Oral health disparities in children – a canary in the coalmine?

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Key points:

- Oral diseases in children remain a major global public health problem with significant negative impact on quality of life. Oral diseases are however largely preventable, and now disproportionally affect more disadvantaged populations.
- Oral health disparities are caused by the broad conditions in which people are born, grow, live, work and age, the so-called social determinants.
- Dental treatment and clinical prevention alone will not eliminate oral health disparities, and indeed may even widen inequalities. Instead a radical multi-faceted integrated approach that addresses the underlying root cause of oral diseases in childhood is urgently required.

Synopsis

Despite being largely preventable, oral diseases are still a major public health problem in child populations in many parts of the world. Increasingly however, oral diseases disproportionally affect socially disadvantaged groups in society. It is unjust and unfair that children and families from disadvantaged backgrounds experience high levels of oral diseases. This paper will analyse oral diseases through a health disparities lens. Action to combat oral health disparities requires a radical multi-faceted strategy that addresses the shared underlying root causes of oral diseases, the social determinants of health inequality.

Background

The values of equal opportunity and equality have a long and distinguished political history across the democratic nations of the world. Indeed these values are embedded at the core of many national constitutions as the foundations of modern societies. The founding fathers of the US Constitution highlighted that *all people are created equal with the right to life, liberty and the pursuit of happiness*. However across the globe many communities and populations are facing huge challenges that severely limit their future opportunities and life chances. Increasingly the world is becoming a deeply divided and polarised place with escalating economic and social differences evident both within and among countries.[1,2] One very stark manifestation of economic and social inequalities is the disparities that exist in health including oral health status in our populations. Tackling health inequalities to promote health equity has therefore now become a major policy priority around the world.[3,4]

Definitions of health disparities and health inequalities

Many different definitions of health disparities and health inequalities exist depending on the context, discipline and policy arena. A common theme across different definitions however is the recognition of population-specific health differences in prevalence of disease, health outcomes, or access to health care, particularly those that are avoidable, unjust, and unfair when considered from a social justice, ethics, and human rights perspective.[3] Health disparities have been defined as differences that exist among specific population groups in the attainment of full health potential and in incidence, prevalence, mortality, burden of disease, and other adverse health conditions.[5] Health equity is the

state in which everyone has the opportunity to attain their full health potential and no one is disadvantaged from achieving this potential because of their social position or other socially defined circumstance. An underlying concept across the various definitions is the recognition that health inequalities and disparities stem from systematic differences in society that are preventable (we can do something to change them) and unjust (we collectively consider these differences as unacceptable and unfair) among groups and communities occupying unequal positions of power in society.[6] Based upon historical and political differences across the world, different health disparities research foci have been emphasized. In the US for example, particular emphasis in research and policy is placed upon exploring racial and/or ethnic health disparities, whereas in many other Organization of Economically Developed Countries (OEDC), socioeconomic health inequalities are the main focus of attention. In addition to race/ethnicity and socioeconomic status, sexual orientation, gender identity, primary language, geographic location, and various forms of disability are also included in health disparities research.

Health disparities in US children and adults – an overview

A healthy childhood provides the foundations and opportunities for life. Unfortunately not all groups in society have the best start in life. In the US for example, stark racial/ethnic inequalities exist in early life for various health outcomes. Although overall infant mortality rates have decreased since 2005, sharp racial/ethnic disparities persist. In 2013 infant mortality rates among African Americans (11.1 per 1000 live births) was more than double the rate among whites (5.06 per 1000 live births).[7] Amongst US adults, life expectancy

was recently found to be directly related to income levels.[8] Between the top 1% and bottom 1% of the income distribution, life expectancy differed by 15 years for men and 10 years for women. The analysis also revealed the life expectancy gap widened in recent years. Between 2001 and 2014, the individuals in the top 1% of the income distribution gained approximately 3 years of life expectancy, whereas individuals in the bottom 1% experienced no gains.

How does the US compare in terms of health outcomes to other similar OEDC members? A recent National Research Council and Institute of Medicine report compared health outcomes among 16 high-income countries.[9] Despite spending more on health care as percent of gross domestic product than any other country, the US fared worse in 9 health domains including important areas of child and maternal health such as:

- Adverse birth outcomes – higher rates of infant mortality and low birth weight
- Injuries and homicides – deaths from motor vehicle accidents, non-transport related injuries, and violence which are the leading cause of death in US children, adolescents and young adults.
- Adolescent reproductive health – adolescent pregnancies and sexually transmitted infections are highest in the US
- Obesity and diabetes – US obesity rates in children, adolescents and young adults are highest amongst the 16 comparable countries.

Wider consequences of health disparities

Concerns about health disparities are not merely a theoretical or ethical issue – they have profound social, political, and economic consequences for society. Children raised in poverty, food insecurity, poor housing, or who lack of access to high quality early years education are more likely to suffer chronic adult illnesses and the intergenerational perpetuation of poverty and poor health – the spiral of disadvantage across generations.[10] The economic effects of health inequalities are the consequence of both increased health expenditure and the broader diminished economic productivity in society. In the US eliminating health disparities for racial/ethnic minorities between 2003-2006 would have reduced indirect cost associated with illness and premature death by an estimate of more than $1 trillion.[11] In the European Union inequality losses related to health have been estimated to account for 15% of the costs of social welfare systems and 20% of health care costs.[12]

Oral diseases in children and young people are a major public health problem in many parts of the world. This paper will analyse oral diseases through the lens of health disparities. Oral diseases in childhood are early markers of social disadvantage and can be used as social indicators of patterns of systemic disease in populations. We will argue that action to combat oral health disparities requires a radical multi-faceted strategy and integrated approach that addresses the underlying root causes of oral diseases in childhood.

Oral health disparities – an overview

Globally oral diseases remain highly prevalent chronic conditions that have a significant negative impact on quality of life across the lifecourse from early

childhood, through adulthood to older age.[13] Increasingly however oral diseases disproportionally affect socially disadvantaged groups in society. Stark disparities in clinical outcomes, subjective oral health measures and oral health related behaviors exist across a range of different indicators of socioeconomic position including educational status, income, occupation, and area based measures of deprivation.[14–16] Oral health disparities are not merely the differences between the rich and poor in society. As is the case with most other health conditions, a consistent stepwise graded relationship exists across the entire social spectrum, with oral health being worse at each point as one descends down the social hierarchy, the so called social gradient. The social gradient in oral health is a universal phenomenon found at all points across the lifecourse and in different populations around the world.[17–19] Oral health disparities also exist across certain racial/ethnic groups in society reflecting socioeconomic disadvantage and cultural differences.

Systematic reviews of the international literature have highlighted the considerable body of epidemiological evidence on oral health disparities in children and adults.[20–23] Various large scale studies have also reported that children from deprived neighborhoods had higher dental caries levels and greater dental pain experience than their counterparts from more affluent neighborhoods.[24–29]

The evidence on disparities in oral health specifically in low and middle-income countries (LMIC) is still very sparse. Moreira et al. showed 70-90% of children attending school experience dental caries with highest rates in LMICs such as

India, Thailand and Indonesia.[30] Recent studies have also shown socioeconomic gradients in prevalence of dental caries, self-rated oral health, and oral health related behaviors of children and adolescents from LMICs.[19,31–35] A systematic review on Brazilian epidemiological studies between 1999-2008 showed poor socioeconomic conditions were associated with adverse adult periodontal outcomes.[36]

The effect of oral health disparities is not just confined to childhood. Thomson et al. (2000) showed that childhood socioeconomic position had a significant influence on the lifelong trajectories of oral health.[37] Nicolau et al. (2005) showed that adolescents with poor material conditions, both at birth and 13 years of age, had poorer oral health outcomes than those having better standard of living at either life stage.[38]

Oral health disparities in children in the United States.

In the US, oral health disparities exist in children for cleft lip +/- palate[39] and gingivitis,[40] but the largest population health impact of disparities is on dental caries. The previous US Surgeon General recently summarized progress in the 15 years since the first and only *Surgeon General's Report* on oral health. Children's dental insurance coverage and dental sealant have increased, while caries experience and untreated caries have decreased.[41] For example, based on the US National Health and Nutrition Examination Survey (NHANES), prevalence of caries experience in primary dentition fell from 28% in 2004-2011 to 23% in 2011-2014.[42] Mean number of decayed or filled primary tooth surfaces (dfs) increased in 3-5 year olds from 2.1 in 1988-1994 to 2.6 in 1999-2004 and 2011-

2014, but mean number of decayed, missing, or filled permanent tooth surfaces (DMFS) decreased in 12-17 year olds from 4.4 in 1988-1994 to 3.5 in 1999-2004 and 2004-2011.[43]

Nevertheless, children's oral health disparities persist based on families' economic, educational, linguistic, immigration, racial/ethnic, and geographic statuses. Despite overall reductions in prevalence of children's caries experience and untreated caries comparing NHANES from 1999-2004 to 2011-2014, economic disparities across the household income percent Federal Poverty Level (FPL) gradient remain essentially unchanged over time.[44] primary dentition caries experience for 2-8 year olds in 1999-2004 with <100% FPL was 52% compared to 27% in those ≥200% FPL corresponding to a relative risk (RR) of 1.92; in 2011-2014 prevalences were 48% and 27%, respectively for a RR of 1.78; primary dentition untreated caries RR for 2-8 year olds of <100% FPL to ≥200% FPl in 1999-2004 of 2.34 to 2011-2014 of 2.28. Disparities in severe caries in the primary dentition (3 or more decayed surfaces) appears to have decreased substantially over time: prevalences for 2-8 year olds in 1999-2004 were 16% for <100% FPL and 5% for ≥200% FPl in 1999-2004 with RR= 3.16; in 2011-2014 prevalences were 8% and 4% respectively with RR=2.00.

Compared to non-Hispanic Whites, untreated caries in the primary dentition, disparities for racial/ethnic minorities increased from 1999-2004 to 2011-2014.[42] NHANES analyses from 1988-1994 to 1999-2004 to 2011-2014 showed mean dfs and DMFS for 3 child age groups along a consistent four-category poverty-income ratio gradient over time.[43]

Accounting for child-, family-, and community/state-level socioeconomics and other factors, racial/ethnic disparities in the 2007 National Survey of Children's Health for parent reports of child's fair/poor oral health rating, preventive care, and delayed care/unmet need attenuated or disappeared.[45] County-level untreated caries rates in 6-9 year old children from a small area estimation NHANES 2005-2010 model varied significantly by individual-, tract-, and county-level variables.[46]

Disparities in access to oral health care services

In much of the world, particularly in many LMICs, coverage, availability, and access to oral health care services – including early diagnosis, prevention, and basic treatment for children and adolescents – are grossly inadequate or completely lacking.[47–50] Studies in high income countries including the US demonstrate inequalities in access to oral health care services for young children[51,52] based on family income,[53,54] race/ethnicity[55] and caregiver education[56,57]. Similar challenges are also being faced by the children and adolescents from LMICs in South America,[58] Africa,[59] and Asia.[60]

Access to oral health care services in pregnant women[61] and children with special health care needs[62] has also been well-researched in high income countries.[63–65] However, there is lack of evidence from many LMICs.[65]

Impact of oral health disparities

Oral diseases have many adverse consequences for individuals, families and society. For example dental caries can have negative impacts on quality of life

such as pain and discomfort, impaired chewing, decreased appetite, sleep problems, poor self esteem, reduced social interaction, and poor school and work performance.[66] The social gradient in oral diseases means that people from the most disadvantaged backgrounds suffer disproportionally. Children from poorer backgrounds have higher caries rates and consequently often suffer dental pain and its consequences, leaving them at a substantial disadvantage compared to their wealthier and healthier peers. Children with poor oral health are almost three times more likely to miss school-days from dental pain and have poorer subsequent school examination performance.[67] In the United Kingdom (UK) extracting carious teeth is the most common reason for admitting children under the age of 11 years for surgery under general anaesthesia, a psychologically traumatic and costly procedure.[68] Children from disadvantaged and poorer backgrounds are far more likely to be admitted to hospital to have carious teeth extracted.[69,70] A recent Health Policy Institute survey showed almost one-third of low income US adults, twice the rate of their high income counterparts, reported the appearance of their teeth and mouth affected their ability to interview for a job.[71] Dental treatment is often costly and in many countries is not included in the mainstream health care system or is excluded from many health insurance plans. Thus, dental treatment costs often fall on individuals covered through personal out of pocket expenditures, a major challenge for low-income individuals. Across 41 LMICs 7% of households reported personal expenditures for dental treatment significantly impacted family budgets limiting their ability to purchase essential daily necessities.[72] The disproportionate impact of oral diseases on poor school performance, reduced employment opportunities, and financial burden for dental treatment on the poorest segments of our

communities perpetuates and reinforces social and economic inequalities in society.

Understanding the causes – social determinants agenda

Contemporary analysis of the underlying causes of these unfair, unjust, and unacceptable differences in oral health status across populations must inform action to address oral health disparities. Perhaps a good starting point is the need to dispel and dismiss certain commonly held views on health disparities such as:

- *Poor people behave badly – that's their choice*
- *We can't all be equal; differences in society will always exist*
- *Its too difficult to change society for the better*

Over the last 30 years or so, a considerable body of scientific research has explored the range of interacting factors that cause health disparities. Poverty, unemployment, poor housing, low educational attainment, violence, loneliness, and discrimination all influence the health of children and families, and ultimately determine health disparities,[73] These overriding social, economic, environmental, and societal factors, known as the social determinants of health (SDOH), create the unequal conditions in society that ultimately cause health inequities among and within countries.[3] Marmot (2007) has described SDOH as the 'fundamental structures of social hierarchy and the socially determined conditions these create in which people grow, live, work and age' - the inequitable distribution of power, money, and resources. In other words, the root causes of inequality in society.[74]

Families living in disadvantaged communities have very limited choices available to them. Their daily lives are governed by a constant struggle to do the best they can for their children. Health-related behaviors such as tobacco use, poor diets, and drug and alcohol misuse are important influences on health, but these behaviors are largely determined by the social and physical conditions in which people live and indeed are often used as coping strategies to deal with stress and hardship.

International comparative studies have shown that health disparities are much worse in countries such as the US and UK that have the widest socioeconomic inequalities between rich and poor. In contrast in more egalitarian countries such as the Nordic nations and Japan, where the economic differences are much smaller, health disparities are less pronounced . In other words, more equal and socially cohesive societies have healthier populations,[75]

A SDOH perspective has been applied to better understand inter-relationships between the proximal – biological and behavorial –influences on child oral diseases and how these are largely determined and driven by the broader distal – social, community, economic and political –factors in society. Researchers have developed various SDOH conceptual models and frameworks to describe the range of influences, inter connections and pathways leading to oral health disparities.[76–81]These models provide valuable insights to inform developing interventions to tackle oral health disparities and highlight the need for joint collaborative action at different levels and across sectors, the common risk factor

approach.[80] Action focusing solely on the proximal biological and behavioral factors will be ineffective at achieving sustained improvements in oral health and may indeed widen oral health disparities.[82] A good example to illustrate this was a school-based health education program in Scotland that significantly increased oral health disparities - children from more advantaged social backgrounds appreciably improved their oral hygiene behaviors as a result of the program, whereas their contemporaries from poorer households had minimal benefit, widening the oral health gap.[83]

Time for action to tackle oral health disparities

The universal and pervasive nature of the social gradient in oral and general health outcomes has profound implications for action to tackle health disparities. Reducing health disparities is therefore everybody's business affecting the whole of our society, not just the poorest and most marginalised. Politicians, policy makers, clinicians, professional organisations, commercial sector, civil society, and the wider community all have an important role to play. The US DHHS (2016) recently developed an oral health framework with 5 goals including "increase[ing] access to oral health care and eliminate[ing] disparities," which had 8 suggested strategies.[84] Including:

- Expand the number of health-care settings that provide oral health care, including diagnostic, preventive, and restorative services in federally qualified health centers, school-based health centers, Ryan White HIV/AIDS-funded programs, and IHS-funded health programs.
- Strengthen the oral health workforce, expand capabilities of existing providers, and promote models that incorporate other clinicians.

- Improve the knowledge, skills, and abilities of providers to serve diverse patient populations.
- Promote health professionals' training in cultural competency.
- Assist individuals and families in obtaining oral health services and connecting with a dental home.
- Align dental homes and oral health services for children.
- Create local, regional, and statewide partnerships that bridge the aging population and oral health systems.
- Support the collection of sex- and racial/ethnic-stratified data pertaining to oral health.

To reduce the social gradient in health, actions must be universal, but with scale and intensity proportionate to the level of disadvantage and need.[85] The traditional clinical 'high risk' approach solely focusing on individuals and families at greatest risk of disease, alone cannot tackle the broader root causes of oral health disparities. The inter-related and shared underlying causes of both oral and general health disparities requires coordinated and integrated upstream action including healthy public policy, the creation of supportive environments and strengthened grass roots community action for good health. However, health care systems particularly primary care and pediatric services also have an important contribution to make to promote greater oral health equity.

Role of health services

Giving every child the best start in life is one of the key recommendations from a strategic review of actions needed to promote health equity.[85] Clinicians working in pediatrics are therefore in a unique position to support and empower children and families to attain their full health potential including good oral health; DHHS (2016) has suggested strategies to achieve this goal including interprofessional colloaboration, provide oral health training to primary care providers, development of policies/practices that reconnect the mouth to the rest of the body and create programs that support a systems change approach that promotes a unified patient-centred model of care.[84] For example providing evidence-based support in a non victim blaming manner on breastfeeding and healthy eating advice including ways to reduce sugar consumption is important for both good oral and general health.[80] Working in partnership with clinical colleagues in primary dental care settings is critical to ensure that children and families receive additional dental support on such things as the appropriate use of fluoride toothpastes, and access to dental treatment and preventive care from an early age. Rather than working in isolated and compartmentalized professional silos, providing more integrated care in co-located premises offers opportunities for more effective and coordinated joint care.

Collaborative work across clinical boundaries is important, but collaboration can be extended more broadly to other essential sectors such as social and welfare services, education services, employment opportunities, housing support, debt management and financial planning advice, immigration support, and community groups. Signs in everyday language and linking with these other

sectors and agencies to provide warm handoffs can help vulnerable families access key support and potentially avoid future problems.

Upstream action to promote oral health equity

Although over 40 years have passed since John McKinlay first proposed the need for upstream action to tackle underlying root causes of poor health, this approach still remains highly relevant in promoting health equity today.[86] Reviews of the public health literature indicate that interventions to effectively reduce health inequalities include.[87,88]

- Structural changes in the environment
- Legislation and regulation
- Fiscal policy
- Programs that focus on early childhood
- Community action
- Programs that prioritize disadvantaged population groups

Many of the above interventions can tackle oral health disparities at both local and national levels. For example food policies in early life settings and schools can be implemented to create healthier environments for infants and children.[89]At the local level in the US, Berkeley, California starting in 2015 and Philadelphia starting in 2016 enacted sugar taxes; this was followed by Albany, CA, Oakland, CA, San Francisco, CA, Boulder, CO, Cook County (Chicago), IL, Portland, OR, and Seattle, WA. At national level, fiscal policies can be introduced with even greater impact to promote healthier and more affordable food and drink choices. Norway and Denmark enacted sugar taxes in the 1920s and 1930s.

More recently additional countries have enacted sugar taxes, such as: Samoa (1984), French Polynesia (2002), Nauru (2007), Hungary (2011), France (2012), and Mexico (2013). Evaluations have shown taxes decreased sugar sweetened beverage consumption in Mexico[90–92] and Berkeley, CA.[93] In the UK a national 20% sugar tax will commence in 2018 on sugar sweetened beverages with total sugar content over 5g per 100ml.[94] Legislation and regulation can also be used to improve food labeling, and control the marketing and advertising of high sugar foods and drinks that are specifically targeted at young children. Such measures will substantially reduce both dental caries and obesity levels in children.[95]

Specific oral health community based population level interventions include fluoridation of public water supplies, as well as fluoride varnish and fissure sealant programs. Community water fluoridation was initiated in the first US city in 1945 and is implemented in many countries around the world including Australia, Ireland, and Brazil. Water fluoridation has been described as one of the top ten public health achievements of the 20th century[4] and systematic reviews have demonstrated its effectiveness in preventing dental caries.[96–98] The most recent Cochrane review applying very stringent selection criteria found insufficient evidence to determine whether water fluoridation had an effect in reducing socioeconomic inequalities in caries outcomes.[98] In contrast an Australian National Health and Medical Research Council review concluded consistent evidence existed that water fluoridation reduced caries levels across socioeconomic groups and reduced inequalities, despite study quality often being quite poor.[96] A very recent Australian study has shown that fluoridation reduced absolute inequalities in childhood caries, but did not eliminate them.[99]

Topically applied fluoride varnish is a highly concentrated form of fluoride, which has been used extensively as a clinician-applied caries preventive intervention in infants, children and adolescents for many decades. Due to its adherent nature, fluoride varnish stays in contact with the tooth surface for several hours. A Cochrane systematic review concluded fluoride varnish is effective in both permanent and primary teeth[15] but it is unclear whether fluoride varnish reduces disparities in caries levels. Dental sealants are effective in preventing dental caries mainly in the pits and fissures of occlusal permanent tooth surface. They provide a physical barrier to protect natural tooth surfaces and grooves, inhibiting build-up of bacteria and food trapped within such fissures and grooves. A Cochrane systematic review on dental sealants found moderate-quality evidence that resin-based sealants applied on occlusal surfaces of permanent molars are effective in preventing caries in children and adolescents but is unclear whether fissure sealant programs promote oral health equity.[100]

Wider significance of social patterning of oral diseases – "canary in coalmine"

Children's oral epidemiologic surveillance data is a relatively inexpensive and non-invasive way to identify early marker evidence of early life social disadvantage manifesting in health effects. Not only is poor children's oral health itself an in important health problem that leads to reduced quality of life but it is also a precursor for other clinical conditions with the same common causes of early life social disadvantage. Thus, childhood caries and other oral

health problems can be viewed as sentinel health problems which should alert health providers to potential additional health sequelae.

Conclusion

Oral health disparities in children are a major public health problem across the world. Oral diseases and their effects on quality of life have a disproportionate impact on socially disadvantaged groups and indeed contribute and reinforce wider social and economic inequity in society. Oral health disparities in children are caused by a complex array of interconnected biological, behavioral, social, economic, and political factors – the social determinants. Future action to promote oral health equity in children requires a radical multi-strategy and integrated approach that address the underlying root causes of oral disparities.

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