proportion of ex-smokers increased (5.0 - 40.9%). These differences are reported in *table 42* below. The percentage of participants on ART increased with age (80.6-100%).

***Table 42.* The demographic and health-related risk factors by age group among of the HIV positive sample (n & percentage of age group).**

Characteristic (N=195)	<40 (N=40)	40-50 (N=72)	50-60 (N=61)	>60 (N=22)
Gender/Sexuality				
MSM	21 (52.5%)	52 (72.2%)	39 (63.9%)	19 (86.4%)
Het. Male	9 (22.5%)	7 (9.7%)	8 (13.1%)	1 (4.5%)
Female	10 (25.0%)	13 (18.1%)	14 (23.0%)	2 (9.1%)
Ethnicity				
Born in the UK	21 (52.5%)	43 (59.7%)	41 (68.3%)	16 (72.7%)
White British	15 (37.5%)	38 (52.8%)	38 (63.3%)	15 (68.2%)
Black African	1 (2.5%)	1 (1.4%)	4 (6.7%)	0 (0.0%)
Work status				
Employed	27 (67.5%)	49 (68.0%)	29 (48.3%)	8 (36.3%)
Unemployed	6 (15.0%)	10 (13.9%)	7 (11.7%)	1 (4.5%)
Sick/disabled	3 (7.5%)	9 (12.5%)	3 (5.0%)	1 (4.5%)
Retired	0 (0.0%)	0 (0.0%)	6 (10.0%)	12 (54.5%)
Highest education level				
University or above	22 (55.0%)	38 (53.5%)	30 (50.0%)	14 (63.6%)
A levels	8 (20.0%)	16 (22.5%)	6 (10.0%)	1 (4.5%)
GCSE/O-level	1 (2.5%)	9 (12.7%)	16 (26.7%)	2 (9.1%)
None	8 (20.0%)	4 (5.6%)	7 (11.7%)	5 (22.7%)
Money for basic needs				
Always	27 (67.5%)	36 (50.0%)	32 (52.5%)	18 (81.8%)
Never	3 (7.5%)	8 (11.1%)	4 (6.6%)	0 (0.0%)
Smoking status				
Current	17 (42.5%)	21 (30.0%)	17 (29.3%)	3 (13.6%)
Ex-smoker	2 (5.0%)	20 (28.6%)	22 (37.9%)	9 (40.9%)
Non-smoker	21 (52.5%)	29 (41.4%)	19 (32.8%)	10 (45.5%)
Recreational drug use	18 (45.0%)	21 (29.6%)	18 (29.5%)	1 (4.5%)
BMI				
Underweight (0-18.4)	1 (3.1%)	3 (5.1%)	1 (2.0%)	1 (7.7%)
Healthy weight (18.5-24.9)	18 (56.3%)	34 (57.6%)	18 (36.0%)	4 (30.8%)
Overweight (25+)	13 (40.6%)	22 (37.3%)	31 (62.0%)	8 (61.5%)
Years since diagnosis				
0-5	16 (45.7%)	11 (16.9%)	4 (7.0%)	1 (5.3%)
5-10	10 (28.6%)	7 (10.8%)	11 (19.3%)	3 (15.8%)
10-20	9 (25.7%)	30 (46.2%)	16 (28.1%)	6 (31.6%)
20+	0 (0.0%)	17 (26.2%)	6 (45.6%)	9 (47.4%)
ART status				
Currently on ART	29 (80.6%)	63 (95.5%)	58 (100%)	20 (100%)

6.3.4 **Age-related demographic differences: HIV negative population sample**

In terms of ethnicity, the number of participants who were 'White British' increased with age (36.4% of participants aged <40 – 61.5% aged >50). In relation to gender/sexuality, the proportion of heterosexual men did not differ much with age (49.2% aged <40 - 50.0% aged >50), but MSM and women were more likely to be younger (67.2% MSM aged < 40 years, 30.8% aged >50, and 35.4% - 19.2% respectively).

Levels of education were highest in the <40s age group (63.6% university educated, 12.1% with no qualifications) and lowest in the >50s (53.8% university educated, 11.5% with no qualifications). Employment was also highest in the <40s age group (89.4%) while unemployment remained relatively stable with age. Being sick/disabled increased with age (0.0% - 19.2%), as did retirement (0.0% - 11.5%). ‘Always having money for basic needs’ was highest in the 40-50s age group (77.4%) and lowest in participant aged over 50 (61.5%).

The proportion of current smokers remained relatively stable across age (40.3% - 34.6%), while the proportion of non-smokers decreased (48.5% aged <40 - 34.6% aged >50). The probability of being an ex-smoker increased with age (12.1% - 30.8%). Recreational drug use was highest in adults aged under 40 (27.9%) and lowest in those aged over 50 (12.9 – 15.4%). These differences are reported in *table 43* below.

Table 43. **The demographic and health-related risk factors by age group of the HIV negative sample (n & percentage of age group).**

Characteristic (N=122)	<40 (N=65)	40-50 (N=31)	>50 (N=26)
Gender/Sexuality			
MSM	10 (67.2%)	12 (38.7%)	8 (30.8%)
Het. Male	32 (49.2%)	11 (35.5%)	13 (50.0%)
Female	23 (35.4%)	8 (25.8%)	5 (19.2%)
Ethnicity			
Born in the UK	39 (58.2%)	16 (51.6%)	16 (61.5%)
White British	24 (36.4%)	8 (25.8%)	16 (61.5%)
Black African	5 (7.6%)	3 (9.7%)	0 (0.0%)
Work status			
Employed	59 (89.4%)	26 (83.9%)	16 (61.5%)
Unemployed	3 (4.5%)	1 (3.2%)	1 (3.8%)
Sick/disabled	0 (0.0%)	0 (0.0%)	5 (19.2%)
Retired	0 (0.0%)	0 (0.0%)	3 (11.5%)
Highest education level			
University or above	42 (63.6%)	18 (62.1%)	14 (53.8%)
A levels	10 (15.2%)	3 (10.3%)	5 (19.2%)
GCSE/O-level	3 (4.5%)	3 (10.3%)	3 (11.5%)
None	8 (12.1%)	3 (10.3%)	3 (11.5%)
Money for basic needs			
Always	42 (63.6%)	24 (77.4%)	16 (61.5%)
Never	1 (1.5%)	2 (6.5%)	0 (0.0%)
Smoking status			
Current	26 (40.3%)	10 (33.3%)	9 (34.6%)
Ex-smoker	8 (12.1%)	7 (23.3%)	8 (30.8%)
Non-smoker	32 (48.5%)	13 (43.3%)	9 (34.6%)
Recreational drug use	17 (27.9%)	4 (12.9%)	4 (15.4%)

Demographic differences of older adults by HIV status were also compared. In older adults (participants over the age of 50) PWH were more likely to be MSM (69.4 vs. 31.0%). No significant difference was found in relation to ethnicity, employment, education, money for basic needs, smoking habits or recreational drug use.

6.4 Conclusions

The Resilience study population are predominantly white, UK-born, MSM who are well-educated and employed. However, only 61.2% always had money for basic needs, 26.5% currently used recreational drugs, 32% were current smokers and 48.7% were overweight. As such they are at risk of lifestyle factors affecting their biopsychosocial health. The HIV-positive and -negative populations were comparable in birth country, education, money for basic needs, recreational drug use or smoking behaviour. However, PWH were more likely to be older, MSM and unemployed or sick/disabled. As such, these differences are important to bear in mind in the main analyses.

In relation to age, overall, older participants were more likely to be British, male, always have money for basic needs and be ex-smokers. They were less likely to use recreational drugs, be educated to university level or employed. In relation to PWH, older adults were more likely to have been diagnosed with HIV for longer and be on ART. No difference was found by age in relation to birth country or BMI. This pattern of results according to age is comparable to those found in the ASTRA study.

There was a substantial difference in age between the HIV positive and negative populations. This reflects the difference in age between the respective clinic populations and could not be completely addressed by recruitment strategies without excluding older adults with HIV. This does, however, highlight the important of adjusting for age when comparing clinic samples.

6.4.1 Contributions

This project was designed and implemented in tandem with research into the effects of smoking on health in people with and without HIV. The inclusion of the measures identified here and the research questions are the work of the author, with the exception of the measure of physical activity. Study design, protocol, management, participant recruitment, data collection, data input and cleaning were the joint responsibilities of the author and Dr James Brown, the designer of the conjoined project[82]. The work shown here and in the following chapter - including background research, analysis and interpretation of results -are the sole work of the author.

7 The effects of age, ageing with HIV and HIV status on resilience

7.1 Aims

The primary aim of this research was to explore differences in resilience according to age and time diagnosed with HIV, and the association between resilience and mental and physical health (ADLs and physical activity) in adults with HIV.

A secondary aim was to compare resilience, mental and physical health by HIV status ('HIV positive' or 'HIV negative'). Measures of resilience, symptoms and physical function are described below.

7.2 Methods

7.2.1 **Symptom measures**

7.2.1.1 Resilience

The RS-14[320], a shortened version of the Resilience Scale, was used to measure resilience (Appendix C). This is a 14-item, 7-point Likert scale. According to a recent systematic review of the psychometric rigour of resilience measurement scales there is no 'gold standard' scale, but the Connor-Davidson Resilience Scale (CD-RISC), the Resilience Scale for Adults and the Resilience Scale (RS) have the best psychometric ratings[352]. Of these, the CD-RISC[329;353] and the Resilience scale[51;115;264] have been used in the older adult and HIV/AIDS literature but only the RS[320] was specifically developed to measure resilience in older adults - albeit only among women[115]. As such it was chosen for this particular project.

The RS-14 scores are summed (range=14-98) to create a resilience reading. Specifically, a summated score of ≥82 indicates moderately high-to-high resilience; 74-81 indicates moderately low to moderately high levels of resilience; and ≤73 indicating very low- low resilience[320]. For the purpose of logistic regression analysis participants reporting 'high' (scores ≥82) were compared to those reporting 'moderate - low' resilience scores (scores <82). As before, this was also considered to be a more clinically useful analysis than including resilience in the regression as a continuous scale.

7.2.1.2 Depression and Anxiety

Mental health was assessed using clinically standard validated questionnaire measures of depression and anxiety. Specifically, depression and anxiety symptoms were assessed via self-report, using the PHQ-9[156] and GAD-7 scales[157] respectively. As previously described in Chapter 2 (section 2.2.2), these scales are validated diagnostic instruments, based on the DSM-IV criteria for depression[156] and generalised anxiety disorder (GAD)[157], for measuring the prevalence and severity of depression and anxiety. Use of the GAD-7[157] and PHQ-9[156] also allowed for ease of direct comparison to the results of the ASTRA study[164].

For both the PHQ-9 and GAD-7, participants were asked to respond to the question "Over the past 2 weeks, how often have you been bothered by any of the following problems?". Participants could respond with one of four options: 'not at all', 'several days', 'more than half the days' or 'nearly every day' to each of the symptoms. For each scale, these responses were scored from 0-3 respectively and added to create a 'total score' (possible range of 0-27 for the PHQ-9 and 0-21 for the GAD-7) which is used to measure the participant's level of depression/GAD. For the purpose of this analysis participants were also categorised into two groups using the standard score-based definitions for anxiety and depression with scores ≥10 taken to indicate depression and anxiety in each case.

7.2.1.3 Activities of Daily Living and Physical activity

Difficulty with ADLs was identified using the EQ-5D[155], a five-item quality of life instrument. This instrument asks participants to report their 'status of health today' in relation to Mobility, Self-care, 'Usual activities' (e.g. work, study, housework, family or leisure activities), Pain/discomfort and Anxiety/Depression. Response options comprise a five-point Likert scale. Participants can report no problems, slight problems, moderate problems, severe problems or being unable to perform each activity. Difficulty with ADLs was assessed through the first three domains only. Responses for each of the three remaining domains were divided into participants having no problems compared to those with problems (from slight problems to being unable to perform each activity). An overall measure of problems with physical function was used, where participants who reported problems with at least one of the three activities were compared to those showing no difficulties. In addition the three individual domains were considered separately.

Participants were also asked to report whether they undertook "regular physical activity (at least once a week)"; to which they could respond 'yes' or 'no'. If so, they were asked to specify the type of physical activity which they undertook, with the possible options of: running, cycling, swimming, gym-use or 'other'.

7.2.1.4 Demographic factors

Other demographic factors included in the analysis were age group, gender/sexuality (MSM, heterosexual men, women) and country of birth (UK-born or other).

7.2.2 **Missing values**

Missing values for individual questions on symptom questionnaires (PHQ-9, GAD-7, Euroqol) were counted as the absence of symptoms (coded as '0'). For the RS-14, if at least one question had a valid response, missing values for the other questions were coded as '5.5'; the resilience score that corresponded to the mid-point of the scoring chart.

7.3 Statistical analysis

Chi squared, chi squared test for trend, and logistic regression were used to assess the association between age group and each of the well-being measures (dependent variables: high resilience, depression, anxiety, problems with physical function and regular physical activity) separately among the HIV-positive and HIV-negative groups. The participants were grouped according to their age into: <40, 40-49, ≥50 years of age. An age group of <30 was not used for analysis as this was an exclusion criteria for HIV-negative participants. In the main analysis, age was categorised into groups rather than used as a continuous variable to allow the exploration of non-linear age differences. However a sensitivity analysis also considered age as a continuous variables. Although I have previously stressed the importance of analysing older age groups individually, unfortunately the age dispersion of the sample populations did not allow this and all adults over the age of 50 were, by necessity, grouped together.

For analysis within the HIV-positive group, the effect of age on each of the above factors was assessed, adjusting for gender/sexuality (MSM; heterosexual man; woman), country of birth (UK-born; other) and time since diagnosis of HIV (<5 years; 5-10 years; 10-20 years and >20 years). For the HIV-negative group, the effect of age was assessed adjusting for gender/sexuality and Country of birth only.

Age and time since diagnosis of HIV (where appropriate) were fitted as categorical variables in logistic regression models; tests for trend across age and time with diagnosed HIV were also performed. In addition, the association between resilience and depression, anxiety, problems with ADLs and physical activity was assessed using chi squared tests and logistic regression model with adjustment for age group, gender/sexuality and country of origin. Finally, the association between HIV-status and each of the well-being measures was assessed in a logistic regression model with adjustment for age group, gender/sexuality and country of origin.

The results are presented below, as odds ratios (OR) with 95% confidence intervals (CI).

7.4 Results

7.4.1 **Resilience**

Using the entire sample population (HIV-positive and HIV-negative, N=321), the mean resilience score was 76.9 (S.D. = 17.7); corresponding to a rating of 'moderate' resilience on average. The range was 14-98; the entire range of the RS-14 scale. By group, 107 (33.3%) participants showed low resilience (score ≤64), 64 (19.9%) showed moderate resilience (score 65-81) and 150 (46.7%) showed high resilience (score ≥82).

7.4.1.1 Resilience by HIV status and age

When looking at average resilience scores by age group, for each age group the average score corresponded to a 'moderate' level of resilience. In each age group, HIV negative participants showed higher mean resilience scores, but differences were comparatively small. *Table 44* reports the mean and median RS-14 scores by age and HIV status and *Table 45* reports the prevalence of resilience categories by HIV status.

Table 44. **The average resilience score by age group and HIV status.**

	HIV positive (N=195)			**HIV negative (N=126)**		
Age in years	Mean	S.D.	Median	Mean	S.D.	Median
<40 (N=108)	72.8	17.7	74.5	78.0	16.9	80.5
40-50 (N=103)	76.5	18.2	82.0	79.5	18.0	79.0
≥50 (N=100)	77.0	18.3	77.0	78.9	13.8	82.0
TOTAL	*76.00*	*18.1*	*78.0*	*78.5*	*16.5*	*80.5*

Table 45. **Prevalence of resilience (RS-14 groupings) by age group and HIV status.**

	HIV positive (N=195)			**HIV negative (N=126)**		
Age in years	Low (≤64)	Average (65-81)	High (≥82)	Low (≤64)	Average (65-81)	High (≥82)
<40 (N=108)	20 (50.0%)	6 (15.0%)	14 (35.0%)	20 (29.4%)	16 (23.5%)	32 (47.1%)
40-50 (N=103)	24(33.3%)	11 (15.3%)	37 (51.4%)	7 (22.6%)	9 (29.0%)	15 (48.4%)
≥50 (N=110)	29 (34.9%)	16 (19.3%)	38 (45.8%)	7 (25.9%)	6 (22.2%)	14 (51.9%)

In unadjusted analysis, age group was not significantly associated with high resilience in either the HIV positive ($\chi2$ test for trend, (N=195) = 4.93, p=0.55) or HIV negative groups ($\chi2$, (N=126)=.96, p=0.99). HIV status ($\chi2$, (N=327)=4.65, p=0.10) was not significantly associated with resilience.

The adjusted association of age with high resilience is presented in *Table 46*, for HIV positive and HIV-negative participants separately. Among HIV-positive participants (after adjustment for gender/sexuality, time diagnosed with HIV and country of birth) the prevalence of high resilience increased with age: a trend nearing significance. Longer time diagnosed with HIV, on the other hand, was related to a strong and statistically significant decrease in the prevalence of resilience. Among HIV-negative participants, resilience also tended to increase with age but this association was not statistically significant.

In analysis including all participants (HIV-positive and HIV-negative) adjusted for age, gender and country of birth, HIV status was not significantly related to high resilience (Odds Ratio=1.51, 95% C.I.=0.68-1.95, p=0.61 for comparison of HIV-negative with HIV-positive group).

Table 46. **Adjusted association of age, time with diagnosed HIV, gender/sexuality and country of birth with resilience in HIV positive and negative adults (logistic regression analysis).**

		High resilience (score ≥82) Adults with HIV (N=197)			**High resilience (score ≥82) Adults without HIV (N=130)**		
Independent Variable		p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age		0.11			0.78		
	Test for trend	*0.08*	*1.52*	*(0.95, 2.41)*	*0.48*	*1.18*	*(0.75, 1.87)*
	<40	0.05	0.37	(0.14, 0.98)	0.48	0.71	(0.28, 1.82)
	40-50	0.82	0.92	(0.45, 1.88)	0.68	0.80	(0.27, 2.32)
	50+*		1			1	
Years with diagnosed HIV		0.22					
	Test for trend	*0.05*	*0.37*	*(0.14, 0.98)*			
	0-5*		1				
	5-10	0.89	0.93	(0.32, 2.65)			
	10-20	0.36	0.65	(0.26, 1.65)			
	20+	0.07	0.38	(0.13, 1.08)			
Sex		0.64			0.54		
	MSM*		1			1	
	Hetero male	0.51	1.39	(0.51, 3.79)	0.30	1.64	(0.65, 4.13)
	female	0.41	1.41	(0.63, 3.15)	0.35	1.63	(0.59, 4.57)
Country of birth	Other*		1			1	
	UK	0.92	0.96	(0.49, 1.89)	0.26	0.65	(0.31, 1.37)

* reference group

7.4.1.2 The relationship between resilience and mental and physical health

Using chi squared analysis, the unadjusted associations of resilience with depression, anxiety, ADL problems and physical activity was assessed for adults with and without HIV. In adults with HIV, high levels of resilience were found to be significantly related to lower prevalence of depression (6.7% vs. 36.5% for prevalence of depression among participants with high vs. moderate - low resilience), anxiety (3.4% vs. 29.7% respectively) and problems with ADLs (19.1% vs. 52.7% respectively; ps<.001 for all chi squared test for trend). The percentages and p values are reported in *table 47*.

***Table 47*. Physical and mental symptom prevalence in relation to resilience in adults with HIV.**

	Resilience			
	Low (score ≤73) (N=74)	Average (74-81) (N=34)	High (score ≥82) N=89)	p. value
Depression present	27 (36.5%)	6 (17.6%)	6 (6.7%)	p<.001
Anxiety present	22 (29.7%)	7 (20.6%)	3 (3.4%)	p<.001
ADL problems	39 (52.7%)	13 (38.2%)	17 (19.1%)	p<.001
Physically active	38 (51.4%)	19 (57.6%)	58 (65.2%)	p=0.20

[x] RS-14 score ≥82
p values by chi-squared test for trend

In adults without HIV, high levels of resilience were, similarly, found to be significantly related to lower prevalence of depression (7.8% vs. 25.7%; for depression prevalence for high vs. low resilience p=0.02). No significant relationship was found between resilience and anxiety, problems with ADLs or physical activity. The percentages and p values are reported in *table 48*.

***Table 48.* Physical and mental symptom prevalence in relation to resilience in adults without HIV.**

	Resilience			
	Low (score ≤73) (N=35)	Average (74-81) (N=27)	High (score ≥82) N=64)	p. value
Depression present	9 (25.7%)	3 (9.7%)	5 (7.8%)	p=0.03
Anxiety present	4 (11.4%)	2 (6.5%)	3 (4.7%)	p=0.45
ADL problems	9 (25.7%)	5 (16.1%)	7 (10.9%)	p=0.16
Physically active	28 (80.0%)	19 (70.4%)	44 (68.8%)	p=0.47

[x] RS-14 score ≥82

7.4.2 The effects of HIV status on mental and physical health

7.4.2.1 Depression and Anxiety symptoms

Depression and anxiety symptoms were highly prevalent in the sample. Specifically, depression prevalence occurred at 19.8% of PWH and 13.1% of HIV negative participants and anxiety symptoms in 16.2% and 6.9% respectively. When looking at PHQ-9 scores (range=0-27) by age group, the mean scores and prevalence were highest in those aged under 40 years of age and lowest in those aged ≥60 in the HIV positive participants. Depression prevalence was highest in those aged 40-50 years of age and lowest in those aged ≥60 in HIV negative participants. For all age groups, HIV negative participants showed lower mean depression scores than participants with HIV. Similar results were found for anxiety. *Table 49* reports the prevalence (PHQ-9 score ≥10), mean and median PHQ-9 scores by age and HIV status. *Table 50* reports the same for anxiety.

***Table 49.* The average depression score and number (n and %) of participants showing depressive symptoms by age group and HIV status.**

	HIV positive (N=195)				HIV negative (N=126)			
Age in years	Mean	S.D.	Median	N (%)	Mean	S.D.	Median	N (%)
<40 (N=108)	6.7	5.7	5.5	11 (27.5%)	3.9	4.3	3	6 (8.8%)
40-50 (N=103)	5.7	6.1	3	15 (20.8%)	4.4	4.7	3	6 (19.4%)
≥50 (N=110)	5.2	5.5	4	13 (15.7%)	3.7	6.0	1	5 (18.5%)
TOTAL	*5.7*	*5.8*	*4*	*39 (20.0%)*	*3.0*	*4.8*	*3*	*17 (13.5%)*

***Table 50.* The average anxiety score and number (n and %) of participants showing depressive symptoms by age group and HIV status.**

	HIV positive (N=195)				HIV negative (N=126)			
Age in years	Mean	S.D.	Median	N (%)	Mean	S.D.	Median	N (%)
<40 (N=108)	5.9	4.8	5.5	8 (20.0%)	3.7	3.9	3.5	5 (7.4%)
40-50 (N=103)	4.9	5.1	4	13 (18.1%)	4.0	3.8	4	1 (3.2%)
≥50 (N=110)	4.4	5.1	3	11 (13.3%)	3.2	4.5	1	3 (11.1%)
TOTAL	*4.9*	*5.0*	*4*	*32 (16.4%)*	*3.7*	*4.0*	*3*	*9 (7.1%)*

In unadjusted analysis, the prevalence of depression was not significantly different by age in either the HIV positive ((χ^2, (N=195)=2.49, p=0.48, test for trend) or HIV negative groups ((χ^2, (N=126)=3.76, p=0.29). Anxiety prevalence was not significantly different by age in either the HIV positive ((χ^2, (N=195)=1.12, p=0.77) or HIV negative groups ((χ^2, (N=126)=1.39, p=0.67).

The adjusted associations of age with depression and anxiety among the HIV-positive and HIV-negative groups are presented in *Table 51*. After adjustment for gender/sexuality, country of birth, and time diagnosed with HIV (where applicable), there was evidence of associations between age and depression and anxiety among HIV positive participants, with a trend of lower depression and anxiety with older age. The trends were nearing statistical significance. Time diagnosed with HIV was not significantly related to depression or anxiety in this sample, although symptom prevalence tended to increase with longer time with diagnosed HIV; the relationship between longer time with diagnosed HIV and higher prevalence of anxiety neared significance. Among the HIV- negative sample, there was no significant associations of age with depression and anxiety.

In a model including all participants (HIV-positive and HIV-negative) with adjustment for age, gender/sexuality and country of origin, a positive HIV status was not significantly related to depression (Exp(B)=0.56, 95% C.I.=0.27-1.14, p=0.11), but was associated with a higher prevalence of anxiety (Exp(B)=0.41, 95% C.I.=0.17-1.01, p=0.05).

Table 51. **Adjusted association of age, time with diagnosed HIV, gender/sexuality and country of birth with depression and anxiety in HIV-positive and -negative adults (logistic regression analysis).**

	HIV positive participants (N=197)						HIV negative participants (N=130)					
	Depression (PHQ-9 score ≥10)			Anxiety (GAD-7 score ≥10)			Depression (PHQ-9 score ≥10)			Anxiety (GAD-7 score ≥10)		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	0.21			0.11			0.40			0.48		
Test for trend	*0.08*	*0.60*	*(0.33, 1.07)*	*0.05*	*0.51*	*(0.26, 0.99)*	*0.23*	*1.47*	*(0.78, 2.75)*	*0.97*	*1.02*	*(0.43, 2.42)*
<40	0.10	2.70	(0.82, 8.94)	0.09	3.40	(0.83, 13.94)	0.27	0.48	(0.13, 1.78)	0.84	0.85	(0.18, 4.09)
40-50	0.17	1.90	(0.75, 4.82)	0.05	2.72	(0.98, 7.49)	0.94	1.05	(0.27, 4.03)	0.24	0.24	(0.02, 2.56)
50+*		1			1			1			1	
Years with diagnosed HIV	0.70			0.06								
Test for trend	*0.35*	*1.23*	*(0.80, 1.87)*	*0.06*	*1.60*	*(0.98, 2.61)*						
0-5*		1			1							
5-10	0.69	1.30	(0.36, 4.76)	0.45	1.75	(0.40, 7.58)						
10-20	0.77	1.20	(0.37, 3.90)	0.89	1.11	(0.28, 4.45)						
20+	0.30	2.02	(0.54, 7.51)	0.04	4.70	(1.09, 20.26)						
Sex	0.81			0.87			0.65			0.26		
MSM*		1			1			1			1	
Hetero male	0.53	1.46	(0.45, 4.77)	0.92	1.08	(0.26, 4.50)	0.74	0.82	(0.24, 2.76)	0.26	0.41	(0.09, 1.90)
female	0.73	1.19	(0.45, 3.17)	0.63	0.75	(0.24, 2.36)	0.36	0.48	(0.10, 2.28)	0.13	0.16	(0.02, 1.68)
Country of birth Other*		1			1			1			1	
UK	0.65	1.21	(0.52, 2.80)	0.12	2.19	(0.83, 5.80)	0.61	1.33	(0.44, 4.02)	0.81	1.20	(0.27, 5.27)

* reference group

7.4.2.2 *Activities of Daily Living*

In response to all ADL domains, problems with ADLs were more prevalent in PWH than HIV negative participants, with 34.9% of PWH reporting one or more problem with ADLs, compared to 15.9% of HIV negative participants. In particular, PWH under the age of 40 reported more than three times the number of ADL problems as their HIV-negative counterparts. Mobility was the most common problem reported in both groups. However, it is worth noting the small number of HIV negative adults with problems with ADLs. *Table 52* reports the prevalence of problems with ADL in relation to age and HIV status.

Table 52. **Prevalence of problems with ADLs (n and %) by age group and HIV status. p values are provided for age-related differences.**

	HIV positive (N=195)				**HIV negative (N=126)**			
Age in years	ADL problems	Mobility	Self-care	Usual activity	ADL problems	Mobility	Self-care	Usual activity
<40 (N=108)	11 (27.5%)	8 (20.5%)	4 (10.3%)	10 (25.0%)	6 (8.8%)	6 (9.1%)	1 (1.5%)	3 (4.5%)
40-50 (N=103)	19 (26.4%)	15 (20.8%)	10 (14.1%)	15 (21.1%)	9 (29.0%)	6 (20.0%)	5 (16.7%)	6 (19.4%)
≥50 (N=110)	38 (45.8%)	36 (43.4%)	13 (15.7%)	31 (37.3%)	5 (18.5%)	4 (14.8%)	2 (7.4%)	4 (14.8%)
TOTAL	*68 (34.9%)*	*59 (30.4%)*	*27 (14.1%)*	*56 (29.0%)*	*20 (15.9%)*	*15 (13.2%)*	*8 (6.7%)*	*13(10.7%)*

In unadjusted analysis, ADLs were not significantly different by age in either the HIV positive (($\chi2$, (N=195) = 4.93, p=0.55, chi squared test for trend) or HIV negative groups (($\chi2$, (N=126) = .96, p=0.99). HIV status was related to a significant increase in ADL problems overall (($\chi2$, (N=327) = 13.98, p<.001) and in relation to each individual domain (ps<.05).

The adjusted association of age and HIV status with ADLs is presented in *Tables 53 and 54*, separately for the HIV positive and negative participants. After adjustment for gender/sexuality, time diagnosed with HIV (for the HIV-positive group) and ethnicity, ADLs rates did not differ by age among the HIV-positive or HIV-negative samples. However longer time with HIV diagnosis was strongly associated with increasing ADL prevalence overall and for each domain. This trend held true across the subgroups. In a model including all participants, and adjusted for age, gender/sexuality and country of origin, HIV-positive status was related to a significant increase in problems with ADLs (Odds Ratio=2.72, 95% C.I.=1.42-5.23, p=0.003, for comparison of HIV-negative with HIV-positive group).

Table 53. **Adjusted association of age, time with diagnosed HIV, gender/sexuality and country of birth with problems with ADLs in HIV positive adults (logistic regression analysis).**

(N=197)	One or more problems with ADLs			Mobility problems			Self-care problems			Problems with usual activities		
Independent Variable	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age	0.72			0.49			0.62			0.60		
Test for trend	*0.88*	*0.96*	*(0.57, 1.61)*	*0.71*	*1.11*	*(0.65, 1.89)*	*0.33*	*0.71*	*(0.35, 1.41)*	*0.76*	*1.09*	*(0.64, 1.86)*
<40	0.67	1.27	(0.43, 3.78)	0.92	1.06	(0.34, 3.26)	0.39	1.93	(0.43, 8.65)	0.95	1.04	(0.33, 3.22)
40-50	0.63	0.82	(0.38, 1.79)	0.27	0.64	(0.28, 1.43)	0.45	1.49	(0.53, 4.22)	0.36	0.68	(0.30, 1.54)
50+*		1			1			1			1	
Years with diagnosed HIV	0.01			0.01			0.46			0.04		
Test for trend	*.001*	*2.03*	*(1.35, 3.03)*	*.001*	*2.06*	*(1.35, 3.16)*	*0.01*	*2.45*	*(1.32, 4.56)*	*.004*	*1.85*	*(1.22, 2.81)*
0-5*		1			1						1	
5-10	0.02	5.51	(1.29, 23.56)	0.04	5.85	(1.10, 31.01)				0.07	3.96	(0.88, 17.71)
10-20	0.02	5.45	(1.37, 21.62)	0.02	6.43	(1.30, 31.86)				0.03	4.87	(1.20, 19.79)
20+	<.001	13.76	(3.16, 59.94)	.001	15.50	(2.90, 82.75)				.004	2.02	(2.02, 40.47)
Sex	0.22			0.41			0.26			0.05		
MSM*		1			1			1			1	
Hetero male	0.09	2.61	(0.87, 7.78)	0.22	2.04	(0.66, 6.35)	0.12	3.10	(0.75, 12.81)	0.02	4.06	(1.30, 13.67)
female	0.47	1.39	(0.57, 3.40)	0.41	1.46	(0.59, 3.64)	0.35	1.69	(0.56, 5.11)	0.36	1.54	(0.61, 3.89)
Country of birth Other*		1			1			1			1	
UK	0.03	2.45	(1.12, 5.35)	0.07	2.11	(0.94, 4.74)	0.21	1.95	(0.68, 5.58)	0.02	2.60	(1.14, 5.92)

* reference group

Table 54. **Adjusted association of age, gender/sexuality and country of birth with problems with ADLs in HIV negative adults (logistic regression analysis).**

(N=130)		One or more problems with ADLs			Mobility problems			Self-care problems			Problems with usual activities		
Independent Variable		p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age		0.04			0.22			0.05			0.05		
	Test for trend	*0.08*	*1.69*	*(0.93, 3.06)*	*0.20*	*1.53*	*(0.80, 2.93)*	*0.09*	*2.10*	*(0.88, 5.00)*	*0.04*	*2.13*	*(1.05, 4.33)*
	<40	0.15	0.38	(0.10, 1.41)	0.28	0.46	(0.11, 1.86)	0.15	0.16	(0.01, 1.94)	0.06	0.21	(0.04, 1.06)
	40-50	0.36	1.80	(0.51, 6.44)	0.65	1.40	(0.34, 5.77)	0.29	2.65	(0.44, 15.87)	0.71	1.31	(0.31, 5.49)
	50+*		1			1			1			1	
Sex		0.52			0.43			0.37			0.36		
	MSM*		1			1			1			1	
	Hetero male	0.72	1.27	(0.35, 4.64)	0.44	1.79	(0.41, 7.93)	0.16	5.10	(0.52, 50.40)	0.28	2.62	(0.46, 14.83)
	female	0.29	2.15	(0.53, 8.69)	0.20	2.84	(0.58, 13.85)	0.28	3.17	(0.24, 41.25)	0.15	3.82	(0.61, 23.99)
Country of birth	Other*		1			1			1			1	
	UK	0.27	1.83	(0.63, 5.34)	0.53	1.44	(0.46, 4.47)	0.89	0.90	(0.19, 4.22)	0.92	1.06	(0.31, 3.68)

* reference group

7.4.2.3 *Physical activity*

When looking at raw regular physical activity prevalence by age group, among HIV-positive participants the likelihood of participants partaking in any regular physical activity was not associated with age. In HIV negative participants, physical activity also tended to decrease with age, except that adults under the age of 40 were less likely to participate in running, cycling or gym use when compared to older participants.

In terms of the overall proportion reporting regular physical activity, HIV negative participants were generally more likely to be active than PWH. *Table 55* reports the prevalence of each physical activity by age and HIV status.

Table 55. **Prevalence of physical activity (n and %) by age group and HIV status.**

HIV positive (N=195)					
Age in years	**Physically active**	**Runs**	**Swim**	**Cycle**	**Gym use**
<40 (N=40)	26 (65.0%)	9 (22.5%)	5 (12.5%)	7 (17.5%)	14 (35.0%)
40-50 (N=72)	39 (54.2%)	14 (19.4%)	6 (8.3%)	7 (9.7%)	15 (20.8%)
≥50 (N=83)	48 (57.8%)	13 (15.7%)	7 (8.4%)	11 (13.3%)	19 (22.9%)
TOTAL	113 (58.2%)	36 (18.6%)	18 (9.3%)	25 (12.9%)	48 (24.7%)
p values	*p=0.70*	*p=0.82*	*p=0.36*	*p=0.59*	*p=036*

HIV negative (N=126)					
Age in years	**Physically active**	**Runs**	**Swim**	**Cycle**	**Gym use**
<40 (N=68)	54 (81.8%)	28 (4.4%)	14 (21.2%)	11 (16.7%)	28 (42.4%)
40-50 (N=31)	22 (71.0%)	9 (29.0%)	4 (12.9%)	8 (25.8%)	16 (51.6%)
≥50 (N=27)	12 (44.4%)	2 (7.4%)	3 (11.1%)	3 (11.1%)	3 (11.1%)
TOTAL	88 (72.1%)	39 (32.0%)	22 (18.0%)	22 (18.0%)	47 (38.5%)
p values	*p=0.01*	*p=0.02*	*p=0.73*	*p=0.58*	*p=0.01*

In unadjusted analysis, the prevalence of regular physical activity was not significantly different by age in PWH, but decreased with age in HIV negative participants. Interestingly, free-text reports of 'walking' as a physical activity increased with age in this group (5.9% of <40s to 30.0% of >60s, p=0.06). HIV status was significantly associated with regular physical activity;

with fewer HIV positive participants (58.7%) than HIV negative participants (72.2%) reporting physical activity (χ2, N=322)=6.11, p=0.01).

The adjusted association of age and HIV status with physical activity is presented in *Table 56*, in relation to the HIV positive and negative participants respectively.

***Table 56.* Adjusted association of age, time with diagnosed HIV, gender/sexuality and country of birth with physical activity in HIV positive and negative adults (logistic regression analysis).**

Physical activity		**HIV positive participants (N=197)**			**HIV negative participants (N=130)**		
Independent Variable		p. value	Odds ratio	95% C.I.	p. value	Odds ratio	95% C.I.
Age		0.40			0.01		
	Test for trend	*0.49*	*0.85*	*(0.53, 1.36)*	*.004*	*0.48*	*(0.29, 0.79)*
	<40	0.32	1.67	(0.61, 4.60)	.004	4.54	(1.64, 12.59)
	40-50	0.67	0.86	(0.42, 1.76)	0.08	2.71	(0.89, 8.30)
	50+*		1			1	
Years with diagnosed HIV		0.58					
	Test for trend	*0.42*	*0.87*	*(0.63, 1.21)*			
	0-5*		1				
	5-10	0.38	1.65	(0.54, 5.08)			
	10-20	0.89	0.94	(0.36, 2.41)			
	20+	0.69	0.81	(0.28, 2.30)			
Sex		0.25			0.79		
	MSM*		1			1	
	Hetero male	0.22	0.53	(0.19, 1.46)	0.94	1.04	(0.37, 2.88)
	female	0.17	0.56	(0.25, 1.27)	0.55	1.44	(0.44, 4.67)
Country of birth	Other*		1			1	
	UK	0.29	1.44	(0.73, 2.85)	0.55	1.30	(0.55, 2.08)

* reference group

Using the overall measure of regular physical activity, after adjustment for gender/sexuality, time diagnosed with HIV, and ethnicity, prevalence of regular physical activity was not related to age or time with diagnosed HIV in PWH. In participants without HIV, however, physical activity decreased with age. Spontaneous mention of walking as an activity also increased with age in this population (Odds Ratio=2.70, 95% C.I.=1.17-6.25, p=0.02). In a model including all participants, adjusted for gender/sexuality, time diagnosed with HIV (for the HIV-positive group), and country of origin, HIV negative participants were more likely to report overall physical activity than HIV positive participants (Odds Ratio = 1.81 for HIV-negative vs. HIV-positive participants, 95% C.I.=1.02-3.21, p=0.04, for comparison of HIV-negative with HIV-positive group).

7.5 Discussion

The aim of this chapter was to assess a) age-related differences in resilience in adults with and without HIV, b) 'time with diagnosed HIV'-related differences in resilience in adults with HIV, c) the association of resilience with symptoms of depression, anxiety, and physical ability in adults with and without HIV and d) to compare prevalence of depression, anxiety, problems with ADLs, and regular physical activity, by age, in adults with and without HIV.

Comparable levels of resilience (48.4% vs. 45.6%) were found in adults with and without HIV respectively. In adults with HIV, resilience increased with age, although this change did not reach significance. Longer time with diagnosed HIV, however, was related to significantly lower resilience. No difference was found, by age, in HIV negative participants. High resilience was also found to be significantly related to lower prevalence of depression, anxiety, ADL problems and physical activity in PWH.

In relation to HIV status, PWH were more likely to have depression (19.8% vs. 13.1%) and anxiety (16.2% vs. 6.9%) than HIV negative participants, as well as problems with ADLs (34.9%vs. 15.9%), and were less likely to be physically active (57.9% vs. 69.8%). In adjusted analysis, anxiety, ADL problems and physical activity were significantly different by HIV status, but the pattern of higher prevalence among the HIV-positive group was maintained for the other measures. Anxiety was found to decrease with age in PWH, with a non-significant decreasing trend for depression and no clear difference found in relation to physical activity or prevalence of problems with ADLs. Time diagnosed with HIV was related to an increase in problems with ADLs, a nonsignificant increase in anxiety prevalence and no change in depression or physical activity. In HIV negative participants physical activity decreased with age and problems with ADLs increased nonsignificantly. No difference was found in relation to mental health with age.

7.5.1 **Resilience**

High resilience was significantly related to decreases in the reports of depression, anxiety and problems with ADLs in PWH, but not physical activity. Resilience has been consistently linked to mental[113;337] and physical health[338;341;342] and health-care activities[339;340;343] in the general population, but no studies had explored the relationship between resilience and well-being in a HIV positive population. From the data presented here, it appears that high levels of resilience are possible in an HIV positive population and are related to improved well-being; as in the general population, but not health-related activities.

There are two main possibilities behind the relationship between resilience and mental and physical well-being. Firstly, high levels of resilience may buffer adults against mental and physical distress by increasing health-related behaviours[339-341;343] and the use of adaptive coping mechanisms[152;320-324]. While the latter of these suggestions may relate to the current results, no relationship between resilience and physical activity was found, so the former may be ruled out. Alternatively, it is possible that having poor physical and mental health prevents adults from developing resilience by taxing their available resources and/or reducing access to social support. However, based off previous longitudinal data, for which the direction of causality is more assured, it appears that resilience does have a positive effect on both physical and mental health[113;341;342]. Therefore, it appears that resilience may be strongly related to well-being in PWH and may even be a protective factor against health decline, although the presence of other confounding factors in this relationship (factors associated with both resilience and poor mental health) cannot be ruled out.

7.5.2 **Age**

Resilience increased nonsignificantly with age in PWH. As resilience was also found to be related to better mental health, this may partially explain the results found in Chapter 4, which found improvements in mental health with age despite lower levels of physical health. While there was no literature available on age-related differences in resilience in PWH, resilience is thought to increase with age in the general population[112-114;346;347] due to life experiences of coping with adversity - such as bereavement, physical changes and adaptive life roles[115]. Were this to be the true, one might expect to see a stronger association between resilience and age in PWH as they are likely to have experienced even more life stressors. This was suggested in the results presented here: an increase in resilience was shown for age in PWH but not in the HIV-negative control group. However, the lack of change among the HIV-negative group may also be due to the smaller number of older adults available at the sexual health clinic (27 participants over the age of 50 vs. 83 PWH).

As in the ASTRA data, depression and anxiety prevalence decreased with age in PWH. However, the relationship between age and depression was only nearing significance, and no relationship was found between age and problems with ADLs. The pattern of trends with age and time with diagnosed HIV in depression, anxiety, and ADL problems that were observed in the HIV-positive sample in this resilience study were very similar to those found in the HIV-positive participants from the ASTRA study (Chapters 3 and 4), although power was reduced to assess differences in this smaller sample. This similarity of findings from a new study carried out at a later time strengthens the thesis conclusions regarding differences in physical and psychological health with age and time since HIV diagnosis.

Finally, the relationship between age and physical activity was explored. In HIV-negative participants physical activity decreased with age, likely due to age-related reductions in functional ability and in the availability of age-appropriate physically active social circles. In PWH, however, there was no significant relationship between age and prevalence of regular physical activity. Based on the results, it seems possible that this is due to the low levels of physical activity across all ages of PWH; that is that levels of activity are particularly low among younger PWH. This could be due to the significant prevalence of fatigue and other physical symptoms apparent in this population as shown in the ASTRA study results (Chapter 3), although illness and fatigue were not explicitly explored in this study. However, it is also possible that lack of physical activity is related to the problems with ADLs reported in ASTRA in older adults through sedentary behaviour.

Finally, the number of HIV negative participants spontaneously reporting 'walking' as a physical activity increased with age, which marks an age-related change in physical ability resulting in 'walking' being seen as a physically taxing exercise. It also highlights that, to older adults, walking appears to be an acceptable form of exercise (30% of 60 and over reporting walking as an exercise): information which could be utilised in future interventions.

7.5.3 Time diagnosed with HIV

Longer time with diagnosed HIV was related to a decrease in prevalence of high resilience and an increase in problems with ADLs, and anxiety consistent with its adverse association with all health measures reported in the ASTRA results (Chapters 3 and 4). Problems with ADLs, as already discussed, may increase with time diagnosed with HIV due to drug toxicities and the side effects from early ART, coupled with age-related changes in health. Resilience has not been previously explored in relation to 'ageing with HIV', but may decrease with increased ageing due to the continued accumulation of stressors related to illness, stigma and ageing which prevent PWH from developing adaptive coping mechanisms. In other words, similar to the toxic stress model[351], prolonged ill health and stress appears to inhibit PWH's ability to develop positive mental responses. As with the increases in resilience with age, these decreases correlated with the high prevalence of depression and anxiety reported in this population in the ASTRA study and may help to explain the problems with between mental and physical health reported in adults ageing with HIV.

7.5.4 **HIV status**

Only one previous study compared resilience by HIV status, and that reported a non-significant decrease in resilience in PWH[349]. The current results, identical to those of the previous study, found a non-significantly lower level of resilience in adults with HIV, when compared to HIV-negative adults. There are several possible explanations for the non-significance of this result. Firstly, it is possible that as the control group is well matched to PWH in relation to risk behaviours and self-esteem, no difference in resilience exists. Alternatively, it is possible that HIV does not affect resilience in the same way as other chronic illnesses and is not related to lower resilience rates, although the results relating to time diagnosed with HIV do not support this. This could be due to the large amount of support available to PWH through their HIV clinic, which could create a buffer against reduced positive mental well-being.

Anxiety and problems with ADLs were significantly higher in PWH than HIV-negative participants, and physical activity was lower. Indeed, anxiety and problems with ADLs were over twice as likely in PWH than HIV negative adults, as was naming 'walking' as a physical activity. This mirrors the results of the ASTRA study, which suggested higher prevalence of mental and physical health distress than the general UK population, and adds to their bearing by including direct comparisons to a clinically matched control group. Depression, however, was nonsignificantly higher in prevalence in PWH in adjusted analysis. The lack of significant difference, however, may be due to the high rates reported in both populations, which were far higher than those identified using the PHE statistics[218]. In other words, PWH appear to not only have higher prevalence of mental health disorders and disability to the general UK population, but also to age- and risk-behaviour matched adults. Alternatively it is possible that the PHQ-9 and GAD-7 overestimate the prevalence of depression and anxiety - at least in comparison to other measures.

7.5.5 **Limitations**

There are two main limitations to this analysis. The first limitation is that the sample size of older HIV-negative participants was small due to the lack of older adults attending the clinic, which resulted in lack of power for age-related comparisons, as shown in the width of the confidence intervals reported. The small sample size also limited the power of this study and may have resulted in type two errors. It also meant that we were unable to perform sub-group analysis in relation to gender or ethnicity, or interaction tests, and that we were required to combine all adults over the age of 50 into one group. As such, we cannot comment on age-related differences in resilience within the OPWH population.

Secondly, where no response was indicated in regards to questions from the PHQ-9, GAD-7 or RS-14 a standardised result was input. As such, the depression, anxiety and high resilience rates reported here may be an underestimate of true prevalence in these populations.

It is also important to note that the associations reported are only correlational and, while causal explanations have been suggested, longitudinal data is required to provide more evidence of causality.

Finally, the HIV negative participants here were all recruited from sexual health clinics, which may have homogenised the responses. Further analysis using control participants from the background population may create different results.

7.5.6 **Conclusions and Implications**

This study, while small, is the first information available on the association between resilience and age in PWH, and one of the first studies to explore resilience in relation to HIV. As such, although power was limited, the study results are integral to understanding age- and 'ageing with HIV'- related changes in well-being in PWH. It also confirmed earlier results in identifying psychological symptoms as a cause for concern amongst PWH, which requires more academic and clinical attention.

The information shown suggests that resilience is strongly related to depression, anxiety, physical health, and health-related activities and may be a mediator between physical and mental health in relation to both age and time with diagnosed HIV. It should be included in studied assessing well-being in OPWH, and could be developed into an intervention. Resilience-based interventions have, for example, been piloted amongst diabetics[354] with positive results. These interventions involve three main premises for improving resilience: taking responsibility, empowering the self (through education and self-management) and creating meaningful connections; explored across multiple support group meetings[354;355]. Such interventions could be considered for PWH, especially those who have been diagnosed with HIV for an extended period of time. Finally, this study also identified low levels of physical in PWH, compared to HIV-negative adults. As general physical fitness is an important part of physical and mental well-being this could also be addressed in future care. These will be discussed further in the next chapter.

8 Interventions to improve well-being in adults ageing with HIV

Up until this chapter I have focused on identifying age- and 'ageing with HIV'-related differences in well-being in PWH in the UK. Due to the lack of previous UK literature, it was important to identify potential care needs of this specific population beyond routine HIV care as it is currently delivered. However, it is important to not only identify age-related differences but also to show how this information can be utilised by health-care organisations to improve the well-being of OPWH.

In order to do this, I performed a second systematic review in order to identify interventions that have previously been found to be successful within this population. I then combined this information with the results of this thesis and the general gerontological literature to suggest measures which are most likely to improve the overall well-being of OPWH.

8.1 A systematic review of interventions to improve the wellbeing of OPWH.

To identify studies evaluating interventions aimed at improving well-being for older adults with HIV, a systematic review was conducted following Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) standards[119]. All methodologies measuring well-being were included in the outcome, provided that they used validates measures.

I searched 22 databases which publish articles on health, HIV, or psychology from their earliest recorded dates until December 2012 for all peer-reviewed publications, regardless of language, which contained key words within the matrix of relevant terminology. The databases included were: AIDS, Cochrane Database of Systematic Reviews (CDSR), database of systematic and non-systematic reviews of public health interventions (DoPHER), Medline/Pubmed, JAIDS, SAGE, JSTOR, LILACS, Mary Ann Liebert, METALIB, Psychnet, sciencedirect, Springerlink, Taylor and Francis, Wiley and EBSCO in July-August 2014. This was then updated in September 2015. The search terms used were HIV [or] AIDS coupled with ‘50’ [or] ‘age’ [or] ‘aging’ [or] ‘elder’ [or] ‘elderly’ [or] ‘fifty’ [or] ‘mature’ [or] ‘old’ [or] ‘older’ [or] ‘senior'.

8.1.1 **Inclusion and Exclusion criteria**

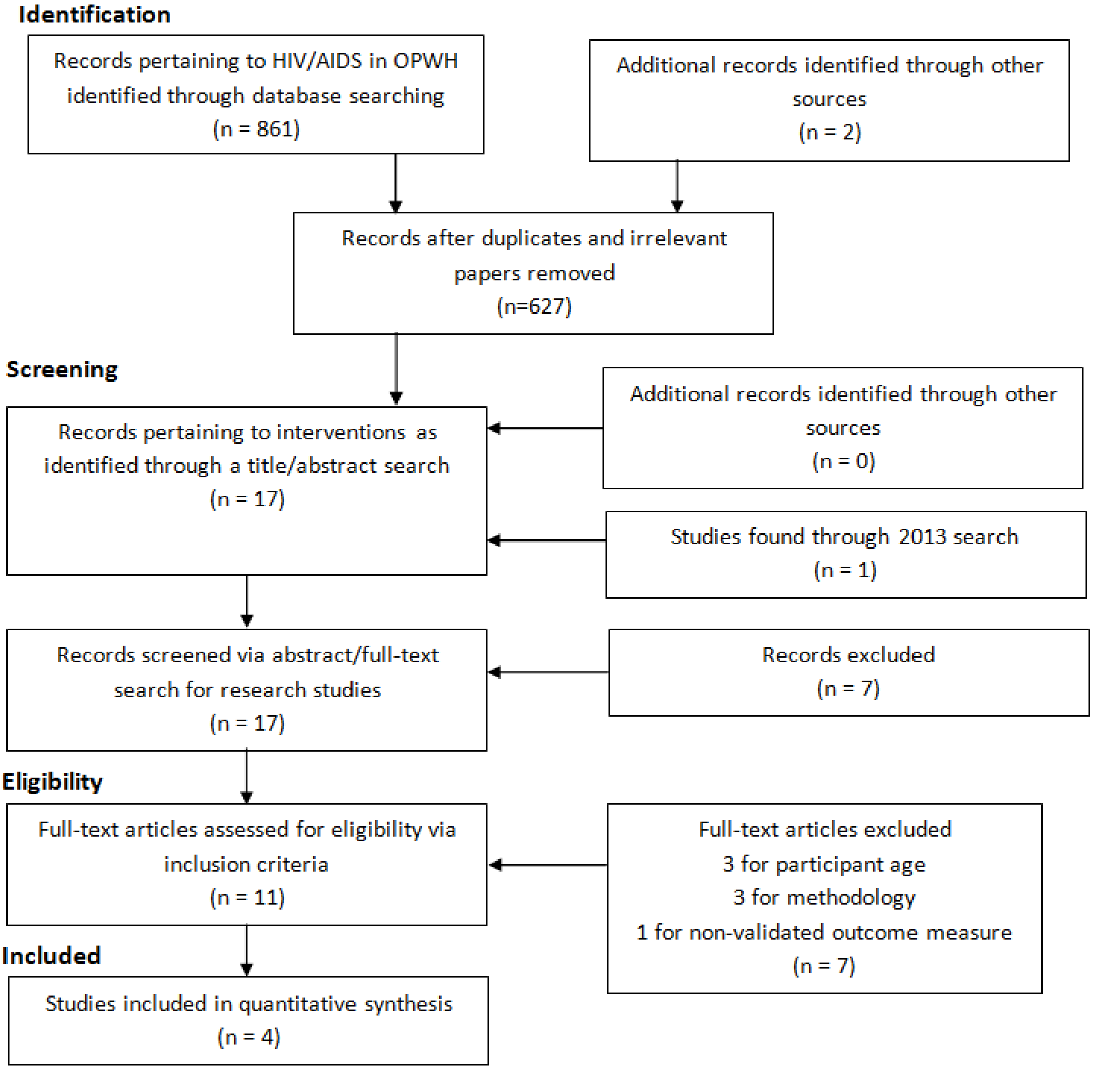
Inclusion criteria incorporated the paper being (a) a peer-reviewed, original research article that (b) studied at least one intervention in relation to (c) physical, psychological or social issues associated with HIV in (d) adults over 50 with HIV (with at least 80% being over 50, or an indeterminate percentage with a mean of over 50) from any country. Despite the age-related changes found in the ASTRA study beyond the traditional '50 years of age' cut-off, the inclusion criteria was limited to limitations with adults over the age of 50 only so as to be clear that older adults were the intended recipients. These can be found in more detail in *table 57*. Studies were excluded if they did not explicitly examine interventions in psychological or social issues associated with HIV with a measurable outcome. Prevention interventions among OPWH were not included. Studies whose full text could not be retrieved were excluded.

Table 57. **Inclusion criteria in order of use.**

No.	Inclusion Criteria	Status of paper and response		
		Yes	**Unclear**	**No**
0	Is the study clearly outside the scope of the review?	**Exclude**	*Go to question 1*	*Go to question 1*
1.	Are the participants HIV-positive?	*Go to question 2*		**Exclude**
Type of study				
2.	Is it randomised, including cross-over, cluster and factorial trials?	*Go to question 4*		*Go to question 3*
3.	Is it a non-randomised intervention study (before and after study), cohort or case-control observational study?	*Go to question 4*		**Exclude**
Participants in study				
4.	Are the participants over the age of 50 years?	*Go to question 6*		*Go to question 5*
5.	If some of the participants are under the age of 50, can the data be disaggregated to show that 80% of the sample is over the age of 50 or, if indeterminate, is the mean age over 50?	*Go to question 6*		**Exclude**
Interventions				
6.	Does the intervention aim to improve biopsychosocial well-being or quality of life for OPWH either as a primary or secondary aim?	*Go to question 7*		**Exclude**
7.	Are participants receiving the intervention in comparison to other adults over 50 affected with HIV who received a) usual care, no care of placebo and/or b) a different intervention that meets the criteria outlined in question 6 or c) fit the criteria for question 3?	*Go to question 8*		**Exclude**
Outcomes				
8.	Does the study measure physical, psychological and/or social factors measured by validated instruments?	*Include subject to clarification of 'unclear' points*		***Exclude***
N.	**Final Decision**	**Include**	**Unclear (more info)**	**Exclude**

A total of 861 records were returned from database searches. An additional two records were identified through lead authors. The removal of duplicates and papers not directed at OPWH reduced the final count to 627 papers. A key term search was conducted through the text of the final list and 17 paper relevant to the review were identified, 11 of which were empirical studies. No further papers were identified through bibliography mining. A final four studies met the screening criteria and were included in the final analysis. The selection process is depicted in *figure 29.*

Figure 29. **Preferred Reporting Items for Systematic Reviews diagram summarizing selection procedure for studies on interventions for OPWH.**



A total of 17 papers were identified, of which 10 were empirical studies. No further papers were identified through bibliography mining. Of the 10 studies remaining, four met the screening criteria listed in *Table 58, Appendix E and* were included in the final analysis. One was a pilot study[356] and was excluded from analysis due to the small sample size (N=16). All four studies originated from the same research group.

8.1.2 **Results**

8.1.2.1 Intervention Characteristics

All three interventions used a randomised control trial design[357-359] and involved at least one follow-up assessment. Two interventions[357;358] involved group therapy, one of which was telephone administered[358]. Types of group therapy were a 12-session, 90-minute coping improvement group intervention[357], a 12-session, 90-minute interpersonal support group intervention[357], a 12-session, 90-minute telephone-administered coping effectiveness training (CET)[358] and a 12-session, 90-minute telephone-administered supportive-expressive group therapy (SEGT)[358]. The final intervention involved telephone-delivered motivational interviewing, in one or four sessions lasting 50 minutes[359]. The coping improvement group interventions covered personal histories, appraisal of HIV and ageing stressors, development of problem-solving and emotion-focused skills and interpersonal support[356;357]. The interpersonal support group intervention discussed videos on nutrition, treatment adherence and sexual risk reduction, how these affected their own lives, and how to adapt them to suit an over-50s group[357]. SEGT explored feelings about aging, HIV and being an OPLWA while facilitating support through other members, family, health workers, and social groups, encouraging the expression of emotions, redefining self-image and feelings about death, developing activities and improving quality of life (QoL)[358] and CET discussed stressor severity and developed and optimised coping skills, including social support[358].

The measures used to assess outcomes varied between papers, with only one appearing more than once. Only two interventions[356-358] had psychosocial well-being of OPLWA as their primary objective, and both were aimed at reducing depression in OPWH with clinically relevant depression scores. The other primarily aimed to decrease risky sexual behaviour, with psychosocial well-being of participants as a secondary goal[359]. Finally, although length of time with HIV is reported in all three studies[357-359], no analysis on the effect this had on treatment effect occurred.

8.1.2.2 Intervention Effects

The coping improvement group intervention explored by Heckman and colleagues in 2011[357] of almost 300 participants was successful in reducing depression ($p<0.01$) immediately post-intervention, if not at 4 or 8-month follow-ups (although depression prevalence were still lower than at baseline). The support group intervention also showed successful reduction in depression ($p<0.04$), but only at 4-month follow-up: not at post-intervention or 8-month follow-up[357].

Lovejoy's[359] (2012) pilot telephone-delivered individual motivational interviewing intervention aimed at reducing sexual risk behaviour, depression, anxiety and stress in 100 PWH over the age of 45. For one-session interviews, no significant difference was found in depression ($p=0.44$), anxiety ($p=0.99$), or stress (0.85) at a 3-month follow-up compared to a control, but differences were found for all three at 6-month follow-up (depression: $p=0.03$, anxiety: $p=0.04$, stress: $p=0.04$)[359]. Similar results were found for the 4-session interviews, where at three months there were no significant results for depression ($p=0.83$), anxiety ($p=0.66$) or stress ($p=0.88$), but at six months all three were significantly reduced (depression: $p=0.01$, anxiety: $p=0.01$, stress: $p=0.01$)[359]. Although the differences in depression, anxiety, and stress showed a larger effect size for the 4-session interview, no significant difference was found between the two interview conditions, suggesting that length of the intervention is relatively irrelevant to the outcome[359].

Heckman and colleagues' 2013 SEGT teletherapy was successful in reducing depression in a sample of 361 OPWH at post-intervention ($p=0.01$), 4-month ($p=0.01$) and 8-month ($p=0.01$) follow-up compared to control[358]. CET teletherapy had no effect on depression at any time point ($p=0.99$, 0.25 and 0.56 respectively)[358]. Thorough post-hoc analysis also revealed that the reduction in depression was greater the more sessions were attended for both SEGT ($p=0.04$) and CET ($p=0.01$) and that the higher depression was pre-test, the lower it was post-test ($p=0.01$ for SEGT and CET).

8.1.3 Discussion

This is the first review to systematically summarise the research available on interventions to improve well-being in OPWH. The most obvious finding available from this systematic review is that research is lacking. Three studies were found, all from the same American research group but each using different methodologies and measures. The lack of repeat studies and comparable methods makes it impossible to determine whether these interventions would be effective across OPWH in other geographic areas. Furthermore, the interventions were all run by clinicians with Masters-or-above level qualifications[357-359], which are not always accessible for all clinics. Finally, no interventions were identified focusing on long-term HIV care. As such, we are reliant upon the OPWH literature to suggest strategies that may be beneficial to adults ageing with HIV.

However, it is important to note that all three interventions did result in positive effects on the mental health of OPWH. While the methodology used was complex - making pinpointing which elements caused the improvement in psychosocial wellbeing difficult - what can be taken from this review is that well-being can indeed be improved in OPWH through interventions and that, regardless of content, the social contact made available through group interventions may improve well-being. Indeed, Heckman and colleagues[357] note that the decrease in depressive symptoms in their interventions may come from contact with other PWH, as no significant difference in intervention results were found and the exchange of contact details was encouraged[357]. Furthermore, telephone-delivered interventions appear to be effective[359;358], even after only one session[359], meaning that interventions need not be in person or extensive to be successful. This would be useful for health-care institutions where space is an issue, as well as OPWH who have difficulty travelling to clinics and are therefore less likely to attend repeated sessions. However, most of the interventions discussed also used 'standard of care' as a control, which means that the positive effects of the results are likely over-estimated and may not differ from those of currently available interventions.

9 Discussion and Implications of research

9.1 Discussion of results

The number of older adults with HIV in the UK is increasing, both in terms of new diagnoses and adults ageing with HIV[19]. However, there has been limited research into the physical, psychological, or social well-being and care needs of older adults with HIV, and even less research dedicated to those ageing with HIV. Research has also not tended to explore the possibility of 'positive' effects of age on well-being, such as resilience, and the possibility of the development of age-appropriate interventions to improve well-being. This has left much of the discussion in the literature to extrapolate information from gerontological literature and studies of HIV-positive populations which were predominantly composed of younger adults. In particular, the majority of research into OPWH originates from North America - to date only five studies that were specifically concerned with biological, psychological or social well-being were identified from the UK.

This thesis aimed to identify the biopsychosocial problems facing older PWH in the UK, both in relation to biological age and 'ageing with HIV', and to explore potential avenues for an age-appropriate intervention. Through the analysis presented, I have identified age- and ageing-related differences in physical symptom prevalence and distress, problems with ADLs (Chapter 3), depression, anxiety (Chapter 4), disclosure, and social support (Chapter 5) in PWH. The thesis results have given insight, within a large population of people with HIV in the UK, into the most prevalent problems limiting well-being in PWH overall and in older PWH and those ageing with HIV. The results presented are also among the first to assess the independent associations of both age and time with diagnosed HIV on indicators of well-being, together with the first available data on resilience in OPWH and its relationship to physical and mental well-being and health-related behaviours.

Below I discuss the evidence presented over this thesis, in relation to ASTRA'S HIV positive UK sample, and the factors which differ by and age time diagnosed with HIV. As physical, mental, and social well-being are strongly inter-related, I also report on the relationships between these variables, in order to identify common themes. As a large amount of data is presented, these associations will be depicted in visual form in *Appendix E, figure 30.*

9.1.1 **The biopsychosocial health of HIV positive people living in the UK**

The data presented, although based on a study sample, gave insight into the biopsychosocial well-being of HIV-positive people living in the UK in the current era of successful treatment. An understanding of the well-being of the HIV population in general is necessary in order to place age-related differences in well-being into context, and this data will therefore be presented below.

In the ASTRA study of 3,258 PWH, high prevalence of symptoms and symptoms causing distress were identified (section 3.3), and problems with ADLs were twice as prevalent as has been found in the general UK population[176]. Almost all (92.8%) participants reported experiencing physical symptoms, with the majority reporting nine or more. Almost half the study sample reported significant distress in relation to these symptoms. The most commonly reported symptoms were fatigue-related, and the symptoms that, where present, were most likely to be distressing were 'pain', 'changes in fat in face or body' and 'difficulty sleeping'. A high symptom prevalence has been recorded in other studies of PWH[360-362], and may occur both in relation to the infection itself and the medication. Fatigue, in particular, is commonly reported in PWH, and appears to be related to ART medication and mental stress[197-199]. The ASTRA data confirms a high burden of symptoms among people living with HIV. Symptom distress is less well recorded in the literature, but is not unexpected in relation to the symptoms common in HIV and was therefore thought to be an important focus in this study, which was likely to impact on well-being.

Compared to the general UK population, and based on a comparison study, PWH in this study reported higher prevalence of depression and anxiety[218], across both the ASTRA and Resilience studies. Indeed, depression symptoms appeared to be 8-10 times more prevalent[218] and anxiety symptoms to be 4-5 times more prevalent[218] (section 4.4.1). A high psychological burden has been found in relation to chronic illness in general[219;250;254;255;363]. In chronic illness, depression can be related to feelings of being overwhelmed, weakness-related shame and fear of a slow - or non-existent - recovery[221]. In relation to HIV, depression has been related to several factors salient in older age groups, such as bereavement[86], poorer physical function[85;87;88], health-induced anxiety[84;89;90] and social isolation[85;91;92]. As such, it may not be considered surprising that these rates are higher than the general population.

Depression and anxiety have also been related to high disease burden across several chronic illnesses[220;223;249;255] and higher rates of medication nonadherence[227], making them important factors to consider when assessing well-being. This was also found in the ASTRA sample (section 4.3.3), with strong relationships found between mental and physical health symptoms. Similarly, social support was a commonly reported problem in the ASTRA sample (section 5.3.1), and the availability of sufficient social support was strongly related to better overall well-being (section 5.3.5).

These results highlight the detrimental relationships between HIV status and mental, physical, and social health. However, it is worth noting that in the study population, the vast majority were on ART, viral load was generally successfully controlled, and the prevalence of immunosuppression was low (81.5% CD4 count of ≥350 cells/mm^3) (section 2.4). In fact, having a low CD4 count was related to few other measures of well-being. Therefore, while CD4 count appears to be generally successfully managed amongst this sample of UK PWH, these results suggest that symptom distress, depression, anxiety, and problems with ADLs are prevalent and consequently may not be a focus of care, and may be less well managed in adults with HIV. In relation to interventions, these factors would appear to be potential intervention avenues for improving well-being, regardless of CD4 count.

9.1.2 **Age-related differences in biopsychosocial health**

9.1.2.1 Physical well-being

Similar to PWH of all ages, the most commonly reported well-being issues in OPWH in the ASTRA study were symptom prevalence, symptom distress, and social support. Problems with ADLs were reported more frequently with age (section 3.3.3), which suggests that OPWH are at risk of disability and this should be addressed accordingly. Mobility and physical activity have also been found to reduce with increasing age in the general population[26;55;175], but the prevalence of problems with ADLs observed in the ASTRA study data was greater than that found in older adults in the general population (54% vs. 45%[176;215]), and occurred at younger ages, which suggests that age and HIV may have a cumulative effect on physical health resulting in faster physical ageing of the body. One hypothesis may be that inflammation caused by HIV infection may accumulate cell damage in a similar, but faster, way to that described in natural physical ageing[50;80;180] and thus causes earlier signs of physical ageing[81]. This could result in greater fatigue, physical frailty, and problems with activities of daily living (ADLs) with age[26;54;55], some of which were shown here. This finding was, moreover, replicated in the Resilience study, which showed more prevalent problems with ADLs in an HIV positive sample than a demographically-matched HIV negative sample (section 7.4.2.2), although the sample size was small. The resilience study also identified lower levels of physical activity in PWH, which could be either a cause or result of increased problems with ADLs[26;54;55]. As such, it would be worth encouraging exercise in OPWH to improve overall well-being[170;276;364-366].

Differences in the prevalence of fatigue with age were not, however, identified; although this may be related to the high prevalence of fatigue in the ASTRA population. Similarly, in adjusted analysis, there was no trend with age in relation to the majority of the physical symptoms - or distress - explored (section 3.3), suggesting that OPWH in the UK are not at higher risk of physical concerns than younger PWH, despite reporting more problems with ADLs. Unfortunately, while comorbidities have been well documented in OPWH[55;64;79;109;130;133;141;142], individual symptoms have not been previously explored, and so it is unclear why symptom prevalence would remain stable across age. However, it is possible that this is due to the high levels of adherence reported overall, making HIV-medication-related symptoms similar across all age groups.

In regards to the symptoms which did increase in prevalence with age, the HIV and gerontological literature suggest that the differences observed are likely due to a collaboration of age-related and HIV-related illness. Specifically, gastric symptoms were more common in older PWH and are common in people taking cART[87], which may imply a higher toxicity in response to ART medication in older adults, possibly due to drug-drug interactions[64;128] and/or age-related homeostatic loss[8]. Tingling in hands and feet is often related to nerve damage from viral infections (such as HIV), toxic exposure from medication, and systemic diseases (most often diabetes) while muscle ache and joint pain may be related to an age-related rheumatic condition[54;69;173]. It is also possible that the changes in reports of symptom prevalence and distress are related to changes in 'social comparison'[201;202] with age. Older adults may consider some symptoms (e.g. sexual interest) to commonly decrease with age and others (e.g. fatigue) to commonly increase, and so find these less distressing than younger adults. Once again this does highlight the importance of age-specific care, as well as an understanding of age-related symptoms and concerns.

Finally, CD4 count remained high across age groups (section 2.4.4). This ties in with the literature which suggests the possibility of a good response to cART regardless of age[64;77-79;126;128;132]. It is possible that the comparable response observed in older adults to younger adults is due to higher levels of adherence in older PWH[161-163], counteracting any age-related immunological decline and contributing to the stable CD4 counts across age seen in the ASTRA population. CD4 count was, further, not found to be related to measures of physical, mental, or social well-being. As such it appears that immunological response is not a concern specific to the well-being of OPWH, nor an appropriate measure, when ART is administered in an appropriate and timely fashion.

9.1.2.2 Mental well-being

Depression and anxiety are commonly associated with chronic illness[58;63;219;221] and older age[56-58] up until the age of 55, where prevalence may decrease again (according to UK statistics)[218]. In the HIV-specific literature, depression has generally not been found to differ by age group[64;120;129;138;145-148], while anxiety has not been well researched. Somewhat in contrast to the previous literature, the results presented here (section 4.3) show that depression and anxiety symptoms decreased in prevalence with age –a finding apparent in both the ASTRA and Resilience studies. As depression and anxiety prevalence increased with time diagnosed with HIV, this suggests that previous results shown in the literature may be explained by the amalgamation of age and time with diagnosed HIV effects and that lack of adjustment for time with diagnosed HIV may obscure the declining trend with age. As such, future studies should adjust for time with HIV when assessing the effects of age.

There are several possible reasons why older PWH may report lower rates of depression and anxiety. For example, older adults have also been found to report fewer negative emotional experiences than younger adults[237-239] and may experience the 'positivity effect': the selective attention to - and recall of - positive events and situations[241-244]. Alternatively, it is possible that the results reflect better 'resilience' in older adults[200], developed throughout their lifespan[90;135;152]. Higher resilience has been consistently linked to positive mental[113;337] and physical health[338;341;342] in HIV negative populations. High resilience was similarly found to be related to a lower prevalence of depression and anxiety rates in the Resilience study, although it did not differ significantly with age. Furthermore, high levels of resilience were identified within the HIV positive population (section 7.4.1.1), suggesting that ‘positive’ mental health is possible in PWH and, in addition, are related to improved well-being. However, while resilience did increase in prevalence with age in PWH, this did not reach significance. While it is possible that this result was an artefact of the smaller sample size, the limitations of the methodology within this study mean that we cannot rule out alternative explanations for the differences in mental health seen with age in PWH. For example, depression (if not anxiety) were also mediated by the improved demographic variables in the older population (greater proportion with money for basic needs, lower alcohol dependency etc.), suggesting that age itself is not the only factor that needs to be taken into account when assessing depression in PWH. Regardless of the underlying cause, it appears the depression and anxiety - while high in PWH - are not of greater concern to OPWH than younger PWH, and do not need to be a specific focus of age-focused care.

With increasing age, however, the association between physical and mental well-being became stronger, such that older adults with anxiety were more likely to report a greater burden of physical symptoms. Anxiety has not been researched thoroughly in relation to OPWH, meaning that there is little evidence to compare the current results to. It has been found that anxiety is higher in adults who report poor overall health[249;255] and/or chronic illness[252-254] than those without, which corresponds with the higher prevalence found in adults with HIV when compared to the prevalence in the general UK population, as well as to the relationship found between the prevalence of anxiety and of symptom prevalence and distress. This suggests that age-related differences in health may be of concern to OPWH and affect both mental and physical well-being. However it is worth noting that in general the relationships between physical, psychological, and social well-being did not differ by age.

While physical symptom distress did not differ with increasing age (section 3.3.2), the stronger association between physical symptoms and anxiety, along with the changes in prevalence of physical symptoms with age, do highlight the need, within HIV care, for an understanding of the effect of age-related changes in health on well-being. This may require specialised geriatric knowledge from HIV practitioners, or a stronger relationship between the two fields in order to offer appropriate care.

9.1.2.3 Social well-being

Retirement was found to be related to higher levels of physical symptom prevalence, distress, ADL problems, depression, and anxiety in comparison to employment both in the overall sample and in PWH aged over 50 (section 5.3.5.4). In the gerontological literature it has been suggested that retirement causes positive effects on mental and physical health through lowered stress[61;316] and increased time for social and physical activity[300;301] unless it is forced due to ill health[300;303;304]. This implies that for PWH, retirement may well be forced by ill health or care-giver role needs, and in these situations it is possible that individuals may feel 'cheated' of the sense of achievement attained through work, and not receive all the benefits of well-being which have been related to retirement. It is also possible that ill health itself limits the positive effects of retirement within PWH, although this is not supported by the reported prevalences of physical symptoms by age group.

Rates of 'sufficient' social support appeared to be low in PWH overall (section 5.3.1), although it was not possible to make a comparison with HIV-negative people or the general population. Social support decreased (nonsignificantly) with age and time with diagnosed HIV, making it a factor worth considering when measuring well-being in older adults with HIV. Social support is generally considered to decline with age[64-66] due to reduced opportunities for social interaction caused by retirement[97], illness[64;97], loss of friends and family through bereavement[64;97;117;271], and/or reduced mobility[69;76]. As such it is possible that this effect is related to general ageing, rather than ageing with HIV. Relationship status and disclosure were both found to be related to social support; both factors (being in a relationship and having disclosed HIV-status) reduced in prevalence with age. This suggests that they may be linked to the lower levels of social support available to OPWH compared to younger people with HIV. Previous studies have found that OPWH reported low levels of disclosure of their HIV status to family and friends[93-96]. As older adults are reported to rely on their partners[269;270;277] and family for social support[295-298], this is a concern: in particular as sufficient social support was found to be related to lower levels of depression, anxiety and physical symptom distress.

Good social support has previously been found to be related to better physical and mental health in the general population[272-274] and older adults[70;72**18;20**74], strongly suggesting that social engagement is an important determinant of health and well-being. These results are reiterated here. Therefore, without acceptable levels of social support PWH may not receive the levels of psychological and physical support[269;270] required to respond appropriately to ill health and/or strict medication regimens. As such I would suggest that, despite only moderately lower levels of social support in older adults, this is still an important factor to address. In particular, there was some evidence that being in a supportive relationship was increasingly related to social support and disclosure with older age, suggesting that this is an important factor for improved social well-being in OPWH.

9.1.2.4 Variations within the age bands

One important finding that was revealed during the analysis undertaken in this thesis was that consistent differences in physical, mental, and social health were apparent between PWH aged 50-60 and those aged over 60. Specifically, adults over the age of 60 generally showed fewer concerns in relation to physical symptoms, depression, anxiety or levels of social support. This suggests that, with age, PWH may develop more adaptive coping methods and that the process of adaptation to illness may continue into later life. Similarly, adults aged under the age of 30 often reported greater biopsychosocial distress than older age groups. As such this underlines the need to view changes in well-being across the entire age spectrum, rather than combining all adults over the age of 50, and suggests that the 'over 50' cut-off for defining 'older adults with HIV' is likely to amalgamate important data and two (or more) subgroups with different care needs, or perception of need.

Much of the previous literature on older adults with HIV has assumed that biopsychosocial needs are greatest in older people with HIV[23;26;135;367;368]. This assumption may, in part, be due to the lack of research comparing well-being in younger and older adults with HIV, rather than in older adults alone. It may also be a result of the amalgamation of age- and time with diagnosed HIV- effects on well-being, as already discussed. However, the results of the ASTRA study do not show a linear reduction in well-being with age. In fact, in regards to many of the well-being factors assessed, PWH aged under 30 years of age show a higher burden of reported symptoms and symptom distress than the other age groups. As such, this age group may also need to have their specific care needs explored in future research.

9.1.3 'Ageing with HIV'-related differences in biopsychosocial health

Living with HIV for a long period of time may cause HIV-specific stressors in older adults. For example, those who were diagnosed before the availability of effective cART are likely to have experienced many of their friends and partners dying from AIDS or previous HIV-related illnesses and conditions, and experiencing severe medication side-effects, some of which may have resulted in ongoing ill-health, and have lived with the fear of a poor prognosis and death. These experiences may well be unique enough that older adults with HIV and adults 'ageing with HIV' should be treated as separate groups, with separate histories, experiences, and well-being needs[101;102]. However, very little information was found into the effects of 'ageing with HIV' in previous literature; with no previous research identified into the effects of ageing with HIV on mental or social health, or developing interventions specific to this sub-group.

One of the major findings of this thesis is that time diagnosed with HIV was revealed to have a much clearer and stronger relationship with well-being than age. Symptom prevalence, distress, ADL problems, depression, anxiety, social support, and unemployment all increased in prevalence with increasing time diagnosed with HIV. As such, adults with long-term diagnosed HIV appear to be in need of aid in improving their biopsychosocial well-being. As identified through symptom prevalence and distress, they have different care needs to more recently diagnosed adults and may require specific intervention content. Currently, adults with long-term HIV who maintain a high CD4 count are seen by HIV clinicians only once a year and are not routinely measured for well-being beyond their CD4 count. As CD4 count has been shown here not to relate to measures of physical, mental, or social well-being, this suggests that the needs of adults ageing with HIV is not being assessed or habitually met.

Symptom distress likely increases with time diagnosed with HIV due to the increase in symptom prevalence, which leaves participants with higher levels of distress regarding the progression of their HIV status. Adults who have lived with HIV for a long time may also have lived through HIV as a terminal illness and seen friends and peers becoming ill, before progressing to AIDS and eventual death. As such 'social comparisons' could be causing them greater levels of distress. For example, in previous research OPWH expressed fear related to the 'unknown' future of their health and HIV status and being hyper-aware of changes in their bodies[106], which is likely to increase reports of symptom prevalence and distress, and could result in higher levels of health-related anxiety. Such concerns may be particularly prevalent among those diagnosed in the pre-cART era and may results in the increased distress observed in PWH diagnosed for twenty years or longer. The increase in symptom prevalence with time diagnosed with HIV may also relate to the lower reported satisfaction with social support - despite increased rates of disclosure. Namely, with increased physical distress and more problems with ADLs it is likely that this population requires a higher levels of formal - and informal - support which, based on the results of the ASTRA study, do not appear to be forthcoming. Furthermore, as the necessity of support becomes more common, PWH may feel more dissatisfied with whatever support is available in terms of 1) meeting their higher level of needs and 2) feeling shame, or to be a 'burden'[310] to their loved ones: thus reducing overall satisfaction. However, there is little previous literature to support this assumption.

With longer time diagnosed with HIV, depression and anxiety prevalence also increased in both the ASTRA (section 4.3) and Resilience studies (section 7.4.2.1). The few studies identified in the literature which explored time with diagnosed HIV reported that depression is higher in newly diagnosed PWH[88;89;258] and improves as participants develop more effective coping strategies and come to terms with their diagnosis. However, the results presented in this thesis show the opposite, which suggests that PWH may not be developing effective coping strategies, or are experiencing too many changes in health-related stress over time to design effectively adaptive strategies[217]. This would be especially true in the face of reduced social support. As longer time with diagnosed HIV was related to a decrease in the prevalence of resilience which, in turn, was related to higher prevalence of depression, anxiety, and problems with ADLs, it seems likely that the continued accumulation of stressors related ageing with HIV are preventing PWH from developing adaptive coping mechanisms[351] and therefore that protective factors - such as resilience - are not apparent in this population. However, whether the reduction in resilience reported with increasing time diagnosed with HIV is a cause (and therefore a potential target of interventions), or effect, of the reduced biopsychosocial health is unclear and longitudinal data is required.

Adults 'ageing with HIV' appear to be a very separate group to older adults with HIV in general in regards to their biopsychosocial health and report separate - and more concerning - care needs. Combining these two sub-groups is likely to cause misleading inferences regarding the effect of age, and this should be taken into account when reviewing previous literature, and developing further studies of well-being in OPWH or adults ageing with HIV. Indeed, I have suggested that the findings from previous studies which showed no significant change in depression prevalence with age may well be the result of an amalgamation of these two groups. However, more data is needed to corroborate the findings of these two studies before this can be strongly defended. Similarly, due to the absence of available literature on ageing with HIV I can only surmise on the meanings behind these results based on overall OPWH literature. As such, the information provided here, while a broad image of the biopsychosocial impact of ageing with HIV, is scarce in regards to the factors driving these changes.

9.2 Service implications

From the results of the studies presented here it is apparent that physical health distress was prevalent across all age groups, problems with ADLs increased with increasing age while social support, the presence of close relationships, and disclosure of HIV status all decreased with increasing age, making these the most important measures of well-being to address in OPWH. Furthermore, there were age-related differences in the symptoms present and/or levels of distress, which suggests that age-specific physical care may be necessary. Adults ageing with HIV, on the other hand, report universally reduced well-being and would likely benefit from interventions aimed at improving physical, mental, or social well-being. Moreover, it appears that resilience can be utilised to improve overall well-being and may also be an important factor to consider when seeking to improve well-being in OPWH and adults ageing with HIV.

In the absence of interventions identified specifically for OPWH or those ageing with HIV, methods which have been shown to be effective in the gerontological literature are considered and presented below. It is worth noting, though, that community support is currently available to PWH through charities such as the Terrence Higgins Trust (THT) and 'Positively UK' and well-being may be improved in adults ageing with HIV simply through encouraging clinics to signpost these community services to older patients. For example, 'Positively UK' is currently developing 'project 100', which aims to develop social support networks in PWH. However, as OPWH report feeling unwelcome at support groups with younger members - which also often do not address age-specific concerns[76;258;312;368] - age-specific intervention groups are most likely to be effective when improving social support in OPWH.

9.2.1 **Physical symptom distress and problems with ADLs**

In relation to physical symptom distress, one previous small piece of qualitative work identified that OPWH (N=18) are concerned about their – and their doctor's – ability to differentiate between ageing and HIV progression and would prefer more regular health screenings for comorbid conditions (such as cancer)[369]. While more frequent screenings may be useful, they may also fuel fear and increase hyper-awareness of bodily change in PWH. Age-specific changes, on the other hand, could easily be discussed in a group intervention, allowing participants to identify common health issues, and could be visited by a physician in one or more sessions to provide more in-depth information on common HIV- and ART-related symptoms. This could alleviate low-level anxiety about health and reassure older adults that their physicians understand (and have been actively made aware of) the symptoms of most concern to the group.

In regards to physical activity, the THT currently advocates the use of exercise to improve physical and mental well-being, but suggests no age-appropriate programmes. Two types of physical exercise, however, have been found to be beneficial to older adults with HIV: 1) progressive resistance exercise, which can safely increase muscular strength, physical fitness, and body composition in sedentary older adults[364;366], and 2) aerobic exercise, which involves brisk walking, running, swimming, or bicycling and is related to improved cardiovascular and pulmonary health in older adults[366]. Boundaries to physical exercise could also need to be assessed and set to reduce the participant's concerns of 'over-exerting' themselves[69;71;76] and adaptable schedules could be set. Such interventions could reduce frailty in adults ageing with HIV, as well as fatigue, and reduce the prevalence of ADL problems. However, such interventions are most effective when undertaken over several days a week for six weeks, and require trained session leaders[364;366] and so may be more difficult to implement successfully.

9.2.2 **Social support**

It has repeatedly been observed that OPWH have unmet social needs[100;368-370]. By introducing OPWH to other adults ageing with HIV in a group intervention setting, social support may be improved regardless of the intervention content. Meeting other ageing adults in a safe and HIV stigma-free setting can reduce feelings of isolation[260] and allow them to share positive experiences[330] and coping strategies[371]. It could also be an opportunity to set up support links between adults ageing with HIV: thus alleviating the clinic care burden.

Participants could also be encouraged to continue interactions outside the group, exploring hobbies together in order to feel more comfortable, which in turn could be beneficial to physical health. Once an intervention group has been established and piloted successfully, participants could also be invited to volunteer and speakers or mentors for future groups, which could increase their feelings of meaning in life, and give them a means of 'employment' even when they are unable to stay in full-time work[372]. This would also increase their social circle and support network beyond members of the initial group.

9.2.3 **Resilience**

While it is contentious whether resilience can be learnt[350], interventions have been developed with the aim of improving resilience[330;354;355], as mentioned in the Chapter 7 (section 7.4.6).These interventions encourage participants to take responsibility for themselves, empower themselves through education and self-management and create meaningful connections with others[354;355]. Furthermore, these interventions have successfully reduced depressive symptoms, negative affect, and stress, and improved self-esteem and the use of effective coping strategies in comparison to a wait-list control group[354], and can be conducted by specialists or nonspecialists[330], meaning that they are available for use in most health-care settings. However, resilience interventions in adults are not well researched - resilience has no operational definition as of yet and so our understanding of how to develop effective resilience interventions is limited - and so the potential efficacy of such treatment on PWH is, as of yet, still unknown.

9.3 Limitations

The data presented here is amongst the first in the UK to explore age-related differences in well-being in the HIV positive population, to assess the effects of 'ageing with HIV' on mental and social health and to identify resilience as a potential protective factor against declining biopsychosocial health. This thesis also includes information on two other under-researched factors of well-being: anxiety and symptom distress. As such, the results presented here add considerably to the literature in this area. However, it is inescapable that data is presented within methodological limitations. While these have been discussed in the relevant chapters, general limitations of this work are acknowledged below.

9.3.1 **Scope of research**

The work presented here displays a wide-ranging, epidemiological overview of the well-being of PWH in relation to several measures of physical, mental, and social health. While these findings will be useful for directing future research and development of interventions to improve well being in PWH, the quantitative nature of the questionnaire studies, including large sample sizes and the number of biopsychosocial factors was made possible by sacrificing an in-depth exploration of any one measure. In other words, the methodology chosen in this thesis was based on scope rather than detailed analysis. The reasons behind the differences in well-being identified with age and time diagnosed with HIV was not explicitly studied in qualitative studies, and interpretation of the results was reliant upon the limited literature available. As such, although the interpretation of these results is based on the best available evidence, the results themselves can be used as a template only for identifying *what* care needs differ over age and time with diagnosed HIV, not *why* they change.

Related to this limitation is the study design chosen. All data collected here were cross-sectional and quantitative in design. Cross-sectional data is useful for estimating the prevalence of outcomes of interest and allows for many factors to be explored at once in a relatively short amount of time. However, as the data is collected at one point in time it is impossible to disentangle the direction, or temporality, of associations, and therefore to make causal inferences regarding the relationships between variables from this data: especially as physical, mental and social health are so strongly interlinked. The cross-sectional nature of this data also prevents the identification of whether 'time with diagnosed HIV'-related differences in well-being are related to calendar year of diagnosis (and the associated variations in prognosis and medicine) or the accumulation of HIV-related problems over time. However, it can be suggested that the linear relationship between time with diagnosed HIV and physical, mental, and social factors supports the latter conclusion.

Due to the large number of tests conducted throughout this thesis, it is possible that type I errors may be apparent and the significance of p-values should be interpreted with caution. Therefore the data presented here can only provide a 'snapshot' of the well-being of PWH and the causation, and interpretation of these results are purely speculative, post-hoc, and based on the limited available literature. This is especially true in relation to the effects of resilience on physical and mental health and longitudinal analysis of these variables would be greatly beneficial. The issue could have been resolved with the inclusion of Bonferroni correction tests. However, due to the large number of tests conducted the correction would have been so large as to mask significant difference in the results. This was considered to be a larger issue for identifying care needs than the possibility of type I errors and so no such tests were performed.

Finally, as in any exploration of well-being, and any intervention development, it is important to include the participants themselves into the analysis of their needs. As such, qualitative input from PWH would greatly contribute to the discussion of potential interventions suggested by these findings. Such focused research can now be conducted within the detailed bands of information provided here.

9.3.2 **Generalisability**

Sampling for both studies occurred predominantly within London (73.8% of ASTRA participants) and within one specific hospital in the case of the resilience study. The UK HIV positive population is predominantly located within London[19], so it is likely that these results are applicable to the general HIV positive population within the UK. However, it is also possible that outside of London well-being needs may differ. Similarly, London itself is a large and demographically broad location. While the clinics involved in the ASTRA study were chosen to allow recruitment of patients across a range of important sociodemographic variables and to increase generalisability of results, the population was not compared across geographic location it is possible that situations (e.g. money for basic needs, social support) may differ by area, and individual clinics may identify variation in the needs of their patients. Therefore it may be beneficial, in the development of targeted interventions, for this information to be explored.

All participants were identified and approached during their visit to an HIV clinic. As previously mentioned, PWH with severe mobility problems, physical or mental illness may be less able to attend the clinic (although some clinics did offer free hospital transport) and so may have been less likely to have been included in the study samples. As such, it is possible that the prevalence of physical and mental illness reported here are under-represented. This may be especially possible based on the decision to code missing data as 'symptom not present'. While I do not think that this would have unduly affected the trends in well-being seen with age or time diagnosed with HIV, it may affect the data on the well-being of the overall HIV positive population. As such the data provided here should be taken as almost a minimal estimate of the issues affecting PWH. However, it can be argued that this is more useful than an over-representation of physical or mental distress.

9.3.3 **Replication of findings**

I have identified (and addressed) several gaps in the current literature in relation to symptom distress, anxiety and positive psychology (e.g. resilience, 'successful' ageing) as well as the effects of ‘ageing with HIV’. However, the lack of prior research limited my ability to infer the meaning behind the changes identified with age and time, especially as my own data was not longitudinal or qualitative in method. This was especially problematic in relation to the results exploring 'ageing with HIV', for which almost no research was identified. Many conclusions were, by necessity, drawn from the general ageing literature. As such the related results should not be taken as conclusive evidence until replicated in other research studies.

Similarly, few interventions were found in relation to well-being in OPWH, and all were implemented by the same study group. As such I could only infer that group settings appear to be beneficial for OPWH and I was required to develop more specific methodology from the general gerontological literature, which is untested with this specific population. Repeat studies by other researchers, in other geographical locations would greatly improve the applicability of this research, as would explorations into the interventions suggested here and their acceptability to the OPWH population.

9.4 Conclusions and implications

This thesis has presented work from two studies into the biopsychosocial well-being of adults ageing with HIV, and two reviews of the literature. I have presented the prevalence of physical, mental, and social problems in PWH in a UK sample. I have also presented age-related differences in well-being, and the relationships between these physical, social, and mental health in order to create a comprehensive overview of the well-being of OPWH. In doing so, I have identified that PWH report higher prevalence of mental and physical health distress than the general UK population and that, with age, social health and physical ability declines, physical symptoms alter in prevalence, but mental health improves. However, with time diagnosed with HIV, all the explored factors of biopsychosocial health worsen. While this has not previously been explored, this suggests that 'ageing with HIV' is a stronger predictor of well-being than biological age in PWH.

A secondary finding of the research reported here is that CD4 count is, in the era of effective cART (and within a highly adherent population), not related to overall well-being. Indeed, few relationships were found between this indicator of health and any other variables explored - likely due to the high levels of clinical care available and engagement of the patients with that care. As such assessment of, and provision for, care needs in PWH must reach beyond viral suppression in order to optimise health and wellbeing in adults with HIV.

The information provided also raises implications for the methodology used within prior and future research into OPWH. First and foremost, strong differences in well-being were observed between PWH aged 50-60 and 60 and over years. In almost every capacity, adults over the age of 60 reported greater well-being in comparison to younger adults. This suggests that adults over the age of 60 (or their generation-specific demographic) have a very different response to ageing with HIV than younger PWH and should be assessed as separate and distinct groups. In particular studies comparing PWH over and under the age of 50 (the classically accepted cut-off for OPWH) are likely to overlook important age-related data and may find their results confounded. In the systematic review alone (section 1.3), 26 studies (68%) of studies used '50 years of age and over' as their older adults group and only five reviewed adults aged over 50 and over 60 years of age separately. This severely limits the ability of the current literature to explore age-related changes in well-being in OPWH as identified here.

Similarly, time diagnosed with HIV was identified as a far greater predictor of distress in relation to physical, mental, and social well-being than age. While age was related to some physical and social declines in well-being, increased time diagnosed with HIV was consistently related to worse well-being across all the variables explored. This suggests that adults 'ageing with HIV' are in need of continued monitoring and care. This needs to be addressed by researchers and clinicians and long-term care must be made available. It also suggests that time diagnosed with HIV is likely to have been a confounding factor in previous reports into ageing with HIV, as few were identified which took time with HIV into account. Future researchers wishing to explore the effects of age on well-being in this population are strongly encouraged to include time with diagnosed HIV as a variable.

This thesis also highlights the dearth of research into the possibility of positive well-being and/or 'successful ageing' in PWH and shows that PWH are not only capable of achieving high states of resilience, but that this is likely related to their physical and mental health. While interventions for OPWH are currently lacking, their results conclusively support the possibility of improved well-being in OPWH through social group support, which could encompass the issues commonly identified by OPWH reported here. Therefore, taking evidence from the results presented here, and gerontological literature, I have suggested intervention content which is likely to improve well-being in adults ageing with HIV by addressing the variables most identified as concerning in the presented populations.

10 Appendices

A. *Table 2.* **Papers included in the first systematic review, ranked by lead Author.**

Study	Date (study) and location	Sample	Outcomes of interest	Measures of included	Results
Althoff et al.[55]	2014 (2007-11) America (several)	1946 MSM, HIV+ve (n=898) vs. HIV-ve (n=1,047) sorted into five-year age groups from <40 to >65.	Frailty phenotype.	Fried et al.'s measure for frailty phenotype, hospital visits.	PWH were more likely to show frailty than those without HIV (p=0.002). Hospital visits increased with age in both groups (p<.05) and were more frequent in PWH aged 50-64 than those without HIV.
Andrade et al.[132]	2012 (UNK) Brazil (Rio de Janeiro)	30 adults with HIV aged <40 or >55 (ns=15).	The frequencies of naive and central memory T cells, CD4 count.	Blood samples.	Naive and central memory T cells were less frequent in older PWH than younger PWH (ps<.05). No difference was found in CD4 count between older and younger PWH.
Bakanda et al.[124]	2011 (2004-10) Africa (Uganda)	22,087 PWH aged 18-49 (n=19,657) and ≥50 (n=2430).	Mortality rates.	Medical records.	Mortality rates increased with age (p<.001).
Balestre et al.[125]	2012 (2006) West Africa	24,107 PWH grouped by age as <25 (n=1486), 25-29 (n=3885), 30-34 (n=5192), 35-39 (n=4939), 40-45 (n=3716), 45-50 (n=2459), 50-54 (n=1370) and ≥55 (n=1060). 36.4% male.	CD4 count gain after 12 months of ART.	Medical records.	With increasing age, CD4 count change decreased (p<.0001).
Bianco et al.[144]	2011 (2008-9) America (several)	242 PWH over 50, 162 male and 80 female, 138 African American.	Depression, social relations, ways of coping.	Geriatric Depression Scale, Provision of Social Relations Scale, Way of Coping checklist.	No difference by gender in depression (p=0.463) or social support (p=1.98). Women used avoidance coping more (p=0.014).
Blanco et al.[107]	2012(2004-9) Spain	2726 PWH starting HAART sorted into ten-year age groups from <30 to ≥60 (356≥50).	Mortality, immunological response and virological response.	Death rates at study end, CD4 increase of more than 100 cell/ml), HIV RNA less than 50 copies/ml.	PWH aged 50-59 were three times more likely to have died than those aged <30 (p<.05). No other age differences were found in mortality rate. The proportion of PWH experiences an immunological response decreased with age (p<.05). No difference was found in virological response.

Brennan, D. J., Emlet, C. A., Brennenstuhl, S., Rueda, S.[135]	2013(UNK) Canada (Ontario)	1129 PWH, 136(12.3%) >65 years old. 117 women, 726 MSM, 76 Bisexual men and 88 African American.	HrQoL, social support, coping, mastery and Depression.	The Medical Outcomes Study (MOS) SF-36 Health Survey, The MOS-HIV Social Support Survey, The Brief COPE, Pearlin's Mastery Scale and The Center for Epidemiologic Studies Depression Scale (CES-D).	HrQoL ($p = .003$) and mastery (p=0.26) was highest in MSM. Women reported the highest mean scores for depression ($p < .001$). Maladaptive coping was seen most often in heterosexual men, followed by women (p<.001) and mastery in MSM (p=0.006).
Brennan, M., Seidel, L., Karpiak, S. E.[139]	2011(UNK) America (New York)	914 PWH ≥ 50. 29% women, 9% bisexual, 24% homosexual.	Wellbeing.	Ryff's Scales of Psychological Well-Being.	A significant main effect of sexual identity (p< .024) with bisexuals reporting lower wellbeing than hetero and homosexuals.
Doyle et al.[120]	2012(UNK) America (San Diego)	113 PWH over 50 (n=72, 63.72%) and under 40 (n=41). 17.7% women, 61% Cauasian.	Depression, anxiety and mood.	Profile of Mood States.	No difference by age in depression (p=0.653), anxiety (p=0.322) or mood (p=0.363).
Duarte et al.[121]	2010(UNK) America (San Diego)	115 adults, HIV+ve <40 (n=20) and >50 (n= 28) and HIV-ve <40 (n=34) and >50 (n=33).	QoL.	Rand 36-item Short Form Health Survey.	Older PWH had worse General, Physical, and Mental Health quality of life scores than all other groups (p< .01).
Emlet et al.[134]	2015 (2007-10) Canada (Toronto)	960 PWH stratified into age groups of <40 (n=198), 40-45 (n=212), 46-49 (n=176), 50-55 (n=191) and >55 (n=183). 81.9% male, 61.5% MSM, 61.4% white.	Stigma (enacted, anticipated or internalised), depression, coping and social support.	HIV Stigma Scale, CES-D, the Brief COPE and the MOSHIV Social Support Survey.	Overall and internalised stigma scores decreased with age (p<.05). No difference was found in enacted or anticipated stigma in adjusted analysis. Depression scores increased with age (p<.001). Maladaptive coping was higher in younger PWH (p<.05) and social support higher (p<.05).
Emlet, C. A.[151]	2005 (2002-3) America (Pacific Northwest)	88 PWH aged 20-39 and >50 (n=44). 66% Caucasian.	Stigma.	HIV-stigma questionnaire.	No significant difference in stigma scores by age (p>.05).
Fatti et al.[77]	2014 (2004-10) South Africa	90,071 PWH aged <55 (n=86,006) or ≥55 (n=4065) at ART initiation	Viral rebound rates and CD4 count.	Medical records.	There was no significant difference in viral rebound or CD4 counts.
Frain et al.[147]	2014 (2012) America (Midwestern)	130 PWH on ART for at least 16 weeks aged 18-49 and >50 (n=65). 73% male.	Depression and self-efficacy.	The Center for Epidemiological Studies Depression Scale (CES-D), and The Self-Efficacy-Chronic Disease Scale (SE-CDS).	No significant difference in depression (p=0.8) or self-efficacy (p=0.9).

Frontini et al.[143]	2011 (2008-9) America	132 PWH ≥59 years of age. 26 women and 106 men. 62.6% African American	Hypertension, Dyslipidemia, liver disease, diabetes mellitus, cardiovascular disease, chronic obstructive pulmonary disease, insomnia and depression.	Medical records.	Women were more likely to have depression (p=0.012). Non-African participants were more likely to have depression (p=0.001) but less likely to have liver disease (p<.05) or diabetes mellitus (p<.01). No other differences were found.
Greig et al.[126]	2012 (2003-10) Africa (several)	17,561 PWH aged 15-49 (n=15,584) or 50-95 (n=1977). 35% male.	CD4 count, CD4 count gain and crude mortality rate	Medical records.	No difference by age in CD4 count. Older adults had a higher crude mortality rate (p=0.016) and a higher median gain in CD4 cell count at 6 and 12 months p<0.001).
Guaraldi et al.[130]	2011 (2002-9) Italy (Emilia-Romagna)	11,416 participants aged >18 with (n=2854) and without (n=8562) HIV stratified into ages ≤40 (ns=5 & 4), 41-50 (ns=39 & 33), 51-60 (ns=27 & 36) and >60 (ns=22 & 24). 4244 women.	Age-related comorbidities: cardiovascular disease, hypertension, diabetes mellitus, bone fractures, and renal failure.	Medical records.	PWH were more likely to show renal failure, bone fracture and diabetes mellitus than controls (ps<.001). No difference was found in cardiovascular disease or hypertension. Overall rates of comorbidities increased with age in both groups (p<.001).
Huggan et al.[136]	2012 (2005-11) Singapore	121 PWH aged <50 (n=106) or 50> (n=38). 106 male.	Mortality rates.	VACS Index.	Older PWH had a higher mean 5 year mortality rates than younger PWH (p<.001).
Jones et al.[142]	2008 (2003-6) America (New York)	104 adults aged >55 with (n=57) and without (n=47) HIV.	Bone mineral density.	Dual x-ray absorptiometry (DEXA) of total hip and lumbar spine.	Significantly decreased bone mineral density at hip (p<.001) and lumbar spine (p=0.008) for PWH.
Marzolini et al.[128]	2011(2008-9) Switzerland	1497 PWH aged <50 (n=1020) or ≥50 (n=477).	HCV co-infection, co-medication, drug-drug interactions, response to ART.	Self-report , medical records, the University of Liverpool drug interaction database and CD4 count.	Older PWH were less likely to have HCV co-infection (p<.001) but more likely to co-medicate (p<.001) and to show drug-drug interactions (p<.001) than younger PWH. Older PWH were more likely to co-medicate with cardiovascular (p<.001), gastrointestinal (p=0.004) and hormonal drugs (p=0.04) than younger PWH. No difference was found in response to ART.
Maskew et al.[127]	2011 (2004-8) South Africa (Johannesburg)	9,139 PWH aged 18-29 (n=1738), 30-39 (n=4302), 40-49 (n=2268) or ≥50 (n=831). 38.2% male.	CD4 count improvement and mortality rate.	CD4 count improvement 6-12 months after ART initiation and mortality rates in first 12 months of treatment as assessed by medical records.	Mortality rates increased with age (p<.05) and CD4 count improvements decreased (p<.05).

Mavandadi et al.[148]	2009 (2004-5) America (Philadelphia)	109 PWH aged <54 (n=74) or >55 (n=35). 55% male, 63.9% African American, 51.4% MSM.	Social support, depression and positive affect.	An abbreviated version of the Duke Social Support Index, Participant Health Questionnaire (PHQ-9), 37-item Profile of Mood States (POMS).	No differences by age in depression (p=0.83), social interaction (p=0.74)or instrumental support (p=0.8). Vigour was higher in older adults (p=0.02) as was subjective support (p=0.04).
Moore et. at.[79]	2014 (UNK) America (San Diego)	302 adults aged ≤40 or ≥50, HIV positive (ns=48 & 77) and HIV negative (ns=70 & 107).	Affective disorder, Hepatitis C, AIDS, CD4 count, plasma load and HrQoL.	The Composite International Diagnostic Interview was administered (CIDI, v2.1), medical history, assessment of medications, current symptoms, CDC staging, and blood draw and MOS-SF-36.	Affective disorder was most frequent in young PWH, followed by older PWH, older controls and younger controls(p<.001). Older adults and those with HIV were more likely to have hepatitis C (p<.001). Older PWH were most likely to have progressed to AIDS (p<.001) but no difference was found in CD4 count or plasma load. HrQoL was lower in PWH and in older than younger adults except for 'emotional well-being' which did not differ.
Moore et al.[140]	2013 (UNK) America (San Diego)	116 adults (83 with HIV, 83 without) aged 48-84 (mean = 59, 85.5% male, 79.5% Caucasian) for HIV-positive and 51-83(mean = 60, 85.5% male, 89.2% Caucasian) for HIV-negative participants.	Successful aging, emotional functioning, anxiety, resilience, optimism, social interactions, personal mastery and feelings towards aging.	Self-rated successful aging (**SRSA**) >5, the Medical Outcome Study 36 Item Short-Form (**MOS-SF-16**) – mental components, the Life events (**LES**), Brief Symptom Inventory – Anxiety Scale (**BSI-A**), the Connor Davidson Resilience Scale (**CD-RISC-10**), Lifetime Orientation Test-Revised (**LOT-R**), Perceived stress scale (**PSS**), Duke Social Support Index Social Interaction sub-scale (**DSSI**), the 7-item Personal Mastery Scale (**PMS**) and the five-item Philadelphia Geriatric Morale Scale Attitudes subtest (**PGMS**).	Lower in HIV+ve adults: **SRSA:** p=0.005, **MOS-SF-36-PC:** p=0.003, **MOS-SF-36-MC:** p=0.001, **CD-RISC-10:** p=0.007, **PGMS:** p=0.009 Higher in HIV+ve adults: **LES:** p=0.007, **BSI-A:** p=0.001, **PSS:** p=0.006 No difference: **LOT-R:** p=0.38, **DSSI:** p=0.51, **PMS:** p=0.06.

Morgan et al.[122]	2012(UNK) America (San Diego)	179 adults with (n=103) and without (n=87) HIV <40 (n= 31 and 43 respectively) and >50 (n=61 and 44).	Mental wellbeing and mood.	RAND 36-item Short Form Health Survey (SF-36) and Profile of Mood States (POMS).	An age by HIV interaction in the emotional functioning subscale (p=0.026). Independent effects of age and HIV for the general health perceptions (ps<0.01) subscales. A main effect of HIV was found in the role limitations due to physical health problems subscale (p=0.005). No significant effects for the emotional well-being, role limitations caused by emotional problems, and social functioning subscales (ps > 0.05).
Nokes et al.[146]	2011 (2003) America (California)	1217 PWH from around America, 964 aged 20-49 and 232 aged >50. 66% male, 37% African American.	Depression , body change distress and HrQoL.	The Center of Epidemiological Studies Depression Scale (CES-D) scale, Body Change Distress Scale and HAT-Quality of Life (HAT-QOL).	No age differences in depression (p=0.2), body change distress (p=0.2) or HrQoL (p=0.92).
Onen et al.[141]	2010 (2006-7) America	122 PWH ≥50 years of age compared to demographically matched National Health and Nutrition Examination Survey (NHANES) statistics. 82% male, 57% Caucasian.	Hypertension, hypertriglyceridemia, low bone mineral density (BMD), lipodystrophy, antihypertensive and lipid-lowering medication use, coronary heart disease, diabetes mellitus, chronic viral hepatitis, non-AIDS defining malignancies and cardiovascular risk.	Medical and national records.	PWH had a higher prevalence of hypertension, hypertriglyceridemia, low BMD, and lipodystrophy, antihypertensive and lipid-lowering medications (ps < .05). No difference was found in prevalence of coronary heart disease, diabetes mellitus, chronic viral hepatitis, non-AIDS-defining malignancies or cardiovascular risk.
Orchi et al.[129]	2008 (2004-7) Italy (Latium Region)	440 PWH aged 18-49 (n=382) and >50 (n=58). 77.2% male, 72% Italy-born.	Depression.	Center for Epidemiological Studies Depression Scale (CES-D).	No difference was found in depression.
Orlando et al.[131]	2010 (2007-9) Italy (Milan)	1217 PWH aged <50 (n=903) and >50 (n=314).	Viral load, switch or discontinuation of cART, cardiovascular risk, chronic liver disease, mortality rates.	Medical records, cART discontinuation for >1month, median Framingham cardiovascular risk score and survival to end of study.	Older PWH were more likely to have a viral load <50 copies per millilitre and have a higher cardiovascular risk score (p<.0001) but less likely to have a chronic liver diseases (p<.0001) than younger PWH. No differences were found in survival rates or switch/discontinuation of treatment.
Parikh et al.[78]	2013 (2003-4) Africa (Uganda & Zimbabwe)	3316 PWH aged 18-49 (n=3097) or ≥50 (n=219). 35% male.	CD4 count, viral load, blood pressure, hepatitis B, hepatitis C.	Clinical records.	Viral load was higher in older PWH (p=0.003) as was blood pressure (p<.001). Hepatitis B rates were lower (p=0.05). No difference was found in CD4 count or hepatitis C.

Rodriguez-Penney et al.[123]	2013(UNK) America (San Diego)	262 adults aged <40 or >50 with (n=50 & 91 respectively) and without (n= 56 & 65) HIV.	HrQoL.	RAND 36-item Short Form Health Survey (SF-36).	No difference by age for Physical (p=0.724) or mental (p=0.464) HrQoL. No difference appeared by HIV status (p>.05).
Sharma et al.[109]	2010 (2002-3) America (New York)	230 male PWH vs. 159 uninfected men aged >49.58% African American.	Bone mineral density and incidence of osteopenia.	Dual x-ray absorptiometry (DEXA) of femoral neck, total hip and lumbar spine.	PWH had lower bone mineral density of the femoral neck (p=0.02), total hip (p<.01) and lumbar spine (p=0.03) than controls. PWH were more likely than those without to show osteopenia.
Sherr et al.[137]	2009(UNK) UK (London)	778 PWH aged under (n=685) and over 50 (n=93). 65.7% MSM, 24.7% African descent.	HrQoL.	Euroqol-5D.	No significant difference (p=0.5).
Shimizu et al.[145]	2011 (2001-5) America (Hawaii)	285 PWH aged 20-39 (n=128) and >50 (n=157). 82.8% male, 57% Caucasian	Depression.	Beck Depression Inventory(BDI).	No difference by age (9.1 vs. 8.6 (p = 0.42)).
Torres et al.[133]	2013 (2008) Brazil (Rio de Janeiro)	2307 PWH aged 18-39 (n=1023), 40-49 (n=823), 50-59 (n=352) or ≥60 (n=109). 63.6% male, 57.2% white.	Viral suppression, $CD4^{+}$ T lymphocyte count, co-morbidities (diabetes mellitus, dyslipidemia, hypertension, cardiovascular diseases, erectile dysfunction, HCV, renal dysfunction, non-AIDS-related cancers), depression, AIDS-defining illnesses.	Viral load less than 400 HIV RNA copies/µL at all available viral load assessment, medical records, co-morbidity specific drug intervention records.	Viral suppression was higher in PWH over 40 (p<.001). No difference was found in CD4 count with age, but it was lower in PWH aged ≥50 (p=0.02). The overall number of comorbidities increased with age, as did the likelihood of each individually (ps<.001) except HBV and AIDS-related cancers where no difference was found.
Uphold, C. R., Rane, D., Reid, K., Tomar, S. L.[138]	2005 (2001-2) America (Florida)	226 men with HIV aged 20-39, 40-49 and 50-70 from rural (n= 17, 38 & 24) or urban (n=34, 69 & 44) backgrounds. 55% Caucasian.	Depression.	Access to Care, from the Participant Satisfaction Questionnaire and the Center for Epidemiological Studies Depression (CES-D) Scale.	No difference by age in depression for rural (p=0.52) or urban (p=0.56) men.

Vance et al.[64]	2011 (2006-7) America (Alabama)	1478 PWH aged 18-29 (n=138), 30-39 (n=343), 40-49 (n=623), 50-59 (n=301) and ≥60 (n=73). 75% male, 47.2% African American.	Viral load, CD4 count, number of prescribed medications, number of co-morbidities, mortality, depression, anxiety, Insomnia, Coronary artery disease, Hypertension, Hypercholesterolemia, Hypogonadism, Erectile dysfunction, Diabetes, Peripheral neuropathy, Hepatitis C, Reflux disease, Obesity, Renal disease, Condyloma, Kaposi sarcoma, pneumonia and Shingles/Herpes Zoster.	Medical records.	Viral load ($p=0.018$)and prevalence of Condyloma ($p<.001$) lowered with age. Number of prescribed medications, co-morbidities, and prevalence of insomnia ($p=0.02$), coronary artery disease, hypertension, hypercholesterolemia, hypogonadism, Erectile dysfunction, Diabetes, Peripheral neuropathy, Hepatitis C, Reflux disease, Renal disease, Shingles/Herpes Zoster ($p=0.002$) and mortality increased with age ($ps<.001$). No difference was found in CD4 count, depression, anxiety, pneumonia, kaposi sarcoma or obesity. Compared to the 50- 59 group, the ≥60 group had higher rates of coronary artery disease ($p< .001$), hypertension ($p=0.006$), hypercholesterolemia ($p=0.001$), diabetes ($p= .001$), and renal disease ($p=0.001$).
Webel et al.[150]	2013 (2011-12) America (Ohio)	101 PWH under (49) and over (52) 50. 83% African American, 52% male.	Social Isolation and HIV stigma.	Hawthorne Friendship Scale and the HIV Stigma Scale.	No difference by age in isolation ($p=0.33$) or stigma ($p=0.14$).

A. Resilience study consent form and information sheet

Study Number: RFH 8804. UCL 13/6039

Participant Identification Number for this trial: ___________________________

CONSENT FORM

Title of Project: **Health Perceptions, smoking and health status.**

Name of Researcher: Dr Marc Lipman, Dr James Brown, Ms Jennifer McGowan

Please initial box

1. I confirm that I have read the information sheet dated............ (version.........) for the above study. I have had the opportunity to consider the information, ask questions and been answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected. ☐

3. I consent to investigators accessing clinical information from my hospital records including the results of any HIV tests that have been performed. I understand that no blood tests will be performed specifically for this research study. ☐

4. I understand that relevant sections of my medical notes and data collected during the study may be looked at by individuals from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records. ☐

5. I understand that the information collected about me will be used to support other research in the future, and may be shared anonymously with other researchers. ☐

6. I agree to my General Practitioner being informed of my participation in the study. ☐

7. I agree to take part in the above study. ☐

______________________	______________________	______________________
Name of Participant	Date	Signature
______________________	______________________	______________________

We are inviting you to take part in a research study. This information is to help you understand why we are doing the research and what it involves. We can answer any questions that you have so that you can decide if you want to join the study.

Title of study: **Health Perceptions, resilience and smoking.**

What is the purpose of the study?

We are aiming to improve our understanding of how many people smoke, what their beliefs about smoking are and other factors that could affect their health. We also want to obtain information about how frequently respiratory symptoms occur and how common abnormalities of lung function are.

Why have I been chosen?

All individuals attending this clinic can participate in this study on days when recruitment for the project is occurring. Your care will not be affected in any way if you don't want to carry on with the study and you may opt out at any time.

What will I have to do?

This study involves completing a questionnaire concerning smoking and other factors that could influence respiratory health, some information regarding you, and any current respiratory symptoms. After this we would like to perform a simple measurement of lung function. We can give you the results of this test and/or pass them onto your GP.

Will my taking part in this study be kept confidential?

Yes. The results will be confidential and your results will be identifiable only by a study number. Some results from this study may be published but you will be anonymous in all results. After completion of the study we will keep the information in secure hospital computers and this may be used in future research projects. Results from this study may be used to support future research.

What are the possible disadvantages and risks of taking part?

Participating in this study will take some of your time. Completing the survey will take around 15-20 minutes. Having the lung function test will take about another 10 minutes. We do not think that there are any other risks of taking part.

What are the possible benefits of taking part?

We cannot promise that there will be any benefits to you of taking part in this study. If you want, you can be given details of your lung function test. If you would like help to quit smoking then we can direct you to appropriate NHS resources. If we identify any abnormality in your spirometry (lung function test) then we will let you and/or you GP know.

Who is organising and funding the research?

This study is organised by the Respiratory and HIV departments of the Royal Free Hospital.

Who has reviewed the research?

Before any research is allowed to happen it is checked by a group of people called a Research Ethics Committee. They make sure that the research is acceptable. Your project has been checked by the ___________________ Research Ethics Committee

What if there is a problem?

If you wish to complain or have any concerns about the way that you have been approached or treated by members of staff then you have access to National Health Service and Royal Free Hampstead NHS Trust complaints procedures. Your research doctor or nurse can provide you with further information regarding this.

Additional information is available from:

Participant Advice and Liaison Service, Royal Free London NHS Foundation Trust, Pond Street, London NW3 2QG

Telephone: 020 7472 6446 / 6447 (020 7472 6445 – 24 hour answer phone)

Fax: 020 7472 6463

Email: rfh.pals@nhs.net

This sheet is for your information and we will give you a copy of the signed consent form.

Name of Researcher Date Signature

Health perceptions, smoking and health status

Ian Charleson Day Centre

Royal Free London Foundation NHS Trust

We very much appreciate your help with this study.

The following questionnaire has been designed to look at people's beliefs about health and smoking. The results will be used to reduce the risk of heart attacks, strokes and lung disease and help people quit smoking.

At the end, there are some questions about how you feel today. We would also like to check your breathing with a machine called a spirometer, which works out how much air you can blow out of your lungs and is a measure of lung function.

The questionnaire should not take more than 20 minutes to complete, then about 5 minutes to do the spirometry.

If you do not want to answer any specific questions or sections, simply leave these blank and move on to the next section. Your care in this clinic will not be affected in any way if you chose not to complete this questionnaire, or any particular questions within it.

Please tick the boxes where appropriate. There are no right or wrong answers so just select the answer that best suits you. We have also left some space for additional comments.

Many thanks for taking the time to help us with our study.

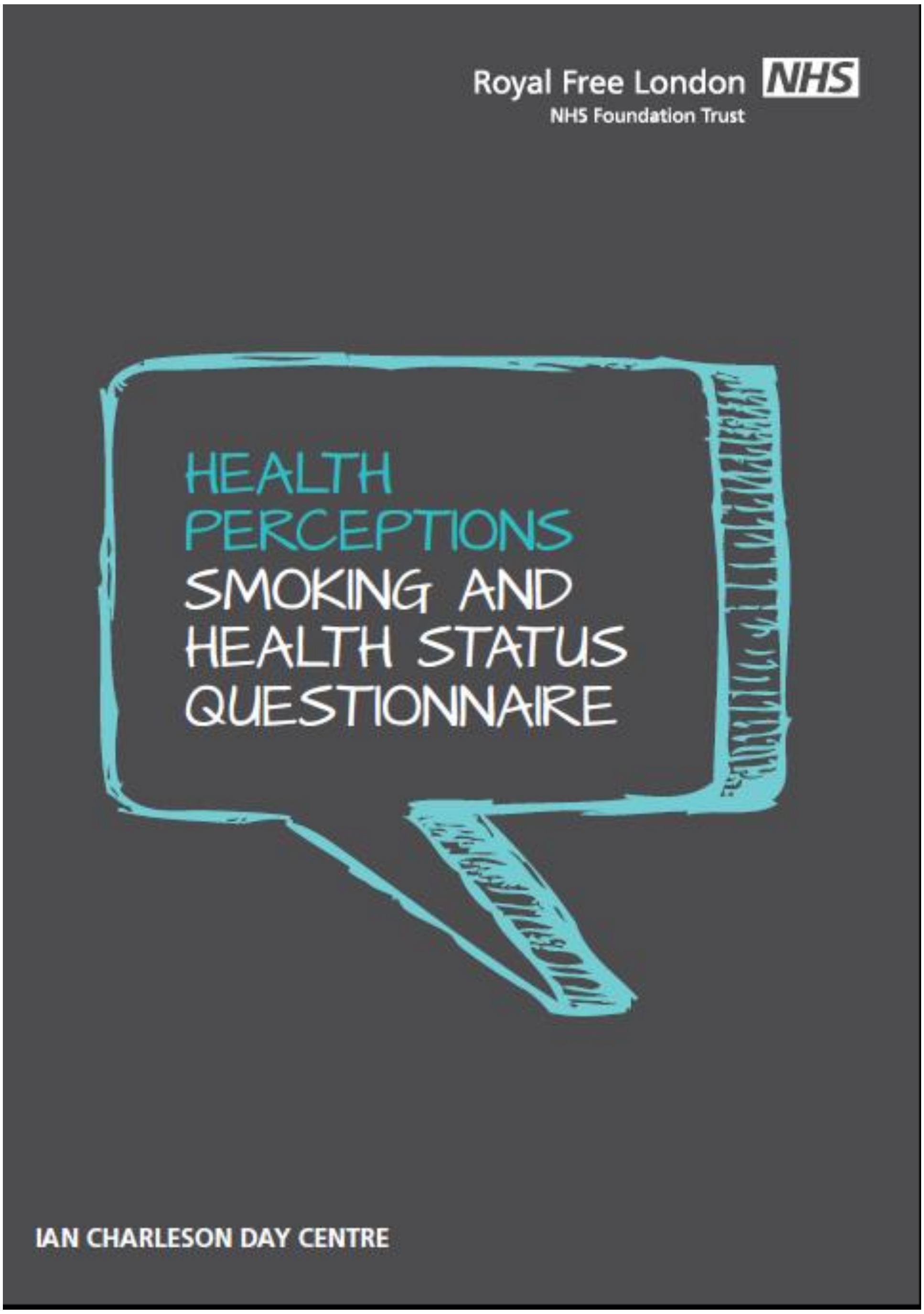
Your responses will be treated in confidence.

Study No: ☐☐☐ Date:

Study Number: ____________________________

Date ______________

B. Resilience study HIV positive participants booklet



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If you do not want to answer any specific questions or sections, simply leave these blank and move on to the next section. Your care in this clinic will not be affected in any way if you chose not to complete this questionnaire, or any particular questions within it.

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Many thanks for taking the time to help us with our study.

Your responses will be treated in confidence.

Study No: ☐ ☐ ☐ Date: ☐

Section A. General Information:

(tick boxes as appropriate)

A1) What is your gender?:

Male ☐ Female ☐ Transgender ☐

A2) What is your age (years) ______

A3) Which ethnic group best describes you? (please tick only one)

- Asian – Indian/ Pakistani/ Bangladeshi ☐
- Black African ☐
- Black Caribbean ☐
- Black other ☐
- Mixed white and black ☐
- Mixed other ☐
- Chinese ☐
- White British ☐
- White Irish ☐
- White other ☐
- Other (please state) : .... ☐

A4) Were you born in the UK?

- Yes ☐
- No ☐

A5) How would you describe your sexuality?:

- Heterosexual / straight ☐
- Homosexual / gay ☐
- Bisexual ☐
- Other (please state) : ______

A6) What is your current level of education? (please tick ONE ONLY)

- Finished education with no qualifications ☐
- O levels / GCSE (or equivalent qualifications at age 16) ☐
- A levels (or equivalent qualifications at age 18) ☐
- University degree or above ☐
- Other qualifications (please specify) ______

A7) What is your current work situation? (please tick ONE ONLY)

- Employed or self-employed FULL TIME (at least 30 hours per week) ☐
- Employed or self-employed PART-TIME (less than 30 hours per week) ☐
- Full time student / education / training ☐
- Unemployed ☐
- Permanently sick / disabled (for 3 months or more) ☐
- Temporarily sick / disabled (for less than 3 months) ☐
- Looking after home / family / dependants full time ☐
- Retired ☐
- Other (please specify) ☐

A8) Do you have enough money to cover your basic needs (e.g. food, heating)

- Yes, all of the time ☐
- Yes, most of the time ☐
- Yes, some of the time ☐
- No ☐

A9) When were you first diagnosed with HIV?

Month / Year ______

A10) Are you currently taking HIV treatment? (antiretroviral treatment)

Yes ☐ No ☐

Section B. General health:

If unknown, please ask the person who gave you your questionnaire for assistance

B1) Were you exposed to cigarette smoke at home as a child?

Yes ☐ No ☐

B2) Are you currently living with someone else who smokes?

Yes ☐ No ☐

B3) Have you EVER been told by a doctor that you have any of the following conditions?

Asthma ☐

Chronic Obstructive Pulmonary Disease or emphysema ☐

Cancer ☐

Heart disease / Coronary artery disease (e.g. heart attack, angina) ☐

Stroke ☐

Diabetes ☐

Any other major condition (please specify) ____________

B4) Are you currently receiving treatment (medicine or other therapy) for depression?

Yes ☐ No ☐

B5) Did you have an influenza (flu) vaccine last winter 2013/14 (approximately between Oct 2013 and January 2014)?

Yes ☐ No ☐

If so, where?

At the Ian Charleson Centre ☐

At my local GP surgery ☐

At a pharmacy/supermarket ☐

Other (please specify) ____________

Don't know ☐

B6) Have you ever had a pneumonia (pneumococcal) vaccine – otherwise called Pneumovax or Prevenar?

Yes ☐ No ☐

If so, when was this? ____________

If so, where?

At the Ian Charleson Centre ☐

At my local GP surgery ☐

At a pharmacy/supermarket ☐

Other (please specify) ☐

Don't know ☐

B7) A. Do you use an inhaler/inhalers for your breathing?

Yes ☐ No ☐

If so, please tick any that you take regularly (more than 1x/week):
(blue inhalers are usually relievers, brown/purple/red/pink are usually preventers)

Ventolin (blue) ☐	Terbutaline (blue) ☐
Beclomethasone (brown) ☐	Pulmicort (brown) ☐
Qvar (brown) ☐	Clenil (brown) ☐
Seretide (purple) ☐	Symbicort (red/white) ☐
Fostair (pink) ☐	Tiotropium/Spiriva (grey) ☐
Atrovent (white/green) ☐	

Other (please name) ____________

B8) Recreational drug use. The answers to these questions are confidential, however if you prefer not to answer these questions this is fine, and please move on to the next section.

Have you ever used any of the following drugs?

Yes ☐ No ☐

If YES, which drugs have you used?

Cannabis (marijuana, grass), smoked	☐	Ketamine	☐
Crack / cocaine smoked	☐	Mephedrone	☐
Cocaine (sniffed or rubbed in gums)	☐	Crystal meth	☐
Ecstasy or GHB	☐	Heroin (injected)	☐
Heroin (smoked)	☐		
Others (please specify)			

B9) Have you used any recreational drugs in the last 3 months?

Yes ☐ No ☐

If YES, which drugs have you used?

Cannabis (marijuana, grass), smoked	☐	Ketamine	☐
Crack / cocaine smoked	☐	Mephedrone	☐
Cocaine (sniffed or rubbed in gums)	☐	Crystal meth	☐
Ecstasy or GHB	☐	Heroin (injected)	☐
Heroin (smoked)	☐		
Others (please specify)			

Section C. Your respiratory health and fitness:

C1) Do you get breathless when you walk?
Please tick the most appropriate statement (ONE ONLY)

1. Not troubled by breathlessness except on strenuous exercise ☐
2. Short of breath when hurrying or walking up a slight hill ☐
3. Walk slower than contemporaries on level ground or have to stop for breath when walking at your own pace ☐
4. Stop for breath after walking about 100m or after a few minutes on level ground ☐
5. Too breathless to leave the house, or breathless when dressing/undressing ☐

C2) In the past 12 months, have you had any of the following illnesses?
(tick box)

Sinusitis	☐	Pneumonia	☐
Bronchitis	☐	Asthma	☐
Chest infection	☐	Pleurisy	☐

Cold or Flu serious enough to miss work or stop normal activities ☐

C3) Do you undertake physical activity regularly?
(at least once per week)

Yes ☐ No ☐ If so: times/wk: ______

Type of physical activity (tick any that apply below):

Run	☐	Cycle	☐
Swim	☐	Gym - weight training	☐

Other ______

Section D. Health and Wellbeing

Under each heading, please tick the ONE box that best describes your health TODAY

MOBILITY

I have no problems in walking about ☐

I have slight problems in walking about ☐

I have moderate problems in walking about ☐

I have severe problems in walking about ☐

I am unable to walk about ☐

SELF-CARE

I have no problems washing or dressing myself ☐

I have slight problems washing or dressing myself ☐

I have moderate problems washing or dressing myself ☐

I have severe problems washing or dressing myself ☐

I am unable to wash or dress myself ☐

USUAL ACTIVITIES (e.g. work, study, housework, family or leisure activities)

I have no problems doing my usual activities ☐

I have slight problems doing my usual activities ☐

I have moderate problems doing my usual activities ☐

I have severe problems doing my usual activities ☐

I am unable to do my usual activities ☐

PAIN / DISCOMFORT

I have no pain or discomfort	☐
I have slight pain or discomfort	☐
I have moderate pain or discomfort	☐
I have severe pain or discomfort	☐
I have extreme pain or discomfort	☐

ANXIETY / DEPRESSION

I am not anxious or depressed	☐
I am slightly anxious or depressed	☐
I am moderately anxious or depressed	☐
I am severely anxious or depressed	☐
I am extremely anxious or depressed	☐

We would like to know how good or bad your health is TODAY.

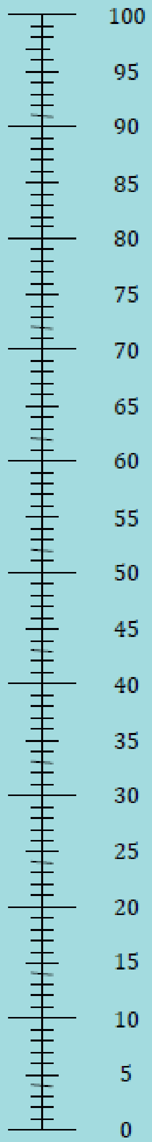
This scale is numbered from **0** to **100**.
100 means the best health you can imagine.
0 means the worst health you can imagine.

Mark an **X** on the scale to indicate how your health is **TODAY**.

Now, please write the number you marked on the scale in the box below.

YOUR HEALTH TODAY =

The best health you can imagine



The worst health you can imagine

Section E: Anxiety and resilience

Over the PAST 2 WEEKS, how often have you been bothered by any of the following problems? Please tick one box in each row.

	Not at all	Several days	More than half the days	Nearly every day
1) Little interest or pleasure in doing things	☐	☐	☐	☐
2) Feeling down, depressed, or hopeless	☐	☐	☐	☐
3) Feeling sad	☐	☐	☐	☐
4) Feeling nervous, anxious or on edge	☐	☐	☐	☐
5) Not being able to stop or control worrying	☐	☐	☐	☐
6) Worrying too much about different things	☐	☐	☐	☐
7) Becoming easily annoyed or irritable	☐	☐	☐	☐
8) Trouble relaxing	☐	☐	☐	☐
9) Being so restless that it is hard to sit still	☐	☐	☐	☐
10) Feeling afraid as if something awful might happen	☐	☐	☐	☐
11) Trouble falling or staying asleep, or sleeping too much	☐	☐	☐	☐
12) Feeling tired or having little energy	☐	☐	☐	☐
13) Poor appetite or overeating	☐	☐	☐	☐
14) Feeling bad about yourself—or that you are a failure or have let yourself or your family down	☐	☐	☐	☐
15) Trouble concentrating on things, such as reading the newspaper or watching television	☐	☐	☐	☐
16) Moving or speaking so slowly that other people could have noticed.	☐	☐	☐	☐
17) Thoughts that you would be better off dead, or of hurting yourself in some way	☐	☐	☐	☐
If you were bothered by any of these problems, how difficult have they made it for you to do your work, take care of things at home, or get along with other people?	☐ Not at all difficult ☐ Somewhat difficult ☐ Very difficult ☐ Extremely difficult			

Please read the following statements. To the right of each you will find seven numbers, ranging from "1" (Strongly Disagree) on the left to "7" (Strongly Agree) on the right. Tick the box below the number which best indicates your feelings about that statement. For example, if you strongly disagree with a statement, click the circle below "1". If you are neutral, click "4", and if you strongly agree, click "7", etc. You must answer every question to submit the test for scoring.

		Strongly disagree						Strongly agree
1.	I usually manage one way or another.	1	2	3	4	5	6	7
2.	I feel proud that I have accomplished things in life.	1	2	3	4	5	6	7
3.	I usually take things in stride.	1	2	3	4	5	6	7
4.	I am friends with myself.	1	2	3	4	5	6	7
5.	I feel that I can handle many things at a time.	1	2	3	4	5	6	7
6.	I am determined.	1	2	3	4	5	6	7
7.	I can get through difficult times because I've experienced difficulty before.	1	2	3	4	5	6	7
8.	I have self-discipline.	1	2	3	4	5	6	7
9.	I keep interested in things.	1	2	3	4	5	6	7
10.	I can usually find something to laugh about.	1	2	3	4	5	6	7
11.	My belief in myself gets me through hard times.	1	2	3	4	5	6	7
12.	In an emergency, I'm someone people can generally rely on.	1	2	3	4	5	6	7
13.	My life has meaning.	1	2	3	4	5	6	7
14.	When I'm in a difficult situation, I can usually find my way out of it.	1	2	3	4	5	6	7

Section F. Smoking:

F1) Which of the following best applies to you?

a. I have never been a smoker (i.e. smoked for a year or more) ☐

b. I smoke cigarettes (or hand-rolled) every day ☐

c. I smoke cigarettes (or hand-rolled), but not every day ☐

d. I do not smoke cigarettes at all, but I do smoke tobacco of some kind (eg. pipe/cigar) ☐

e. I used to smoke but have stopped smoking completely ☐

f. If you are an ex-smoker how old were you when you stopped smoking? (If you cannot remember the exact age, please provide an estimate)

____ years old

If you have never smoked, please move on to section G.

If you are a current or ex-smoker, please answer these questions:

F2) What age did you start smoking? ____ years old

When you smoked the most, how many cigarettes did you smoke a day? ____

F3) If you have tried or managed to quit smoking: which, if any, of the following smoking cessation aids did you use?
(please tick all that apply)

- Nicotine replacement product (eg. patches/gum/inhaler) ☐
- Zyban (bupropion) or Champix (varenicline) ☐
- Attended a Stop Smoking group or support session ☐
- Used alternative or complementary therapies (e.g. hypnotherapy or acupuncture) ☐
- Used Electronic cigarettes ☐
- Other (please specify) ☐
- None ☐
- Never tried to quit ☐

F4) At your most recent serious quit attempt did you cut down before trying to stop?

- Cut down first ☐
- Stopped without cutting down ☐
- Don't know/can't remember ☐
- Never tried to quit ☐

F5) Do you use electronic cigarettes?

YES ☐ NO ☐

If no, please go to F7

F6) If you do use electronic cigarettes is this: (please tick all that apply)

- Because I have stopped smoking and use it as a substitute for cigarettes ☐
- As well as tobacco cigarettes ☐
- To help me give up tobacco cigarettes ☐
- In places where tobacco smoking is not allowed ☐
- Because I prefer electronic cigarettes ☐
- Other reason (please state)

F7) If you have ever quit and restarted, why did you start smoking again? (e.g. stressful life event, just started again one night in the pub…)

Please give more than one reason if you've restarted more than once).

F8) Did you consider stopping smoking when you were diagnosed with HIV?

YES ☐ NO ☐

F9) Did you then stop smoking when you were diagnosed with HIV?

YES ☐ NO ☐

If so, for how long ☐

A few weeks (but less than 3 months) ☐

A few months (but less than 1 year) ☐

Over 1 year ☐

I'm still not smoking ☐

F10) If you are on antiretroviral medication (ARVs), did you consider stopping smoking when you started ARVs?

YES ☐ NO ☐

F11) Did you then stop smoking when you started ARVs?

YES ☐ NO ☐

If so, for how long: ☐

A few weeks (but less than 3 months) ☐

A few months (but less than 1 year) ☐

Over 1 year ☐

I'm still not smoking ☐

If you are a current smoker, please answer these questions.
If you do not currently smoke please move on to section G:

F12) If you currently smoke, how many cigarettes per day do you usually smoke?

Cigarettes ☐ (how many are hand rolled ☐

How much money do you think you spend on tobacco in a week? £ ☐

F13) Which of the following best describes you?

- I want to stop smoking and intend to do so soon ☐
- I want to stop smoking but haven't thought about when ☐
- I don't want to stop smoking ☐
- Don't know ☐

F14) Thinking about stopping smoking now:

a. How important is it for you to stop smoking at this time? (circle one number)

Not at all 1 2 3 4 5 6 7 8 9 10 Very Much

b. How much do you intend to stop smoking?

Not at all 1 2 3 4 5 6 7 8 9 10 Very Much

c. How confident are you that you will be able to stop smoking?

Not at all 1 2 3 4 5 6 7 8 9 10 Very Much

F15) Has your GP advised you to stop smoking in the past year (i.e. last 12 months)?

YES ☐ NO ☐ UNSURE ☐

F16) If your GP spoken to you about smoking in the past year, which of these best described what happened?

- My GP raised the topic of smoking and advised me to stop smoking ☐
- My GP raised the topic of smoking together with the offer of a prescriptionor help from a stop-smoking advisor ☐
- Neither of these ☐
- Don't know ☐
- Other (please state) ____________

F17) Has a doctor in the Ian Charleson Centre ever advised you to stop smoking?

YES ☐ NO ☐ UNSURE ☐

F18) If a doctor spoke to you about smoking in the past year, which of these best described what happened?

- The Doctor raised the topic of smoking and advised me to stop smoking ☐
- The Doctor raised the topic of smoking together with the offer of a prescription or help from a stop-smoking advisor ☐
- Neither of these ☐
- Don't know ☐
- Other (please state) ____________

F19) If you have tried to stop smoking, how many serious attempts to stop smoking have you made in the last 12 months?
(By serious attempt, you decided that you would try to make sure you never smoked again. Please include any attempt that you are currently making and please include any successful attempt made within the last year)

____

Section G. Respiratory symptoms:

St George's Respiratory Questionnaire

This questionnaire is designed to help us learn much more about how your breathing is troubling you and how it affects your life. We are using it to find out which aspects of your illness cause you most problems, rather than what the doctors and nurses think your problems are.

Please read the instructions carefully and ask if you do not understand anything. Do not spend too long deciding about your answers.

Before completing the rest of the questionnaire:

Please tick in one box to show how you describe your current health:

Very good ☐ Good ☐ Fair ☐ Poor ☐ Very poor ☐

Questions about how much chest trouble you have had over the past 3 months.

Please tick one box for each question:

1. Over the past 3 months, I have coughed:

most days a week	☐	only with chest infections	☐
several days a week	☐	not at all	☐
a few days a month	☐		

2. Over the past 3 months, I have brought up phlegm (sputum):

most days a week	☐	only with chest infections	☐
several days a week	☐	not at all	☐
a few days a month	☐		

3. Over the past 3 months, I have had shortness of breath:

most days a week	☐	only with chest infections	☐
several days a week	☐	not at all	☐
a few days a month	☐		

4. Over the past 3 months, I have had attacks of wheezing:

most days a week	☐	only with chest infections	☐
several days a week	☐	not at all	☐
a few days a month	☐		

5. During the past 3 months how many severe or very unpleasant attacks of chest trouble have you had? Please tick one:

more than 3 attacks	☐	1 attack	☐
3 attacks	☐	no attacks	☐
2 attacks	☐		

6. How long did the worst attack of chest trouble last?
(Go to question 7 if you had no severe attacks)

Please tick one:

a week or more	☐	1 or 2 days	☐
3 or more days	☐	less than a day	☐

7. Over the past 3 months, in an average week, how many good days (with little chest trouble) have you had?

Please tick one:

no good days	☐	nearly every day is good	☐
1 or 2 good days	☐	every day is good	☐
3 or 4 good days	☐		

8. If you have a wheeze, is it worse in the morning?
Please tick one:

No ☐ Yes ☐

These questions ask about chest problems. If you have not had any chest problems please still answer every question and simply tick the appropriate boxes (e.g. "False" or "Causes no problem").

Section 1

How would you describe your chest condition?

Please tick one:

- The most important problem I have ☐
- Causes me quite a lot of problems ☐
- Causes me a few problems ☐
- Causes no problem ☐

If you have ever had paid employment.

Please tick one:

- My chest trouble made me stop work altogether ☐
- My chest trouble interferes with my work or made me change my work ☐
- My chest trouble does not affect my work ☐

Section 2

Questions about what activities usually make you feel breathless these days.

Please tick in each box that applies to you these days:

	True	False
Sitting or lying still	☐	☐
Getting washed or dressed	☐	☐
Walking around the home	☐	☐
Walking outside on the level	☐	☐
Walking up a flight of stairs	☐	☐
Walking up hills	☐	☐
Playing sports or games	☐	☐

Section 3

Some more questions about your cough and breathlessness these days.
Please tick in each box that applies to you these days:

	True	False
My cough hurts	☐	☐
My cough makes me tired	☐	☐
I am breathless when I talk	☐	☐
I am breathless when I bend over	☐	☐
My cough or breathing disturbs my sleep	☐	☐
I get exhausted easily	☐	☐

Section 4

Questions about other effects that your chest trouble may have on you these days.
Please tick in each box that applies to you these days:

	True	False
My cough or breathing is embarrassing in public	☐	☐
My chest trouble is a nuisance to my family, friends or neighbours	☐	☐
I get afraid or panic when I cannot get my breath	☐	☐
I feel that I am not in control of my chest problem	☐	☐
I do not expect my chest to get any better	☐	☐
I have become frail or an invalid because of my chest	☐	☐
Exercise is not safe for me	☐	☐
Everything seems too much of an effort	☐	☐

Section 5

Questions about your medication, if you are receiving no medication go straight to section 6.

Please tick in each box that applies to you these days:

	True	False
My medication does not help me very much	☐	☐
I get embarrassed using my medication in public	☐	☐
I have unpleasant side effects from my medication	☐	☐
My medication interferes with my life a lot	☐	☐

Section 6

These are questions about how your activities might be affected by your breathing.

Please tick in each box that applies to you because of your breathing:

	True	False
I take a long time to get washed or dressed	☐	☐
I cannot take a bath or shower, or I take a long time	☐	☐
I walk slower than other people, or I stop for rests	☐	☐
Jobs such as housework take a long time, or I have to stop for rests	☐	☐
If I walk up one flight of stairs, I have to go slowly or stop	☐	☐
If I hurry or walk fast, I have to stop or slow down	☐	☐

	True	False
My breathing makes it difficult to do things such as walk up hills, carrying things up stairs, light gardening such as weeding, dance, play bowls or play golf	☐	☐
My breathing makes it difficult to do things such as carry heavy loads, dig the garden or shovel snow, jog or walk at 5 miles per hour, play tennis or swim	☐	☐
My breathing makes it difficult to do things such as very heavy manual work, run, cycle, swim fast or play competitive sports	☐	☐

Section 7

We would like to know how your chest usually affects your daily life.

Please tick in each box that applies to you because of your chest trouble:

	True	False
I cannot play sports or games	☐	☐
I cannot go out for entertainment or recreation	☐	☐
I cannot go out of the house to do the shopping	☐	☐
I cannot do housework	☐	☐
I cannot move far from my bed or chair	☐	☐

Here is a list of other activities that your chest trouble may prevent you doing. (You do not have to tick these, they are just to remind you of ways in which your breathlessness may affect you):

Going for walks or walking the dog

Doing things at home or in the garden

Sexual intercourse

Going out to church, pub, club or place of entertainment

Going out in bad weather or into smoky rooms

Visiting family or friends or playing with children

Please write in any other important activities that your chest trouble may stop you doing:

Now would you tick in the box (one only) which you think best describes how your chest affects you:

- [ ] It does not stop me doing anything I would like to do
- [ ] It stops me doing one or two things I would like to do
- [ ] It stops me doing most of the things I would like to do
- [ ] It stops me doing everything I would like to do

Section H. Thoughts about lung health:

Please read the following statements and indicate, by ticking the most appropriate box, whether you agree with the statement:

H1) Most smokers will develop lung disease

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

H2) Smoking increases the risk of heart disease

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

H3) Only people who are old or overweight or pregnant die of the 'flu

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

H4) Having the 'flu vaccine:

Means I can't catch the 'flu at all this year:

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

Means I can still get the 'flu, but it might be less severe:

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

Will make me feel terrible:

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

H5) Having the pneumococcal vaccine (Pneumovax or Previnar):

Means I won't ever get pneumonia in the future:

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

Will give me some protection from pneumonia for a few years:

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

Will make me feel terrible

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

H6) HIV is associated with early onset of smoking related lung disease (emphysema/ chronic bronchitis)

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

H7) The risk of developing lung cancer is increased in people living with HIV

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

H8) People with HIV are more likely to get pneumonia.

- Strongly agree ☐
- Tend to agree ☐
- Unsure ☐
- Tend to disagree ☐
- Strongly disagree ☐

How we can help you…

Finally, if you are thinking about quitting smoking, and would like to receive some help and advice there is a free smoking cessation service offered by the Royal Free. If you are interested please leave your name, address and contact number below and we will make a referral for you, or alternatively call the clinic directly on 020 7472 6393

Name:

Address:

Tel No:

Email:

Thank you for taking the time to fill in this questionnaire:

Dr James Brown, Research Registrar

Dr Marc Lipman, Consultant

	Measurement 1	Measurement 2	Measurement 3
FEV1			
FVC			
Ratio			

Height:

Weight:

C. *Table 58*. Papers included in the second systematic review, ranked by lead Author.

***Table 58.* Papers included in the second systematic review, ranked by lead Author.**

Table 58. A summary of the reviewed studies.

Title	Authors, Date & Journal	Date study occurred	Location	Intervention	Methodology: Power	Methodology: Population	Methodology: Eligibility
A randomized clinical trial of a coping improvement group intervention for HIV-infected older adults.	Heckman, T., Sikkema, K., Hansen, N., Kochman, A., Heh, V., Neufeld, S. (2011). *Journal of Behavioral Medicine.*	2007	New York City, Columbus And Cincinnati.	A 12- session coping improvement group intervention or a time-matched interpersonal support group intervention.	.80 or greater.	295 HIV infected men and women 50-plus years old. Age range: 50-76, mean: 55.3 years. 67% were male, 49% of a minority ethnicities and 51% identified as gay or bisexual.	(1) 50 years of age or older, (2) a diagnosis of HIV infection or AIDS, (3) a BDI-II depression score of 10 or higher, (4) a score of 75 or greater on the 3MS (good cognitive function).
Telephone-delivered motivational interviewing targeting sexual risk behaviour reduces depression, anxiety, and stress in HIV-positive older adults.	Lovejoy, T. I. (2012). *Annals of Behavioral Medicine.*	2009-2010	Cincinnati (Ohio) & New York City.	1 or 4 session telephone delivered motivational interviews.	Not specified.	100 HIV infected men and women 45-plus years of age. Mean age: 53.8 years. 54% were male, 87% of an ethnic minority and 44% MSM.	1) 45 years of age or older, 2) a diagnosis of HIV infection or AIDS, 3) owning a landline or mobile phone, 4) reporting at least one case of unprotected sex in the last 3 months, 5) English-speaking.
Supportive-Expressive and Coping Group Teletherapies for HIV-Infected Older Adults: A Randomized Clinical Trial.	Heckman, T. G., Heckman, B. D., Anderson, T., Lovejoy, T. I., Mohr, D., Sutton, M., Bianco, J. A., Gau, J-T. (2013). *AIDS and Behavior.*	2008-2010.	**24 US states**; Arkansas, California, Delaware, Florida, Georgia, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, Minnesota, Mississippi, Nebraska, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Texas, Washington and Wisconsin.	A 12-session telephone-administered coping effectiveness training (CET) or a 12-session telephone-administered supportive-expressive group therapy (SEGT).	.80 or greater.	361 HIV infected men and women 50-plus years of age. Mean age: 59.0 years. 61% were male, 77% from minority ethnicities and 41% MSM.	1) 50 years of age or older, 2) self-reported diagnosis of HIV infection or AIDS, 3) a GDS score ≥10 at eligibility screening, 4) reliable access to a land-based or cellular telephone for the next 12 weeks.

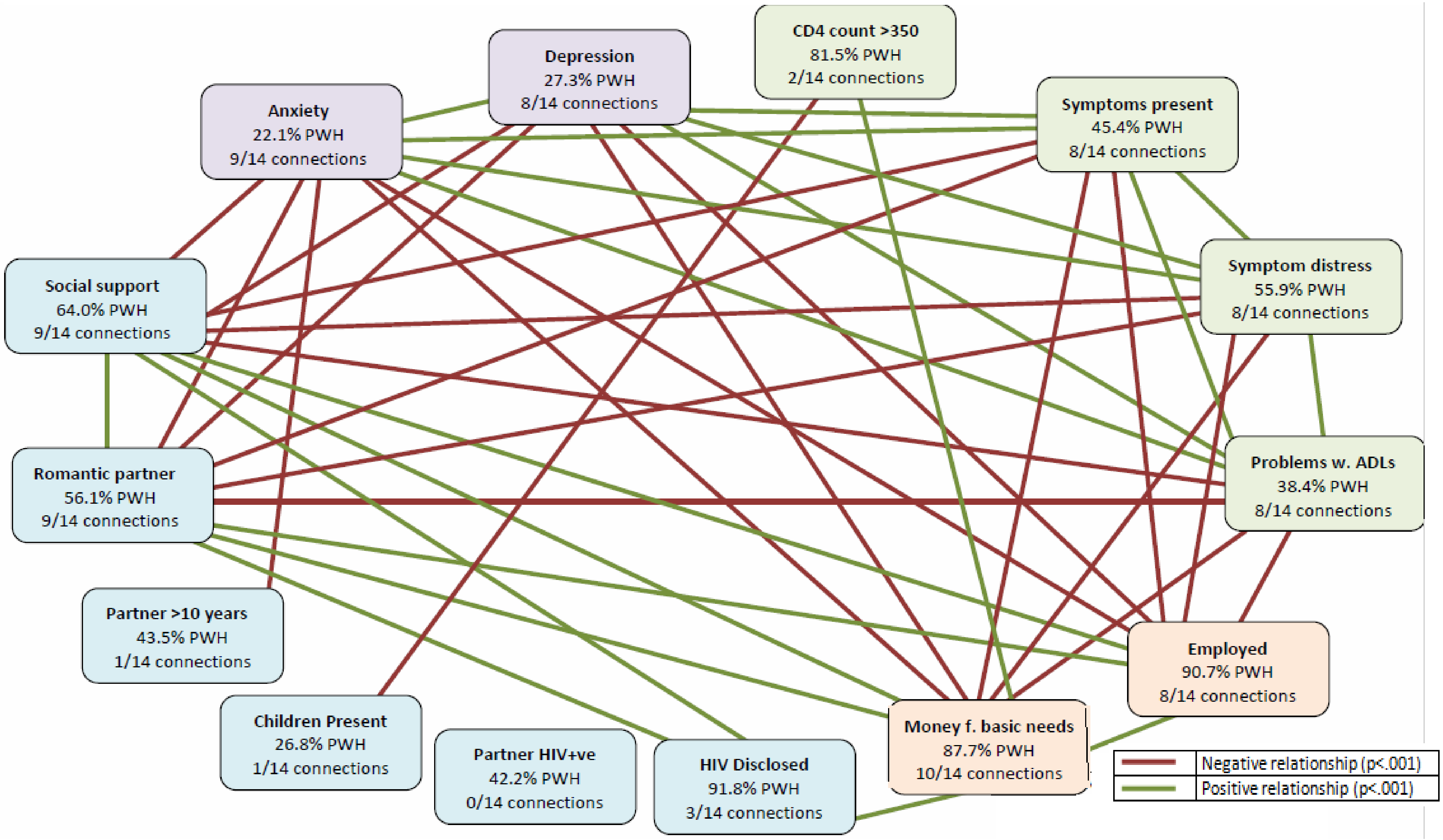
Methodology						Results			
Recruitment	**Randomised**	**Control**	**Study Design**	**Desired Outcome**	**Follow-up**	**Findings**	**Success**	**Drop-out**	**Generalizability**
Brochures from ASOs and community outreach efforts.	Yes, by sexuality (heterosexual men, women, MSM).	Individual therapy upon request (ITUR).	3 arm parallel group RCT.	Decrease depressive symptoms (GDS - Geriatric Depression Scale).	Post-intervention, 4- and 8-month follow-up.	Mixed results over time for both interventions arms. For mild-to-severe levels of depression, mostly fewer depressive symptoms in both interventions. Significant Intervention Condition showing reductions in depression over time.	Partial.	8% attended no sessions and 17% less than half in the coping group. 11% attended no sessions and 20% less than half in the support group.	Average – Self-selection, Western US only, from large cities with good connections to HIV support and who seek medical help (attached to ASOs).
Brochures from ASOs, advertisements in publications and e-mail lists and presentations to social	Yes.	Standard of care.	2 arm parallel group RCT.	Reduced sexual risk behaviour(self report), reduced depression, anxiety & stress (DASS - Depression Anxiety Stress Scales).	3-months and 6-months. No post-intervention.	Decrease in depression, anxiety and stress at 6 months, but no change at 3. No differences were found between the 1 and 4 session trials.	Partial.	5% of 1-session participants and 24% of 4-session participants did not receive all the interviews.	Average – Self report, self-selection, Western US only, from large cities with good connections to HIV support and who seek medical help (attached to ASOs).
Brochures from ASOs, distributed via face-to-face interactions, regular mail, and "high-traffic" areas (e.g., reception	Yes, by sexuality (heterosexual men, women, MSM).	Standard of care.	3 arm parallel group RCT.	Decrease depressive symptoms (GDS - Geriatric Depression Scale).	Post-intervention and 4- and 8-month follow-up.	Fewer depressive symptoms at all levels of follow-up for SEGT participants compare to control. No significant difference between control and CET participants.	Yes, for SEGT only.	SEGT: 7% drop-out post-intervention, 9% at 4-months and 13% at 8. CET: 12%, 14% and 15% respectively. Control: 4%, 8% and 8%.	Good - self-report, self-selection and were attached to ASOs, but participants taken from all over the US. Lower applicability to other countries.

D. Figure 30: A visual representation of well-being in PWH.

Figure 30 shows the prevalence of each variable explored in the general UK PWH population. The prevalence of each variable is identified as a percentage of the population, and the variables themselves are categorised as physical (green), mental (purple), social (blue) and financial (orange) factors. The associations between each variable are then identified, using green and red lines to show positive and negative correlations respectively. While this may appear overwhelming, the aim is purely to depict the inter-related nature of the variables and show which, if addressed in an intervention, would have the largest impact on overall well-being. To allow for ease of identification the number of connections is also stated for each variable individually.

Due to the large number of statistical tests completed (increasing the risk of type I error), only strong associations -those with a p value < .001 - are included in the figure. Resilience is also not included, as it was not analysed in relation to the full spectrum of well-being factors.

Figure 30. **A visual representation of well-being in PWH in the UK.**



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