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Oral Health Inequalities in Adolescents and Young Adults in Ontario

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Abstract

Oral health is consistently linked to physiological, psychological, and social aspects of well-being in adolescents and young adults. In this thesis, I aimed to examine the social determinants of oral health and dental care utilization. First, I conducted a scoping review of the literature, demonstrated the multifaceted nature of oral health and its connections to broader social and economic factors. Then, I conducted a cross-sectional analysis of the Canadian Community Health Survey which showed a social gradient in oral health and dental care utilization among adolescents and young adults in Ontario. When stratified by age, there was a protective association between social and living conditions with oral health for young adults but not for adolescents. Further research should focus on addressing the social determinants of oral health in comprehensive oral health promotion efforts targeting adolescents and young adults.

Keywords

Oral health, social determinants of health, adolescents, oral health behaviours, psychosocial, dental care utilization, public health dentistry, CCHS, Canada

Summary for Lay Audience

Oral health is a critical aspect of overall well-being, particularly during adolescence and young adulthood. This age group is characterized by significant developmental changes, both physically and psychologically, as well as important transitions such as entering the workforce and establishing independence occur. Thus, the aim of this thesis is to understand oral health inequalities in this age group while uncovering the behavioural and psychosocial factors contributing to such inequalities during this transition period.

The first study, aimed to review the existing literature on the social determinants of oral health inequalities in the United States and Canada for individuals aged 12 to 24 years old. A total of 21 relevant studies were located and analyzed, revealing a multifaceted landscape of oral health inequalities in this demographic group. These inequalities were found to be influenced by a complex interplay of factors including unhealthy behaviors, psychosocial stressors such as racial discrimination, and limited access to dental care for disadvantaged individuals. This scoping review results indicate suggests the need for future research, particularly longitudinal and interventional studies, to establish causality and assess the effectiveness of oral health interventions.

The second study, analyzed community survey data and used a large population-based sample from Ontario to examine the association of annual household income with each of self-reported oral health and dental care utilization and whether these associations differed between adolescents and young adults. The findings indicated a protective association between higher household income and self-reported oral health, with young adults benefiting more than adolescents. This protective effect of income on oral health was, however, partially attenuated by psychosocial stress factors. Furthermore, the study revealed that higher-income households had a lower prevalence of infrequent dental visits, emphasizing the importance of income in dental care utilization among both adolescents and young adults. The findings underscore the importance of addressing these oral health inequalities through policy measures aimed at reducing social inequalities and improving access to oral healthcare services to enhance oral health outcomes for this age group.

Co-Authorship Statement

This thesis includes two integrated articles, which will be submitted for publication to a peer-reviewed journal. The co-authorship details for each article are presented below.

Chapter 3: Rahman M, Campbell MK, Ryan B & Gomaa N. Oral Health Inequalities in Adolescents and Young Adults: A Scoping Review

Maria Rahman was involved in the conception and design of the study, study screening, extraction of data, data analysis, interpretation of data, and writing the first and subsequent drafts of the paper. Dr. Noha Gomaa was involved in the conception and design of the study, interpretation of data, writing drafts of the paper, and critical revision of the article. All authors critically reviewed the manuscript and provided feedback.

Chapter 4: Rahman M, Campbell MK, Ryan B & Gomaa N. The Social Determinants of Oral health of Adolescents and Young Adults in Ontario: A Cross-sectional Analysis of the Canadian Community Health Survey

Maria Rahman was involved in the conception and design of the studying, data acquisition and curation, coding and statistical analysis of data, and writing the first and subsequent drafts of the paper. Dr. M. Karen Campbell was involved in the design of the study, interpretation of results, and in the critical revision of the article. Dr. Bridget Ryan was involved in interpretation of results, and in the critical revision of the article. Dr. Noha Gomaa was involved in the conception and design of the study, data acquisition, interpretation of results, writing drafts of the paper, and in the critical revision of the article.

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List of Abbreviations

CCHS – Canadian Community Health Survey

CI – Confidence Interval

CPQ – Child Perceptions Questionnaire

CHMS – Canada Health Measures Survey

CSDH – WHO Commission on Social Determinants of Health

DMFT – Decayed, missing, filled teeth

ICDAS – International Caries Detection and Assessment System

MeSH – Medical Subject Heading

NCD – Noncommunicable disease

LIM – Low Income Measure

OECD – Organization for Economic Co-operation and Development

SDoH – Social Determinants of Health

POH – Perceived oral health

PR – Prevalence Ratio

PRISMA-ScR – Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews

SE – Standard Error

SEP – Socioeconomic Position

SES – Socioeconomic Status

SROH – Self-reported Oral Health

PPS – Probability Proportional to Size

PUMF – Public Use Microdata File

Chapter 1

1 Introduction

Oral health is defined by the World Health Organization (WHO) to be "the state of the mouth, teeth and orofacial structures that enables individuals to perform essential functions such as eating, breathing and speaking, and encompasses psychosocial dimensions such as self-confidence, well-being and the ability to socialize and work without pain, discomfort and embarrassment."[1] Oral health varies over the life course from early life to old age, is integral to overall health, and supports individuals in participating in society and achieving their potential.[1]

1.1 Oral Health Epidemiology

1.1.1 Oral Health Globally

Dental caries (cavities or decay), gum disease, oral cancer, oral infections, injuries, and hereditary lesions are some of the most common oral diseases worldwide.[1,2] According to the recently published WHO Global Oral Health Status Report, oral diseases affect almost 3.5 billion people globally.[3] Since 1990, the first year for which statistics on oral disorders were available from the Global Burden of Disease (GBD) study, oral diseases have continued to be one of the most prevalent diseases worldwide.[3,4] The most common major oral diseases in 2019 were severe periodontal disease (about 1 billion cases), untreated caries of deciduous teeth (about 510 million cases), edentulism (350 million cases), and untreated caries of permanent teeth (about 2 billion cases).[3] A greater number of oral diseases are predicted to persist globally than there are of the five major noncommunicable disease (NCDs), mental disorders, cardiovascular disease, diabetes mellitus, chronic respiratory diseases, and cancer altogether.[3,5]

Nearly half of the world's population is affected by untreated oral diseases.[3,6] A significant evidence that many people lack access to appropriate oral health care, which encompasses prevention, risk protection, restorative and rehabilitative services, is the

increase of 1 billion cases globally over the past 30 years.[3] Untreated dental disorders have serious and incapacitating consequences, including physical symptoms, functional restrictions, and negative effects on emotional, mental, and social wellbeing.[3,7] For those who are able to receive treatment, the costs are quite high and can result in a heavy financial burden.[3]

1.1.2 Economic Burden of Oral Diseases

On average, across countries belonging to the Organization for Economic Co-operation and Development (OECD), about 5% of total healthcare expenditures are allocated to the treatment of oral diseases.[2] Globally, in 2019 the combined direct spending on oral disorders totaled US$387 billion, or an average of US$50 per person worldwide.[2,3,8] Globally, the direct costs linked to dental diseases are estimated to be around $298 billion per year, constituting approximately 4.8% of the total global healthcare spending.[3,9] Additionally, indirect costs resulting from dental diseases amount to approximately $144 billion annually, which is comparable to the economic losses caused by the top 10 leading causes of death worldwide.[9] At the same time, productivity losses due to oral disorders were expected to cost the world's economies roughly US$ 323 billion, or about US$ 42 per person.[3] Recent studies indicate that oral diseases alone lead to productivity losses of over $1 billion per year in Canada.[2] Enhancements in oral health can yield significant economic benefits, not only in terms of reduced treatment costs but also due to potential reduced productivity losses in the labor market.[9]

1.2 Oral Health of Adolescents and Young Adults

Adolescence is a critical period for establishing oral health habits and behaviors that can influence lifelong oral health outcomes.[10] It is during this developmental stage that individuals form their oral hygiene routines, dietary habits, and attitudes towards oral health.[11] Understanding the factors that shape these behaviors is essential for developing targeted interventions to promote optimal oral health practices.[12] Poor oral health during adolescence can have long-term consequences.[11] The prevalence of caries in permanent teeth normally rises rapidly after erupting, peaks in late adolescence and early adulthood,

and then stays steady for the rest of an individual's life.[3,6] Thus, oral diseases in adolescence are associated with increased risks of dental problems and oral health-related issues later in life. For example, individuals with a history of dental caries during adolescence are more likely to experience tooth decay and other oral health problems in adulthood.[10] Therefore, addressing oral health concerns in adolescence and young adulthood is vital for preventing future oral health complications. Additionally, oral health has a significant impact on psychosocial well-being during this stage. Adolescents and young adults with poor oral health may experience decreased self-esteem, social embarrassment, and reduced overall quality of life.[7] Oral health issues can affect social interactions, school performance, and participation in various activities.[13] Addressing oral health inequalities and promoting optimal oral health practices can contribute to improved psychosocial well-being and overall quality of life among adolescents and young adults.[14] Overall, oral health problems have both immediate and long-term implications for health, well-being, and quality of life. Studying oral health in adolescence and young adulthood is important for understanding the determinants of these diseases and developing effective interventions to promote optimal oral health practices and reduce oral health inequalities.[14] By addressing oral health concerns during this critical developmental period, we can lay the foundation for improved oral health outcomes and overall well-being throughout the lifespan.[11]

1.2.1 Oral Health in Canada

Oral diseases are prevalent among adolescents in Canada.[15] Dental caries, commonly known as tooth decay, is one of the most prevalent oral diseases in this age group.[1] According to a Health Canada report published in 2010 based on the Canada Health Measures Survey (CHMS), approximately 57% of Canadian adolescents aged 12 to 19 have experienced dental caries in their permanent teeth.[16] This prevalence indicates a substantial burden of dental caries among adolescents in Canada. Furthermore, the severity and impact of dental caries are also major concerns. The CHMS data revealed that the average number of decayed or filled teeth among Canadian adolescents is relatively high, indicating a substantial need for restorative dental care.[16] Untreated caries can lead to pain, infection, and functional limitations, affecting an individual's overall

health and well-being,[17] and has broader implications for overall health, social interactions, and quality of life. These dental-related illnesses lead to an estimated 2.26 million missed school-days each year.[2] The high prevalence of dental caries in Canadian adolescents underscores the need for effective preventive measures and access to oral healthcare services.[18,19]

1.3 Social Determinants of Health Framework

Despite significant advancements in oral health sciences, such as the development of preventive and therapeutic techniques, oral health inequalities persist.[19,20] These inequalities are particularly evident in populations that bear a disproportionate burden of oral disease and disability.[19] Socioeconomic position (SEP) plays a crucial role in determining oral health outcomes, as individuals higher up the social hierarchy tend to have better oral health.[21,22] This pattern of health inequality is observed even in high-income countries like Canada, suggesting a generalized vulnerability to various diseases as one moves down the social gradient.[22] While individual behaviors are often targeted for intervention, they account for only a small portion of the differences in general and oral health between socioeconomic groups.[19,22] Therefore, focusing solely on behavioral interventions may widen rather than reduce health inequalities.[23] Improving oral health has not benefited all populations equally, with socially disadvantaged individuals and certain ethnic groups experiencing a disproportionate burden of dental caries.[19] In Canada, lower-income families face nearly twice the risk of poor oral health compared to higher-income Canadians, partly due to limited access to dental care.[2] Most dental services in Canada are privately financed, and while some social groups receive government funding for dental care, not all vulnerable individuals qualify for them.[2] Over the past decades, the social determinants of health (SDoH) have gained recognition as major contributors to oral disease among adolescents.[16] How the social determinants of health lead to health inequities are described in the WHO Commission on Social Determinants of Health Conceptual Framework (CSDH).[24,25] It emphasizes the crucial role played by the structural determinants, the socioeconomic and political settings that produce social hierarchy in any society and the subsequent socioeconomic standing of its members (Figure 1.1).[24,25] The concept of "intermediary determinants" describes how

socioeconomic status affects health later on through affecting disease risk.[24–26] Compared to those from higher socioeconomic categories, individuals of lower socioeconomic groups have fewer advantageous conditions for birth, living, working, and aging.[24,25,27] These include the material and social situations, such as housing, employment, and neighbourhood quality; psychosocial factors affecting behavioural and biological processes, as well as stress and social support.[24,25] Last but not least, the model also takes into account the value of equitable access to high-quality healthcare.[25] The primary mechanism by which socioeconomic status causes health inequalities is the unequal distribution of these intermediary factors, which is linked to differences in exposure and vulnerability to conditions that compromise health.[24] Ultimately, sociodemographic factors shape the biology and behaviors related to oral disease development in this age group. While older children and adolescents have some influence over their oral health through knowledge, behaviours, and attitudes, parental influence remains significant.[28] Adolescent oral health is influenced by various systems, including family, culture, schools, neighborhoods, healthcare systems, and government institutions.[16] These systems interact and have overlapping effects. Social determinants also play a role in dental utilization, potentially explaining why Canadian adolescents and young adults have limited access to preventive dental care services.[29]

1.3.1 Access to Dental Care in Canada

One of the notable features of dental care in Canada is the variation in public coverage among provinces and territories.[2] Canada's healthcare system is largely publicly funded, but dental care is not universally covered under the Canada Health Act.[30] As of 2018, it was estimated that approximately 35.4% of Canadians did not have dental insurance.[31] This meant that a significant portion of the population had to pay for dental services out of their own pockets or seek private insurance.[31] Different regions in Canada have established various programs targeting specific demographic groups, such as children, low-income individuals, and seniors.[32] These programs, typically managed at the provincial or territorial level, sought to improve access to dental care for vulnerable populations who face challenges in affording or accessing dental services.[32] A notable program is the Healthy Smiles Ontario (HSO) program which is a government-funded

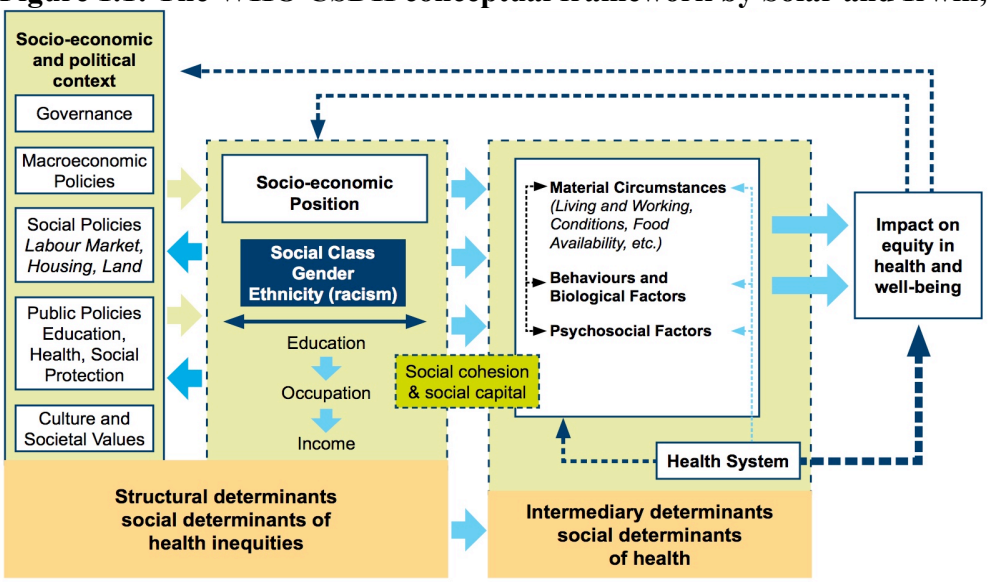
program designed to provide dental care to eligible children and adolescents.[33] This program offers free preventive, routine, and emergency dental services for children and youth aged 17 and under.[33] Eligibility for coverage is based on family income and other factors.[33] Unfortunately, no program is available to cover all dental care costs for young adults after the age of 18.[34]

Private dental insurance is prevalent in Canada, with over half of the population having coverage as of 2018.[31] These private plans offered diverse levels of dental care coverage, ranging from basic preventive services to more comprehensive treatments.[31] This private insurance system helped bridge the gap for those not covered by public programs and provided individuals with more choices regarding their dental care.[35] The availability and specifics of private dental insurance plans could vary widely, with some offering comprehensive coverage, including major dental procedures, while others focused on preventive and basic services.[36] The extent of private insurance coverage often depends on an individual's employment status, as many Canadians received private dental insurance through their employers.[31] However, it's important to recognize that not all adolescents and young adults have access to private dental insurance.[37] Those who do not have this coverage may face challenges in affording dental care.[37] This can potentially lead to inequalities in oral health and access to dental services, as those without insurance may be less likely to seek dental treatment due to cost concerns.[37]

Despite the presence of both public and private dental insurance, cost barriers remains a significant concern for many Canadians.[2] According to Statistics Canada, it is estimated that 22.4% of Canadians avoid visiting the dentist due to cost concerns.[31] The high cost of dental care, especially for major procedures, can deter individuals from seeking timely treatment and preventive services.[38] The issue of cost barriers is particularly problematic for vulnerable populations, such as adolescents and young adults especially if they from low-income families and do not have insurance coverage.[39] Inadequate access to dental care can lead to oral health problems going untreated, potentially resulting in more severe health issues down the line.[40]

Additionally, preventive care plays a critical role in maintaining oral health, and it was relatively common in Canada.[2] In 2010, the Canadian Health Measures Survey (CHMS) revealed that 74% of Canadians aged 12 to 79 reported having seen a dentist in the past year for preventive check-ups.[16] Regular dental check-ups are essential for early detection of oral health issues and the implementation of preventive measures in adolescence and young adults.[41] However, the distribution of dentists providing preventive care across the country is not uniform.[32] In 2022, Canada had 25,500 practicing dentists with urban areas having a more significant concentration of dental practices, while rural and remote regions faced challenges in accessing dental services.[32] The uneven distribution of dentists can exacerbate access issues, as residents of rural areas may need to travel long distances to receive necessary dental care.[42] This geographical disparity is a significant concern for Canada, as it impacts the equitable access to dental services for adolescents and young adults.[42]

Figure 1.1: The WHO CSDH conceptual framework by Solar and Irwin, 2010. [25]



1.4 Pathways Explaining Oral Health in Adolescence and Young Adulthood

Health inequalities are complex phenomena that have been explored through multiple theories and pathways. The materialist explanation focuses on external factors beyond an individuals' control, emphasizing the relationship between socioeconomic position and access to tangible resources.[43] According to this theory, income and wealth play a direct role in determining oral health disparities, as they influence an individual's ability to meet their basic needs and access essential resources for good oral health, such as nutritious food, adequate housing, and healthcare services.[44] It argues that factors like income and education alone are insufficient to fully account for the observed oral health inequalities in society.[45] However, it is crucial to recognize that measures of material wealth alone cannot provide a comprehensive understanding of oral health inequalities, as there are additional contextual and structural factors at play.

On the other hand, the behavioural explanation examines the impact of behavioural and lifestyle choices on health inequalities. It suggests that individuals from lower socioeconomic backgrounds are more likely to engage in behaviours that are detrimental to health compared to those from higher socioeconomic backgrounds.[46] Unhealthy dietary habits, lack of physical activity, smoking, and excessive alcohol consumption are more prevalent in lower socioeconomic groups, contributing to higher rates of oral disease and poorer oral health outcomes.[44] However, this conceptualization has faced criticism for oversimplifying behaviours and neglecting the complex interplay of various social, economic, and environmental conditions.[44] An alternative perspective highlights the influence of culture in shaping behavioural choices and argues that behaviors are not solely a result of free individual choice but are influenced by cultural norms and values that differ among social groups.[44] This theory draws on the notion that lifestyle choices can serve as indicators of social group membership.[44]Additionally, the psychosocial perspective suggests that oral health inequalities result from differences in the experience of psychological stress among socioeconomic groups.[47] Individuals from lower socioeconomic backgrounds have been shown to have higher levels of psychosocial

stress due to a range of factors such as negative life events, lower social support, limited control at work, job insecurity, and residing in communities with lower levels of trust and higher crime rates.[48] Stress can generally impact oral health through two main mechanisms: the direct and indirect models.[44] The direct model posits that stress triggers a specific chain of events leading to the development of specific oral diseases or has a general negative effect on the body, reducing resilience and increasing vulnerability to illness.[44] The indirect model proposes that individuals experiencing higher levels of psychosocial stress are more likely to engage in behavioral or lifestyle choices that are damaging to oral health.[44]

While each theory offers valuable insights into health inequalities, it is important to recognize their limitations and the need for further research. A comprehensive understanding of health inequalities requires considering the interplay between material factors, behavioural influences, and psychosocial stress. As well, it is important to explore factors like race/ethnicity (and consequent exposure to discrimination) and socioeconomic position (SEP) as defined by highest household income and its contribution to the persistence of oral health inequalities among adolescence.

1.5 Gaps in Knowledge

Within oral health epidemiology for Canadian adolescents and young adults, there exists several critical gaps that demand further exploration. Little is known about the socioeconomic differences in oral health status and dental care utilization in adolescents and young adults in Canada, particularly in Ontario. Importantly, uncovering the contributing factors behind the inequalities in oral health and dental care utilization is essential. Analyzing the interplay of individual behaviours, psychosocial, and access to dental care factors can reveal the root causes of inequalities and lead to more effective strategies for their mitigation. Lastly, exploring the impact of life transitions, from adolescence to young adulthood such as leaving home, losing dental insurance, or changing dependence status, is another worthwhile knowledge gap. These transitions significantly affect access to dental care and oral health, making their investigation vital for tailored interventions. By focusing research efforts on these gaps, a more

comprehensive understanding of oral health outcomes in Canadian adolescents and young adults, especially in Ontario, can be achieved, ultimately informing the development of equitable oral health interventions and policies.

1.6 Thesis Aims and Objectives

1. To conduct a comprehensive review of the literature on oral health of adolescence, synthesizing research findings pertaining to the social determinants of health and investigating the socioeconomic factors that are associated with oral health and dental care utilization
2. To analyze cross-sectional data from the Canadian Community Health Survey (CCHS), examining the social determinants of health in relation to oral health and dental care utilization in Ontario, Canada's most populated province.

1.7 References

1. World Health Organization. Oral health. https://www.who.int/health-topics/oral-health (accessed May 25, 2023).

2. The State of Oral Health in Canada. https://www.cda-adc.ca/stateoforalhealth/global/ (accessed July 18, 2023).

3. Global oral health status report: towards universal health coverage for oral health by 2030. https://www.who.int/publications-detail-redirect/9789240061484 (accessed Sept 21, 2023).

4. Global Burden of Disease (GBD). https://www.healthdata.org/research-analysis/gbd (accessed Oct 17, 2023).

5. Benzian H, Daar A, Naidoo S. Redefining the non-communicable disease framework to a 6 × 6 approach: incorporating oral diseases and sugars. *Lancet Public Health* 2023; **0**. DOI:10.1016/S2468-2667(23)00205-0.

6. GBD 2017 Oral Disorders Collaborators, Bernabe E, Marcenes W, *et al.* Global, Regional, and National Levels and Trends in Burden of Oral Conditions from 1990 to 2017: A Systematic Analysis for the Global Burden of Disease 2017 Study. *J Dent Res* 2020; **99**: 362–73.

7. Kaur P, Singh S, Mathur A, *et al.* Impact of Dental Disorders and its Influence on Self Esteem Levels among Adolescents. *J Clin Diagn Res JCDR* 2017; **11**: ZC05–8.

8. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. *Bull World Health Organ* 2005; **83**: 661–9.

9. Listl S, Galloway J, Mossey PA, Marcenes W. Global Economic Impact of Dental Diseases. *J Dent Res* 2015; **94**: 1355–61.

10. Heilmann A, Tsakos G, Watt RG. Oral Health Over the Life Course. In: Burton-Jeangros C, Cullati S, Sacker A, Blane D, eds. A Life Course Perspective on Health Trajectories and Transitions. Cham (CH): Springer, 2015. http://www.ncbi.nlm.nih.gov/books/NBK385369/ (accessed May 25, 2023).

11. Oral Health Across the Lifespan: Adolescents. In: Oral Health in America: Advances and Challenges [Internet]. National Institute of Dental and Craniofacial Research(US), 2021. https://www.ncbi.nlm.nih.gov/books/NBK578291/ (accessed May 25, 2023).

12. Martino S. Oral Health Behavioral and Social Intervention Research Concepts and Methods. *J Public Health Dent* 2011; **71**: S2–6.

13. Seirawan H, Faust S, Mulligan R. The Impact of Oral Health on the Academic Performance of Disadvantaged Children. *Am J Public Health* 2012; **102**: 1729–34.

14. Patrick DL, Lee RSY, Nucci M, Grembowski D, Jolles CZ, Milgrom P. Reducing Oral Health Disparities: A Focus on Social and Cultural Determinants. *BMC Oral Health* 2006; **6**: S4.

15. Gazzaz AZ, Carpiano RM, Aleksejuniene J. Socioeconomic status, social support, and oral health-risk behaviors in Canadian adolescents. *J Public Health Dent* 2021; **81**: 316–26.

16. Canada H. Canadian Health Measures Survey (CHMS). 2010; published online April 16. https://www.canada.ca/en/health-canada/services/healthy-living/reports-publications/oral-health/canadian-health-measures-survey.html (accessed May 24, 2023).

17. World Health Organization. Sugars and dental caries. https://www.who.int/news-room/fact-sheets/detail/sugars-and-dental-caries (accessed May 25, 2023).

18. Rowan-Legg A, Canadian Paediatric Society, Community Paediatrics Committee. Oral health care for children - a call for action. *Paediatr Child Health* 2013; **18**: 37–50.

19. Baiju R, Peter E, Varghese N, Sivaram R. Oral Health and Quality of Life: Current Concepts. *J Clin Diagn Res JCDR* 2017; **11**: ZE21–6.

20. Tebb KP, Pica G, Twietmeyer L, Diaz A, Brindis CD. Innovative Approaches to Address Social Determinants of Health Among Adolescents and Young Adults. *Health Equity* 2018; **2**: 321–8.

21. Guarnizo-Herreño CC, Watt RG, Fuller E, *et al.* Socioeconomic position and subjective oral health: findings for the adult population in England, Wales and Northern Ireland. *BMC Public Health* 2014; **14**: 827.

22. Watt RG, Sheiham A. Integrating the common risk factor approach into a social determinants framework. *Community Dent Oral Epidemiol* 2012; **40**: 289–96.

23. Baum F, Fisher M. Why behavioural health promotion endures despite its failure to reduce health inequities. *Sociol Health Illn* 2014; **36**: 213–25.

24. Social inequalities in oral health: from evidence to action. International Centre for Oral Health Inequalities Research and Policy.

25. World Health Organization. A conceptual framework for action on the social determinants of health. https://apps.who.int/iris/handle/10665/44489 (accessed June 28, 2023).

26. HOSSEINI SHOKOUH SM, ARAB M, EMAMGHOLIPOUR S, RASHIDIAN A, MONTAZERI A, ZABOLI R. Conceptual Models of Social Determinants of Health: A Narrative Review. *Iran J Public Health* 2017; **46**: 435–46.

27. Andermann A. Taking action on the social determinants of health in clinical practice: a framework for health professionals. *CMAJ Can Med Assoc J* 2016; **188**: E474–83.

28. Chawłowska E, Karasiewicz M, Lipiak A, *et al.* Exploring the Relationships between Children's Oral Health and Parents' Oral Health Knowledge, Literacy, Behaviours and Adherence to Recommendations: A Cross-Sectional Survey. *Int J Environ Res Public Health* 2022; **19**: 11288.

29. Amin M.S., Perez A., Nyachhyon P. Barriers to utilization of dental services for children among low-income families in Alberta. *J Can Dent Assoc* 2014; **80**: e51.

30. Quiñonez C. Why was dental care excluded from Canadian Medicare? 2013.

31. Government of Canada SC. Dental Care, 2018. 2019; published online Sept 16. https://www150.statcan.gc.ca/n1/pub/82-625-x/2019001/article/00010-eng.htm (accessed Oct 17, 2023).

32. Canadian Dental Association. https://www.cda-adc.ca/en/about/position_statements/accesstocarepaper/ (accessed Oct 17, 2023).

33. Services covered by Healthy Smiles Ontario | ontario.ca. http://www.ontario.ca/page/services-covered-by-healthy-smiles-ontario (accessed Oct 17, 2023).

34. Government Dental Programs. Ont. Dent. Assoc. https://www.oda.ca/visiting-the-dentist/government-dental-programs/ (accessed Oct 17, 2023).

35. Toward a Universal Dental Care Plan: Policy Options for Canada. IRPP. https://irpp.org/research-studies/toward-a-universal-dental-care-plan-policy-options-for-canada/ (accessed Oct 17, 2023).

36. Freed M, Ochieng N, Sroczynski N, Damico A, Published KA. Medicare and Dental Coverage: A Closer Look. KFF. 2021; published online July 28. https://www.kff.org/medicare/issue-brief/medicare-and-dental-coverage-a-closer-look/ (accessed Oct 17, 2023).

37. Thompson B, Cooney P, Lawrence H, Ravaghi V, Quinonez C. The potential oral health impact of cost barriers to dental care: findings from a Canadian population-based study. *BMC Oral Health* 2014; **14**: 78.

38. Northridge ME, Kumar A, Kaur R. Disparities in Access to Oral Health Care. *Annu Rev Public Health* 2020; **41**: 513–35.

39. Garney W, Wilson K, Ajayi KV, *et al.* Social-Ecological Barriers to Access to Healthcare for Adolescents: A Scoping Review. *Int J Environ Res Public Health* 2021; **18**: 4138.

40. Effect of Oral Health on the Community, Overall Well-Being, and the Economy. In: Oral Health in America: Advances and Challenges [Internet]. National Institute of Dental and Craniofacial Research(US), 2021. https://www.ncbi.nlm.nih.gov/books/NBK578297/ (accessed Oct 17, 2023).

41. American Academy of Pediatric Dentistry. Adolescent oral health care. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry; 2022:282-91.

42. Disparities in the Availability of Dental Care in Metropolitan Toronto | JCDA. https://jcda.ca/article/e3 (accessed Oct 17, 2023).

43. Blane D, Bartley M, Davey Smith G. Disease Aetiology and Materialistic Explanations of Socioeconomic Mortality Differentials. *Eur J Public Health* 1997; **7**. DOI:10.1093/eurpub/7.4.385.

44. Sisson KL. Theoretical explanations for social inequalities in oral health. *Community Dent Oral Epidemiol* 2007; **35**: 81–8.

45. Macintyre S. The Black Report and beyond: what are the issues? *Soc Sci Med 1982* 1997; **44**: 723–45.

46. Watt R, Sheiham A. Inequalities in oral health: a review of the evidence and recommendations for action. *Br Dent J* 1999; **187**: 6–12.

47. Elstad JI. The Psycho-social Perspective on Social Inequalities in Health. *Sociol Health Illn* 1998; **20**: 598–618.

48. Kawachi I, Subramanian SV, Almeida-Filho N. A glossary for health inequalities. *J Epidemiol Community Health* 2002; **56**: 647–52.

Chapter 2

2 Oral Health Inequalities in Adolescents and Young Adults: A Scoping Review

2.1 Abstract

Objectives: To investigate on the role of the social determinants of health in the oral health status of adolescents and young adults in the United States and Canada. ***Methods:*** We conducted a literature search in four databases (CINAHL, Embase, MEDLINE, Cochrane Library), focusing on studies published after 2000 and centered on adolescents aged 12 to 24. We included empirical studies examining the relationship between social factors (socioeconomic status, race/ethnicity) and oral health outcomes, considering all study designs, with exclusion criteria involving non-English studies and those published before 2000. Data were extracted from the selected studies, including study details, population characteristics, social factors examined, oral health outcomes, and findings. ***Results:*** A total of 21 studies were included employing various study designs (sixteen cross-sectional, two longitudinal, three retrospective cohort). Dental caries was the most studied outcome, with most studies assessing its association with social inequalities. Behavioural, psychosocial, and access to dental care factors were also examined, including unhealthy behaviours like infrequent tooth-brushing and higher sugar-sweetened beverage consumption, psychosocial stressors like racial discrimination, and limited access to dental care for disadvantaged individuals. ***Conclusion:*** Oral health inequalities exist in adolescents and young adults and they can be influenced by behavioural, psychosocial, and health system factors. Future research can employ longitudinal studies to establish causality. (young adults)

Keywords: oral health inequalities, adolescents, socioeconomic status, dental care access, behavioral factors, psychosocial stress

2.2 Introduction

Oral health is crucial to overall health and well-being, particularly during childhood and adolescence.[1] The World Health Organization (WHO) defines oral health

as “the state of the mouth, teeth and orofacial structures that enables individuals to perform essential functions such as eating, breathing and speaking, and encompasses psychosocial dimensions such as self-confidence, well-being and the ability to socialize and work without pain, discomfort and embarrassment”.[1] By definition, the impact of oral health therefore extends beyond the oral cavity, encompassing interpersonal relationships within families, friends, and throughout communities and society as a whole.[2] Meanwhile, oral health inequalities, or differences in oral health between social groups, arise from the unequal access to opportunities for achieving oral health, exacerbating the disadvantages faced particularly by socially marginalized groups.[3,4,5]

The WHO Social Determinants of Health (SDOH) Framework, along with the recent WHO Global Oral Health Status report, describe the broader societal influences on health outcomes.[8,9] It recognizes that health inequalities arise from the unequal distributions of power, resources, and opportunities within society.[9] Within this framework, socioeconomic status (SES) is recognized as a fundamental structural determinant that significantly influences health.[9] Factors, such as income, level of education, health-related behaviours, psychosocial stress and social support, shape the conditions in which individuals grow, live, work, and age.[10] These influence access to resources, opportunities, and health services that ultimately impact oral and overall health outcomes.[10] The unequal distribution of these factors contributes to variations in exposure and vulnerability to ill health.[10,11] According to the WHO Global Oral Health Status Report that was published in 2022, there are significant and ongoing socioeconomic inequalities in oral diseases, with disadvantaged and marginalized groups experiencing a higher disease burden.[12] These inequalities exist within and between countries.[12] The social gradient in oral health indicates the way oral conditions are socially structured over the socioeconomic spectrum in a continuous stepwise pattern, as is the case with the majority of chronic diseases.[12,13] Such oral health inequalities have policy ramifications as the social gradient in oral health arguably remains unaddressed by the conventional interventions that focus primarily on behavioural change for high-risk groups such as oral health education programs that have been suggested to potentially widen the social gap in oral health.[12]

Adolescence is a critical period for oral health that can influence lifelong oral health outcomes.[1,2] Poor oral health during adolescence can have long-term consequences.[13,14] The prevalence of caries in permanent teeth may peak in late adolescence and early adulthood.[3,6] Individuals with a history of dental caries during adolescence are more likely to experience tooth decay and other oral health problems later in adulthood.[15] Additionally, oral health may have a significant impact on psychosocial well-being during this stage. Adolescents and young adults with poor oral health may experience decreased self-esteem, social embarrassment, and reduced overall quality of life.[7] Oral health issues can affect social interactions, school performance, and participation in various activities.[16–18] Addressing oral health concerns during this critical developmental period can improve oral health outcomes and overall well-being throughout the lifespan.[16] Importantly, adolescents from families of lower socioeconomic backgrounds face numerous challenges that can contribute to poor oral health.[7] Predisposing factors, such as lower levels of parental education and limited oral health literacy, can result in suboptimal oral health behaviours and practices.[14] Enabling factors, including financial constraints and lack of dental insurance coverage, create barriers to accessing preventive and restorative dental care services.[15] Moreover, the availability and distribution of dental providers in disadvantaged areas can further exacerbate inequalities in access to care.[16]

Most oral health inequalities research to date has focused on children or adults. A recent scoping review by Do et al., (2022) on the socioecological determinants of child oral health highlighted the complex interplay between the social determinants of health and their impact on oral health inequalities among children.[19] The review identified 75 determinants which were divided into several socioecological levels and categories.[19] The socioecological framework's lower micro- and mesosystems level contained the majority of the determinants.[19] These factors interact at various socioecological scales to create an environment that affects people's knowledge, access to resources, and ability to maintain their oral health.[19] It also concluded that victim-blaming interventions that target health-harming behaviours only without focusing the societal root causes are arguably less effective in boosting population oral health as they increase social inequalities, are

largely the result of the predominant research and policy focus on downstream factors.[19,20]

While there have been comprehensive descriptions of oral health inequalities in child and adult populations, those of young adults are generally under examined, especially with how critical this time-period may be for adult oral health given the biological and social changes that take place during this time. There is therefore need to develop a better understand of the determinants of oral health and oral health inequalities in adolescence and young adults. In this scoping review, we aim to identify research priorities and inform future studies aimed at improving our understanding of the relationship between social determinants and oral health outcomes in adolescents and young adults. We do so by focusing particularly on the North American context, particularly, the United States and Canada. These share similarities in terms of their socioeconomic structures, and the prevalence of oral health inequalities among children and adolescents.[17] Both countries have well-established dental care systems, and access to oral health services can be influenced by various factors, including SES, insurance coverage, and geographic location.[3] However, there may also be distinct differences in policies, funding mechanisms, and healthcare delivery systems that contribute to variations in oral health outcomes and inequalities between the two countries.[17] In both countries, the oral health care delivery system has long been separated from the medical care delivery system influencing the funding and availability of dental care.[18] To this end, this scoping review aims to answer the following questions: (1) how do the structural and social factors , such as income and education determine oral health in adolescents and young adults in the American and Canadian contexts, and (2) what are the intermediary factors that contribute to these inequalities?

2.3 Methods

The objective of this scoping review was to identify and synthesize the existing literature and knowledge gaps on oral health inequalities and contributing factors in adolescents in North American settings. We followed the Preferred Reporting Items for Systematic

Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA- ScR) guidelines.[21]

2.3.1 Search Strategy

In February, 2023, a literature search was conducted using the databases CINAHL, Embase, MEDLINE, and Cochrane Library. The search strategies for each database were tailored to their specific indexing terms. The search employed a combination of keywords, search terms, Boolean operators, truncation, phrase searching, and MeSH terms related to social inequalities, oral health, and relevant concepts (Table 2.1). For each database, the categories and keywords were combined using the "AND" operator, while the keywords were combined using the "OR" operator.

Table 2.1: Search strategies for MEDLINE, Embase, CINAHL, and Cochrane Library keyword searches.

Database	Search Strategy
MEDLINE	(("oral health" OR "dental care" OR "dental health" OR "tooth abnormalities" OR "dental caries" OR "tooth wear" OR "tooth injur*" OR "tooth loss" OR "toothache" OR gingivitis OR Periodontitis) AND ("psychosocial stress" OR "psychological stress" OR "psychological distress" OR "mental stress") AND ("health promotion" OR attitude* OR "risk factor*" OR prevention OR prevalence) AND (adolescen* OR teen* OR "young adult*") AND ("North America" OR "United States" OR Canada OR Canadian OR American))
Embase	(("oral health" OR "dental care" OR "dental health" OR "tooth abnormalities" OR "dental caries" OR "tooth wear" OR "tooth injur*" OR "tooth loss" OR "toothache" OR gingivitis OR Periodontitis) AND ("psychosocial stress" OR "psychological stress" OR "psychological distress" OR "mental stress") AND ("health promotion" OR attitude* OR "risk factor*" OR prevention OR prevalence) AND (adolescen* OR teen* OR "young adult*") AND (" North America" OR "United States" OR Canada OR Canadian OR American))
CINAHL	(("oral health" OR "dental care" OR "dental health" OR "tooth abnormalities" OR "dental caries" OR "tooth wear" OR "tooth injur*" OR "tooth loss" OR "toothache" OR gingivitis OR Periodontitis) AND ("psychosocial stress" OR "psychological stress" OR "psychological distress" OR "mental stress") AND ("health promotion" OR attitude* OR "risk factor*" OR prevention OR prevalence) AND (adolescen* OR teen* OR "young adult*"))

Cochrane Library	(("oral health" OR "dental care" OR "dental health" OR "tooth abnormalities" OR "dental caries" OR "tooth wear" OR "tooth injur*" OR "tooth loss" or "toothache) AND ("socioeconomic factors" OR "economic factors") OR ("health promotion" OR attitude* OR "risk factor*" OR prevention or prevalence) AND ("adolescen* OR teen* OR "young adult*") AND (" North America" OR "United States" OR Canada OR Canadian OR American "))

2.3.2 Inclusion/Exclusion Criteria and Data Extraction

The inclusion criteria encompassed empirical studies that examined the relationship between social factors including SES indicated by education, income, occupation, race/ethnicity and oral health outcomes within the United States and Canada. The search was limited to papers published after the year 2000 and to those focusing on adolescents (12 to 24 years of age). All study designs were considered. Non-human studies, and those not available in the English language were excluded.

The search results were transferred to Covidence and any duplicate entries were eliminated. No critical appraisal of the literature was required for the scoping review methodology. PRISMA-ScR checklist was followed for study selection and extracting data.[21] The process for selecting relevant papers was carried out in two distinct stages, with both being performed by one reviewer (MR). The first stage focused on title and abstract screening to identify potentially relevant papers based on the predefined criteria for inclusion as described above. In the second stage, the full text screening of the selected articles was performed. Full-text articles were reviewed and records were excluded if they were not in English, not specific to adolescence, not specific to oral health, or were abstracts only with no full-text available. Additionally, full-text articles are excluded if they were solely based on a questionnaire, and were case reports. Following the PRISMA-ScR checklist, data extraction was carried out to collect key information, including study authors, publication year, study location, population characteristics, social factors examined, oral health outcomes assessed, and study findings.

2.4 Results

2.4.1 Study Selection

The initial literature search yielded a total of 2,849 articles from Medline (OVID), Embase, Cochrane Library, and CINAHL databases. After removing duplicates, 2,241 articles remained for further evaluation. The screening of titles led to the exclusion of 2,029 articles and further screening of abstracts led to excluding 155 articles based on the inclusion and exclusion criteria. The most common reasons studies were excluded are that they did not involve adolescents or young adults (typically aged 12 to 24 years) and were studies exploring social determinants of health without an oral health component. Subsequently, the full texts of 212 articles were assessed (Figure 2.1). Due to the number of included studies and their heterogeneous characteristics, we describe the key results in the narrative form.

2.4.2 Characteristics of Included Studies

The final selection consisted of 21 studies that met the inclusion criteria (Table 2.2). These were conducted between 2001 – 2022 and encompassed a diverse range of populations and geographic locations within the United States and Canada. The sample sizes of the included studies varied widely, ranging from small-scale community-based studies (n=10) to large-scale national surveys (n=11).

A total of 16 studies had a cross-sectional design with 94,727 participants,[22–37] 2 studies had a longitudinal design with 8,803 participants,[38,39] and 3 were of retrospective cohort studies with 67,241 participants. [40–42] Out of the 21 studies, 16 were conducted in the United States,[23,25,26,29–32,34–42] while only 5 studies were conducted in Canada.[22,24,27,28,33]

2.4.3 Oral Health Outcomes

The oral health outcomes assessed in the included studies encompassed both subjective and objective measures. The most commonly used objective clinical measures included the Decayed, Missing and Filled teeth (DMFT) index, the International Caries Detection and Assessment System (ICDAS) system and composite quality score derived from seven dental quality measures (DQMs). Perceived oral health (POH), self-reported condition of the teeth and visits to the dentists were the most commonly assessed subjective measures. The examined outcomes included dental caries, oral hygiene practices, and access to dental care. The presence of dental caries, in particular, was a focus of investigation, with 7 studies assessing its association with social factors.[27,29,31,34,36,39,42]

2.4.4 Social Determinants of Oral Health

The included studies examined a wide range of social determinants of oral health, including socioeconomic status and race/ethnicity. These determinants were analyzed in relation to behavioral, psychosocial, and access to health care to identify their contribution to on oral health outcomes and related oral health inequalities. Out of the 21 included studies, only one study focused on both behavioural and psychosocial factors,[24] while 7 studies focused on behavioural factors,[27,30,32,34,36,39,42] 2 on psychosocial factors[25,33] and 11 on access to dental care factors.[22,23,26,28,29,31,35,37,38,40,41]

The included studies consistently indicated significant associations between social factors such as household income and highest level of household education with oral health outcomes. Specifically, lower socioeconomic status indicated by lower education levels and lower income were consistently linked to worse oral health outcomes, including higher prevalence of dental caries and lower dental care utilization.[22–24,28,30,33–37,39,40] Racial and ethnic inequalities in oral health were also evident, with African-American adolescents experiencing higher rates of oral diseases compared to others.[25,38,41] Racial and ethnic inequalities were not explored in any of the included Canadian studies.

2.4.5 Behavioural Factors

The studies which included behavioural factors encompassed a range of oral health-related behaviors, such as oral hygiene practices, dietary habits, tobacco use, and substance abuse.[27,30,32,36,39,42] Several studies demonstrated that adolescents from lower socioeconomic backgrounds were more likely to engage in unhealthy behaviors, such as poor oral hygiene practices and consumption of sugary foods and beverages, which increased their risk of dental caries. For an example, a recent study by Gazzaz et al. (2021) found that adolescents from households of lower education and income had higher rates of irregular tooth-brushing and more frequent consumption of sugary snacks and beverages.[24] These behaviours were associated with a higher rates of dental caries and poor oral health outcomes. Moreover, individuals facing social inequalities were more prone to tobacco use and substance abuse, further exacerbating oral health problems. The study by Ditmyer et al. (2013) suggested those of lower socioeconomic status to have higher rates of tobacco consumption, a well-known risk factor for several oral health problems.[42]

2.4.6 Psychosocial Factors

Psychosocial factors in the included studies were mainly life stress, exposure to discrimination and lack of social support. Studies suggested found that individuals experiencing socioeconomic inequalities faced higher levels of psychosocial stressors which may ultimately contribute to oral health problems.[24,25,33]

Discrimination is widely recognized as a significant psychosocial stressor.[25] Racial discrimination can manifest as an ongoing stressor when individuals experience repeated instances of mistreatment over an extended period of time. Distrust towards dentists stemming from previous encounters of perceived or actual unequal treatment can result in infrequent dental care visits.[25] A study by McGlumphy (2019) reported that greater exposure to racial discrimination among African-American youth predicted worse perceived oral health.[25] This association remained significant even after considering confounding factors such as added sugar intake, tooth-brushing frequency, dental visit frequency, age, and sex.[25] The findings suggested that experiences of racial

discrimination may uniquely shape the perception of oral health in African-American youth.A study by Gazzaz et al. highlighted that individuals with lower socioeconomic status had limited social support for oral health, which affected their ability to seek preventive and treatment services.[24] Additionally, individuals belonging to lower socioeconomic status families had limited oral health-related knowledge and less favorable attitudes towards oral healthcare, leading to inadequate oral health practices.[33] Individuals from lower household income and education backgrounds also experienced higher levels of chronic stress. Moreover, limited social support networks and lower oral health literacy were identified as barriers to accessing appropriate oral health care services among disadvantaged individuals.[24]

2.4.7 Access to Dental Care Factors

Dimensions of dental care access studied included the affordability of dental care, availability of dental insurance coverage, and the utilization of dental services.[22,23,26,28,29,31,35,37,38,40,41] Individuals from lower socioeconomic backgrounds faced significant barriers to accessing dental care, including limited availability of providers in underserved areas, high treatment costs, and lack of dental insurance coverage.[23,28,31,40] A study by Atkins et al. found that individuals with lower income and education levels had lower rates of dental service utilization and were more likely to delay or forgo dental care due to financial constraints.[23] Furthermore, differences in dental insurance coverage were evident, with individuals from disadvantaged backgrounds being less likely to have comprehensive dental insurance or access to public dental insurance programs.[23] Another study by Duncan et al. (2014) revealed that individuals with lower socioeconomic status were more likely to lack dental insurance or to have limited dental insurance coverage, resulting in unmet dental needs.[28]

2.5 Discussion

The aim of this scoping review was to identify and summarize the factors the social factors involved in the oral health of adolescence and young adults and the potential explanatory pathways to oral health inequalities in this population, including behavioural,

psychosocial and access to dental care factors, following the WHO SDOH framework as a guiding map for our summary. We identified key findings and provided insights into the interplay between these factors and oral health. Sociodemographic factors, such as socioeconomic status, were consistently found to be associated with oral health behaviors and outcomes.[9] Higher SES and affluence were found to be positively correlated with better tooth-brushing habits and improved oral health. These findings suggest that individuals from more privileged backgrounds may have greater access to oral health resources, including oral hygiene products and dental services, resulting in improved oral health outcomes.

Furthermore, our review examined the impact of dental care coverage on oral health services. Kranz et al (2019) found that the inclusion of pediatric dental care in the Affordable Care Act's essential health benefits was associated with increased dental insurance coverage among children but dental visit rates remained unchanged.[26] This finding underscores the SDOH principle of access to healthcare services, which extends beyond insurance coverage to include barriers related to affordability, availability, and cultural competence.[26] While improved insurance coverage may enhance access to dental care, additional strategies addressing these broader access barriers may be needed to ensure equitable utilization of dental services.

Our review also identified consistent findings on the association between psychosocial factors and oral health. We found that experiences of racial discrimination among African-American youth for example were associated with lower perceived oral health.[25] These findings align with the SDOH framework's emphasis on the impact of social exclusion and discrimination on health outcomes. They emphasize the importance of considering the psychosocial context in oral health assessments and interventions, particularly for marginalized populations.[25] Tackling racism and promoting social inclusion are essential steps towards improving oral health equity.[43,44] Additionally, lower family and peer support were associated with a higher likelihood of engaging in oral health-risk behaviors, such as infrequent tooth-brushing and higher sugar-sweetened beverage consumption.[24] Parental support emerged as a protective factor against these

behaviors. These findings highlight the importance of social networks and supportive relationships in promoting positive oral health behaviours.

While our scoping review has made significant strides in elucidating the social factors influencing the oral health of adolescents and young adults, certain knowledge gaps persist within the current literature. The included studies predominantly focused on broad sociodemographic factors, particularly socioeconomic status with oral health behaviors. However, a more nuanced exploration of other social determinants, such as cultural and environmental influences, remains limited. Additionally, while the impact of dental care coverage on oral health services has been discussed, there is a need for a deeper understanding of the specific mechanisms through which insurance coverage affects utilization, especially considering the persistence of unchanged dental visit rates among certain populations. The psychosocial dimension, although addressed to some extent, requires more comprehensive investigation into the intersectionality of factors like race, discrimination, and mental health with oral health outcomes. Furthermore, the role of community-based interventions and the effectiveness of preventive programs in diverse cultural settings should be explored to inform targeted strategies for oral health promotion.

2.5.1 Strengths and Limitations

In this scoping review, we have undertaken a summary and synthesis of the existing literature concerning oral health inequalities among adolescents in the United States and Canada. Our research questions centered on the multifaceted role of the social determinants of health, including socioeconomic status, race/ethnicity, and access to healthcare services, in shaping oral health outcomes during the critical period of adolescence. The studies reviewed encompassed diverse populations and geographic locations within the two countries, yet consistency in findings and offering valuable insights into the complex interplay between sociodemographic factors, behavioral and psychosocial determinants, access to dental care, and oral health outcomes. Our review reveals the importance of addressing these social determinants to mitigate oral health

inequalities and promote equity in oral health care access and outcomes among adolescents.

While this scoping review provides insights, it is important to acknowledge certain limitations. Firstly, due to the scoping nature of this review, we focused on identifying patterns, themes, and key findings in the literature rather than conducting a systematic quality assessment of individual studies. This approach allows for a broad overview of the topic however, it does not provide an evaluation of the methodological rigor and quality of included studies. Therefore, the findings should be interpreted with consideration for the varied methodological approaches and potential biases present in the included studies. For example, the majority of the included studies relied on self-reported measures of oral health outcomes, which may introduce bias and measurement error. Furthermore, the included studies varied in their methodologies and sample characteristics specifically the age range used to characterize adolescence, making direct comparisons challenging. Additionally, the scoping review primarily focused on studies conducted in two high-income countries, namely the United States and Canada. As a result, the generalizability of the findings to low- and middle-income countries is limited. It is crucial to recognize that the social determinants of oral health and their impact on oral health behaviors and outcomes may differ across diverse socioeconomic and cultural contexts. Finally, it is important to note that this scoping review primarily examined cross-sectional and observational studies only, which provide insights into associations but do not establish causality. Future research should aim to include studies from a wider range of countries and populations to provide a more comprehensive understanding of these relationships. Longitudinal studies are needed to further explore the complex interactions between sociodemographic factors, oral health behaviors, and oral health outcomes.

2.6 Conclusion

This scoping review sheds light on oral health inequalities in adolescents and young adults and how they are influenced by the interplay of behavioral, psychosocial, and health system factors. The review underscores the need for comprehensive oral health

promotion strategies that address the social determinants influencing oral health. By considering the multifaceted nature of oral health and its connections to broader social and economic factors, interventions can be developed to target specific populations and address the underlying determinants of oral health inequalities. Promoting health equity requires a collaborative effort involving policymakers, healthcare providers, communities, and individuals to address the socioeconomic and structural factors that contribute to oral health inequalities.

Figure 2.1: PRISMA flow diagram for records identified in scoping review.

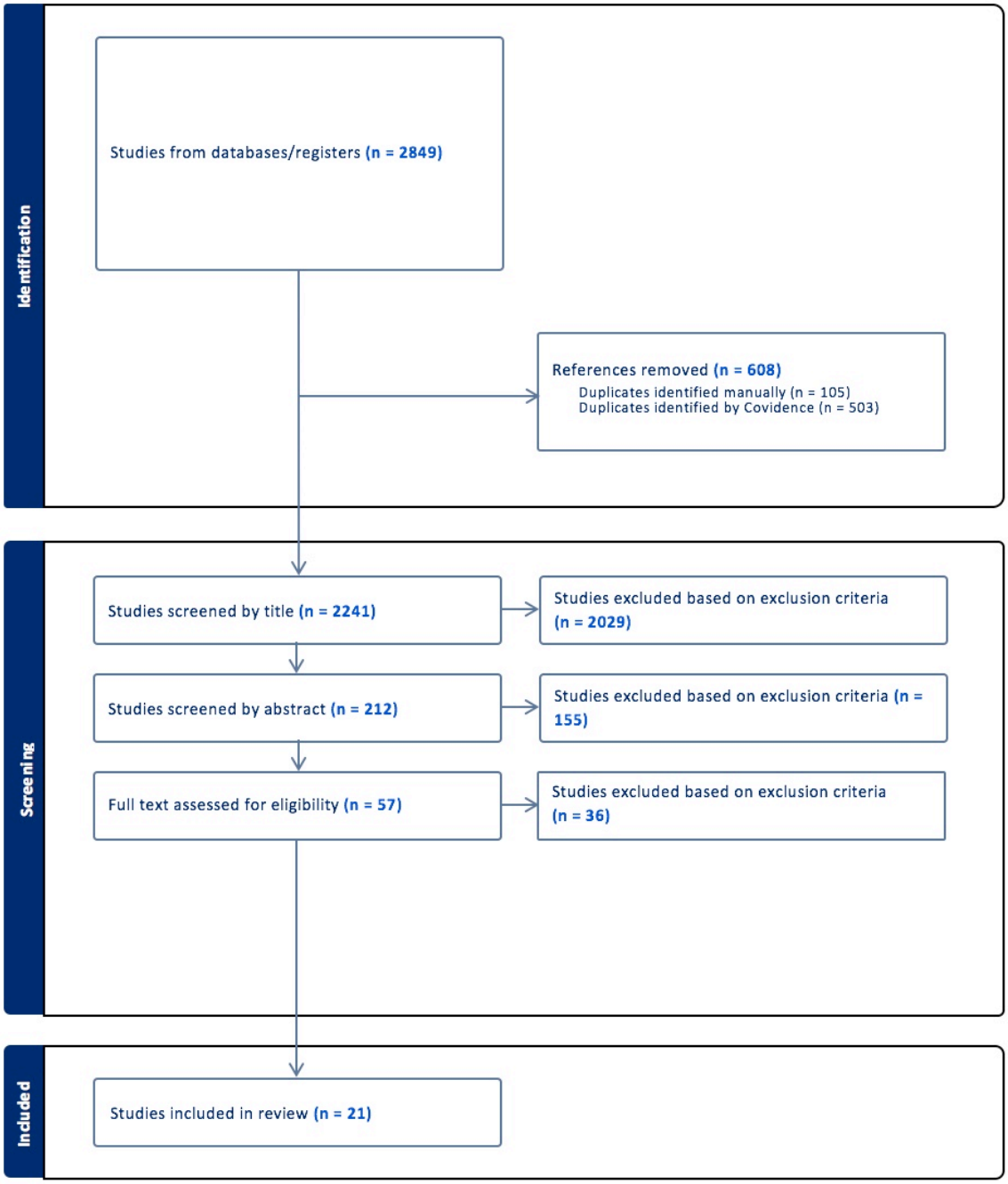


Table 2.2: Summary of included studies involving the role of behavioural, psychosocial and access to dental care factors in oral health and dental care utilization.

Author, Year	Study Design	Country	Study Population (n)	Measure of Exposure	Outcomes	Findings
Amin (2018)[22]	• Cross-sectional study • Survey questionnaire administered via telephone interviews to clients of ACHB and AAHB programs	Alberta, Canada	• N= 820 (parents or guardians) • Age 1-18	• Clients enrolled in the ACHB or AAHB	• Assessed dental service in the 12 months before the survey • Utilization of dental services for children among low-income families	• Majority of respondents reported benefiting from the dental programs • 54.8% of ACHB and 57.4% of AAHB clients reported receiving dental services for their youngest child in the previous 12 months
Atkins et al. (2012)[23]	• Cross-sectional study • Multilevel modeling of Add Health (1994-1995) and ECLS-K (1998-1999)	US	• Sample size is 11,844 • Age 12-21	• Neighborhood poverty level (poverty rate by zip code)	• Dental utilization by American adolescents	• Neighborhood poverty was associated with lower utilization of dental care among American adolescents • Adolescents in low SES neighborhoods were less likely to utilize dental care than their counterparts in higher SES neighborhoods
Gazzaz et al. (2021)[24]	• Cross-sectional study • 2013/2014 Canadian Health Behavior in School-aged Children Study	Canada	• Sample size is 20,357 • Adolescents ages 12–18 years	• Family SES level measured by Family Affluence Scale	• Infrequent toothbrushing • High SSB intake • High sweets consumption	• Adolescents from low SES households had lower parental and peer support, and were more likely to report infrequent toothbrushing and high SSB, even after accounting for support • Lower peer support was associated with infrequent toothbrushing and lower likelihood of high SSB consumption • Parental support was protective but peer support was posing risks and protective

Chankanka et al. (2011)[39]	• Longitudinal study	Iowa, US	• Sample size is 156 • Age 5 – 13	• Tooth brushing frequencies, and composite water fluoride levels collected from 3-5, 6-8, and 11-13 years	• Occurrence of new non-cavitated caries and cavitated caries surfaces, measured at 3 dental exams	• Higher tooth brushing frequency and higher socioeconomic status were associated with fewer non-cavitated caries
Choi et al. (2022)[40]	• Retrospective cohort study • Medical and dental claims from a commercial insurer from January 2015 to December 2019	US	• Sample size 1.31 million (4.88 million person- years) • Younger than 21 years of age	• Level of dental care quality depending on the age group and changes over a period of time	• Composite quality score, derived from seven dental quality measures (DQMs)	• Composite score was linked to shortage of dental professionals, median household income, the proportion of African Americans, unemployment rates, and lower education levels within specific zip code areas
McGlumphy et al. (2019)[25]	• Cross-sectional study	Michigan, US	• Sample size is 156 • Mean age: 14.0+/-0.2 years old	• Perceived stress, daily stress, and racial discrimination experienced by African American youth	• POH	• Greater exposure to racial discrimination was associated with lower POH in African American youth, even after accounting for confounding factors • No significant relationships were found between perceived stress, daily stress, and POH in the studied population
Kranz et al. (2019)[26]	• Cross-sectional study • 2010-2015 National Health Interview Survey (NHIS)	US	• Sample size is 16,404 • Age 1 – 18	• Inclusion of pediatric dental care in the Affordable Care Act (ACA)	• Pre- and post-ACA periods, private dental insurance rates & annual dental visits	• Inclusion of pediatric dental care to the ACA increased dental insurance coverage • Dental visits among children were not affected by this policy

Hoover et al. (2017)[27]	• Cross-sectional study	Saskatch-ewan, Canada	• 133 children/adolescents • Mean age; 8.63 ± 2.96 years	• Status of being a recent immigrant or refugee	• DMFT	• Recent immigrant and refugee children had higher DMFT scores compared to Canadian children
Duncan et al. (2014)[28]	• Cross-sectional study • 2009 Canadian Health Measures Survey	Canada	• Sample size 5,604 • Age 6 – 19	• Income and dental insurance coverage	• Need for dental care, both urgent and non-urgent	• Individuals with dental insurance coverage had a lower need for dental treatment, both urgent and non-urgent, compared to those without insurance coverage • There was an income gradient in the need for dental treatment, with higher-income individuals having a lower need for treatment • Controlling for socio-demographic and oral health variables decreased the association between dental insurance coverage and need for treatment, but the income-related inequality persisted even among individuals with insurance coverage
Dawkins et al. (2013)[31]	• Cross-sectional study	Kentucky, US	• Sample size is 2,453 • Age 6 – 15 years	• Dental insurance	• Presence or absence of untreated dental caries	• Older age, lack of private insurance, and rural residence were associated with a higher likelihood of untreated dental caries, indicating the need for targeted interventions to address these disparities
Yuen et al. (2011)[32]	• Cross- sectional study	South Carolina, US	• Sample size is 156 • Age 10 – 18	• Oral hygiene behavior • Consumption of cariogenic snacks and nondiet soft drinks	• Reported toothache experience in the past 12 months	• Younger age, frequent consumption of cariogenic snacks, and a higher number of cans of nondiet soft drinks consumed during the weekend were significantly associated with an increased likelihood of experiencing toothache in the past 12 months

Locker (2007)[33]	• Cross- sectional study • School-based dental screening program	Canada	• Sample size is 370 • Age 11 – 14 years	• Household income was used to determine disparities in oral health-related quality of life	• CPQ 11-14 scores	• Children from low-income households had poorer oral health-related quality of life compared to children from higher-income households • Family structure, specifically households with only one adult, was associated with higher oral health-related quality of life scores among children
Tellez et al. (2006)[34]	• Cross-sectional study • Neighborhood clusters	Michigan, US	• Sample size is 342 • Age 14–24 years	• Neighborhood effects • Oral hygiene habits	• ICDAS	• There is significant variation in the severity of dental caries among low-income African-American neighborhood clusters • Caries severity was found to be associated with neighborhood factors, such as the number of grocery stores in the clusters, after considering individual characteristics. • Neighborhoods play a unique role in oral health, beyond socioeconomic position and individual risk factors
Kenney et al. (2005)[35]	• Cross-sectional study • 2002 National Survey of America's Families	US	• Sample size is 9,714 • Age 4 – 17 years	• Socioeconomic, demographic, and health factors	• Preventive dental care • Unmet dental needs	• More than half of low-income children without health insurance did not receive preventive dental care visits • Children from low-income families who had private health insurance but no dental benefits had similar levels of unmet dental needs as uninsured children
Cote et al. (2004)[29]	• Cross-sectional study • Refugee Health Assessment Program	US	• Sample size is 224 • Mean age of 10.6 years (SD: 4.82; median: 10.7 years)	• Refugee status	• Caries experience and untreated decay	• Newly arrived refugee children had a high prevalence of dental caries, with 51.3% experiencing caries and 48.7% having untreated decay

VonKaenel et al. (2001)[41]	• Retrospective cohort study	US	• Sample size is 300 • Age 6 – 18 years	• Race, insurance status, and parental marital status	• Visit to hospital emergency department for caries-related dental pain	• The majority of children observed in the emergency department were from low-income backgrounds, came from single-parent households, and were disproportionately from minority groups
Ditmyer et al. (2013)[42]	• Retrospective cohort study	Nevada, US	• Sample size is 66,941 • Age 13 – 18 years	• Tobacco/marijuana use	• Dental health status (prevalence and severity of dental caries)	• Adolescents who used tobacco/marijuana had significantly higher prevalence and severity of dental caries compared to those who did not, across all variables and throughout the 8-year period of the study • This association remained significant even after controlling for gender, race/ethnicity, residential location, and exposure to secondhand smoke
Isong et al. (2012)[38]	• Longitudinal study	US	• Sample size is 8647 • Age 2 – 17 years	• Race (African American/white)	• Dental care (measured by dental visit in the previous 12 months and history of never having had a dental visit)	• In 1964, there were pronounced disparities between African American and white children in dental utilization rates • Over time, these disparities attenuated and became nonsignificant by 2010, indicating a dramatic narrowing of African American/white disparities in children's receipt of dental services
Telford et al. (2011)[30]	• Cross- sectional study • California Health Interview Survey (CHIS)	US	• Sample size is 3,582 • Age 12 – 17 years	• Family poverty level and parental education • Health-influencing behaviors, dental care, and social factors	• Self-reported condition of the teeth	• Adolescents living below the federal poverty guidelines were more likely to report fair or poor tooth condition compared to those who were least poor • Additional disparities in oral health were observed in relation to health-influencing behaviors, social environment, and dental care

Polk et al. (2010)[36]	• Cross-sectional study	Pennsylvania, US	• Sample size is 6,040 • Mean age was 15.43 years	• SES	• Caries experience, measured by Decayed, Missing, and Filled Teeth (DMFT)	• Oral hygiene behaviors such as brushing, flossing, and preventive interventions were found to be lower among individuals with lower SES • Oral health behaviors and preventive interventions did not fully account for the disparities in caries experience defined by SES
Guendelman et al. (2005)[37]	• Cross-sectional study • 2001 California Health Interview Survey	US	• Sample size is 16,528 • <18 years of age	• Family SES	• Health care access and use	• Children from working poor families have higher odds of being uninsured compared to children from nonworking poor • The largest disparities in service use were observed in dental care, and even after controlling for insurance coverage and other factors, these disparities remained

ACHB: Alberta Child Health Benefit; AAHB: Alberta Adult Health Benefit; SSB: Sugar-sweetened beverage; POH: Perceived oral health; DMFT: Decayed, missing, filled teeth; CPQ: Child Perceptions Questionnaire; ICDAS: International Caries Detection and Assessment System; SES: Socioeconomic status

2.7 References

1. Oral Health Across the Lifespan: Adolescents. In: Oral Health in America: Advances and Challenges [Internet]. National Institute of Dental and Craniofacial Research(US), 2021. https://www.ncbi.nlm.nih.gov/books/NBK578291/ (accessed May 25, 2023).

2. Patrick DL, Lee RSY, Nucci M, Grembowski D, Jolles CZ, Milgrom P. Reducing Oral Health Disparities: A Focus on Social and Cultural Determinants. *BMC Oral Health* 2006; **6**: S4.

3. Northridge ME, Kumar A, Kaur R. Disparities in Access to Oral Health Care. *Annu Rev Public Health* 2020; **41**: 513–35.

4. Braveman P. Health disparities and health equity: concepts and measurement. *Annu Rev Public Health* 2006; **27**: 167–94.

5. Whitehead M. The concepts and principles of equity and health. *Int J Health Serv Plan Adm Eval* 1992; **22**: 429–45.

6. Da Mata L, Azevedo A, Pereira M deLurdes. Socioeconomic inequalities in oral health-related behaviors in 18-year-old adolescents: A cross-sectional study. *J Int Soc Prev Community Dent* 2021; **11**: 703.

7. Sfreddo CS, Moreira CHC, Nicolau B, Ortiz FR, Ardenghi TM. Socioeconomic inequalities in oral health-related quality of life in adolescents: a cohort study. *Qual Life Res Int J Qual Life Asp Treat Care Rehabil* 2019; **28**: 2491–500.

8. World Health Organization. Closing the gap in a generation: health equity through action on the social determinants of health - Final report of the commission on social determinants of health. https://www.who.int/publications-detail-redirect/WHO-IER-CSDH-08.1 (accessed May 24, 2023).

9. World Health Organization. A conceptual framework for action on the social determinants of health. https://apps.who.int/iris/handle/10665/44489 (accessed June 28, 2023).

10. Braveman P, Gottlieb L. The Social Determinants of Health: It's Time to Consider the Causes of the Causes. *Public Health Rep* 2014; **129**: 19–31.

11. Graham H. Social Determinants and Their Unequal Distribution: Clarifying Policy Understandings. *Milbank Q* 2004; **82**: 101–24.

12. Global oral health status report: towards universal health coverage for oral health by 2030. https://www.who.int/publications-detail-redirect/9789240061484 (accessed Sept 21, 2023).

13. López R, Fernández O, Baelum V. Social gradients in periodontal diseases among adolescents. *Community Dent Oral Epidemiol* 2006; **34**: 184–96.

14. Chawłowska E, Karasiewicz M, Lipiak A, *et al.* Exploring the Relationships between Children's Oral Health and Parents' Oral Health Knowledge, Literacy, Behaviours and Adherence to Recommendations: A Cross-Sectional Survey. *Int J Environ Res Public Health* 2022; **19**: 11288.

15. Locker D, Maggirias J, Quiñonez C. Income, dental insurance coverage, and financial barriers to dental care among Canadian adults. *J Public Health Dent* 2011; **71**: 327–34.

16. Levy BB, Goodman J, Eskander A. Oral healthcare disparities in Canada: filling in the gaps. *Can J Public Health Rev Can Santé Publique* 2022; **114**: 139–45.

17. Chari M, Ravaghi V, Sabbah W, Gomaa N, Singhal S, Quiñonez C. Oral health inequality in Canada, the United States and United Kingdom. *PLoS ONE* 2022; **17**: e0268006.

18. Vujicic M, Buchmueller T, Klein R. Dental Care Presents The Highest Level Of Financial Barriers, Compared To Other Types Of Health Care Services. *Health Aff Proj Hope* 2016; **35**: 2176–82.

19. Do LG, Song YH, Du M, Spencer AJ, Ha DH. Socioecological determinants of child oral health-A scoping review. *Community Dent Oral Epidemiol* 2022; published online Nov 28. DOI:10.1111/cdoe.12819.

20. Watt RG, Sheiham A. Integrating the common risk factor approach into a social determinants framework. *Community Dent Oral Epidemiol* 2012; **40**: 289–96.

21. Tricco AC, Lillie E, Zarin W, *et al.* PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med* 2018; **169**: 467–73.

22. Amin M.S., Perez A., Nyachhyon P. Barriers to utilization of dental services for children among low-income families in Alberta. *J Can Dent Assoc* 2014; **80**: e51.

23. Atkins R, Sulik MJ, Hart D. The association of individual characteristics and neighborhood poverty on the dental care of American adolescents. *J Public Health Dent* 2012; **72**: 313–9.

24. Gazzaz AZ, Carpiano RM, Aleksejuniene J. Socioeconomic status, social support, and oral health-risk behaviors in Canadian adolescents. *J Public Health Dent* 2021; **81**: 316–26.

25. McGlumphy KC, Damen M, Hasson RE. Psychosocial Stress and Perceived Oral Health in African American Youth. *Pediatr Dent* 2019; **41**: 358–63.

26. Kranz AM, Dick AW. Changes in pediatric dental coverage and visits following the implementation of the affordable care act. *Health Serv Res* 2019; **54**: 437–45.

27. Hoover J, Vatanparast H, Uswak G. Risk Determinants of Dental Caries and Oral Hygiene Status in 3-15 Year-Old Recent Immigrant and Refugee Children in Saskatchewan, Canada: A Pilot Study. *J Immigr Minor Health* 2017; **19**: 1315–21.

28. Duncan L, Bonner A. Effects of income and dental insurance coverage on need for dental care in Canada. *J Can Dent Assoc* 2014; **80**: e6.

29. Cote S, Geltman P, Nunn M, Lituri K, Henshaw M, Garcia RI. Dental caries of refugee children compared with US children. *Pediatrics* 2004; **114**: e733-40.

30. Telford C., Coulter I., Murray L. Exploring socioeconomic disparities in self-reported oral health among adolescents in California. *J Am Dent Assoc* 2011; **142**: 70–8.

31. Dawkins E, Michimi A, Ellis-Griffith G, Peterson T, Carter D, English G. Dental caries among children visiting a mobile dental clinic in South Central Kentucky: a pooled cross-sectional study. *BMC Oral Health* 2013; **13**: 19.

32. Yuen HK, Wiegand RE, Hill EG, *et al.* Factors associated with toothache among African American adolescents living in rural South Carolina. *Soc Work Public Health* 2011; **26**: 695–707.

33. Locker D. Disparities in oral health-related quality of life in a population of Canadian children. *Community Dent Oral Epidemiol* 2007; **35**: 348–56.

34. Tellez M, Sohn W, Burt BA, Ismail AI. Assessment of the relationship between neighborhood characteristics and dental caries severity among low-income African-Americans: a multilevel approach. *J Public Health Dent* 2006; **66**: 30–6.

35. Kenney GM, McFeeters JR, Yee JY. Preventive dental care and unmet dental needs among low-income children. *Am J Public Health* 2005; **95**: 1360–6.

36. Polk D.E., Weyant R.J., Manz M.C. Socioeconomic factors in adolescents' oral health: Are they mediated by oral hygiene behaviors or preventive interventions? *Community Dent Oral Epidemiol* 2010; **38**: 1–9.

37. Guendelman S., Angulo V., Oman D. Access to health care for children and adolescents in working poor families: Recent findings from California. *Med Care* 2005; **43**: 68–78.

38. Isong I.A., Soobader M.-J., Fisher-Owens S.A., *et al.* Racial disparity trends in children's dental visits: US National Health Interview Survey, 1964-2010. *Pediatrics* 2012; **130**: 306–14.

39. Chankanka O., Cavanaugh J.E., Levy S.M., *et al.* Longitudinal associations between children's dental caries and risk factors. *J Public Health Dent* 2011; **71**: 289–300.

40. Choi SE, Kalenderian E, Normand S-L. Measuring the quality of dental care among privately insured children in the United States. *Health Serv Res* 2022; **57**: 137–44.

41. Von Kaenel D, Vitangeli D, Casamassimo PS, Wilson S, Preisch J. Social factors associated with pediatric emergency department visits for caries-related dental pain. *Pediatr Dent* 2001; **23**: 56–60.

42. Ditmyer M., Demopoulos C., McClain M., Dounis G., Mobley C. The effect of tobacco and marijuana use on dental health status in nevada adolescents: A trend analysis. *J Adolesc Health* 2013; **52**: 641–8.

43. Fleming E, Bastos JL, Jamieson L, *et al.* Conceptualizing inequities and oppression in oral health research. *Community Dent Oral Epidemiol* 2023; **51**: 28–35.

44. Park L, Gomaa N, Quinonez C. Racial/ethnic inequality in the association of allostatic load and dental caries in children. *J Public Health Dent* 2022; **82**: 239–46.

Chapter 3

3 The Social Determinants of Oral Health of Adolescents and Young Adults in Ontario: A Cross-sectional Analysis of the Canadian Community Health Survey

3.1 Abstract

Objectives: To assess the associations between social and living conditions, indicated by annual household income, and each of self-reported oral health (SROH) and dental care utilization in adolescents and young adults in Ontario, Canada's most populated province, stratified by age; and to examine the contribution of individual behaviours, psychosocial and access to dental care factors to these relationships. ***Methods:*** We retrieved data of 4,316 Ontario adolescents and young adults, aged 12 – 24 years, from the Canadian Community Health Survey (CCHS) (2017–2018 cycle). Descriptive statistics used sample weights to account for the survey's complex design to ensure our sample was representative of the Ontario population. To examine the relationship between annual household income and SROH and dental care utilization, four logistic regression models were constructed for each of the outcome variables in which explanatory variables (smoking and alcohol consumption, psychosocial stress and the availability of dental insurance) were added in a block-wise method. We further stratified the sample into adolescents (12 – 17 years of age) and young adults (18 – 24 years of age) to compare the associations of interest within each of these age groups. ***Results:*** Annual household income had a protective association with SROH. Respondents from families reporting a higher annual household income were less likely to report poor oral health (PR=0.55, 95% CI 0.35,0.89). When further stratified by age group, we found that the protective association between annual household income and SROH was significant for the young adult age group (18-24 years) but not adolescents (12-17 years of age) even after controlling for covariates in sequential models. This protective association was partly attenuated by psychosocial stress factors (PR=0.50, 95%CI 0.29,0.86). Respondents in the higher annual household income category had a lower prevalence of reporting infrequent dental visits (PR=0.40, 95% CI 0.28, 0.58) than their lower income counterparts. When further stratified by age group, we found that the protective association between annual household income and the frequency of dental visits was significant in both adolescents (aged 12-17 years) and young adults (aged 18-24 years) in fully adjusted models.

Conclusion: There are socioeconomic inequalities in oral health and dental care utilization in Ontario's adolescents and young adults. Policies directed towards closing the social gap in oral health and issues of access to care can help improve oral health outcomes for this vulnerable age group.

Keywords: oral health, inequalities, adolescence, socioeconomic factors, social determinants of health

3.2 Introduction

Oral health is integral to overall health.[1] Oral diseases have been linked to physiological, psychological and social aspects of well-being, such as poor sleep quality, affected growth, behavioural problems, poor academic performance, and time missed from school or work in various age groups, including children and adolescents.[2,3,4] Poor oral health also impacts communication, social interaction, and self-esteem that are essential to development.[5] The World Health Organization (WHO) Commission on the Social Determinants of Health (SDOH) Framework demonstrates that material, psychological, behavioural and health system factors all contribute to health and well-being.[6,7,8] The impact of the SDOH is evident in several populations and age groups over the life course. For example, individuals and families of lower socioeconomic position (SEP), those who report financial barriers to accessing dental care, poor social networks and higher levels of life stress are more likely to have poor oral health behaviours and to have suboptimal oral health.[9–11] Other structural and social factors such as access to quality education, adequate income, nutrition, housing stability, and a safe environment, significantly impact the physical, cognitive, and emotional development of children and adolescents, contributing to unequal developmental outcomes.[11–15]

Adolescence is a stage that is marked by rapid physical and mental development, along with various emotional, cognitive, and behavioral experiences and challenges.[15,16,17] The WHO defines adolescence as the period of life between 10 and 19 years of age based on the biological, psychological, and social changes that occur during this period..[18] In addition to the significant developmental changes, both physically and psychologically, important transitions such as entering the workforce and establishing independence occur.[19,20] These transitions may become more accentuated in young adulthood and can impact health behaviors and outcomes, making it important to understand the health changes that occur during this period of life.[19] Physiological shifts during adolescence have a considerable effect on different elements and functions, including the oral ecosystem.[21] For example, most primary teeth will have naturally exfoliated by the age of 13, and permanent teeth will have emerged.[17,21] Puberty-induced changes in the oral microbiome can also contribute to an alterations of the inflammatory response to plaque, thereby

elevating the risk of periodontal diseases.[21] The risk of dental caries in adolescents also increases despite being a largely preventable disease.[22]

Research from around the world shows a clear social gradient in the oral health of adolescents and young adults.[23-28] Adolescents and young adults from more advantaged socioeconomic backgrounds, such as those with higher family income, and higher social status, tend to have better oral health outcomes.[28] They may have greater access to preventive dental care, regular dental check-ups, and healthier behaviors, all of which contribute to improved oral health.[28] Conversely, those from disadvantaged socioeconomic backgrounds, characterized by lower family income, limited education opportunities, and lower social status, are more likely to experience poorer oral health outcomes.[29] Limited access to dental care, inadequate oral hygiene practices, and a higher prevalence of risk factors such as unhealthy diets and tobacco use contribute to the disparities in oral health within this group.[29] Moreover, adolescence socioeconomic position may have a lasting impact on oral health trajectories throughout a person's life, and the oral health difference will increasingly diverge over time.[30–32] Although, there is mounting evidence on the oral health inequalities in adolescence and young adults, along with their contributing factors, there is a major knowledge gap concerning the magnitude of these inequalities in Canada, particularly in Ontario, Canada's most populated province.[8, 33]

Health inequalities are complex issues explored through various theories. One theory, the materialist explanation, highlights the role of external factors, like income and wealth, in determining oral health inequalities.[34] It argues that socioeconomic position (SEP) affects access to essential resources like nutritious food and healthcare, thereby impacting oral health.[35] However, this theory acknowledges that material wealth alone does not explain all oral health inequalities.[34] On the other hand, the behavioural explanation focuses on how lifestyle choices contribute to health inequalities.[36] It suggests that people with lower SEP tend to engage in unhealthy behaviours like poor diet, lack of exercise, smoking, and excessive alcohol consumption, leading to more oral health issues.[34] However, critics argue that this oversimplifies behaviour and overlooks the influence of culture on choices.[34] Traditionally, strategies for addressing oral health in adolescents have focused on tackling individual-based factors such as oral hygiene practices through in-school oral health education programs, dietary choices and/or

tobacco and substance use.[33] While important, these approaches arguably do not recognize that a successful transition into adulthood with good oral health requires promoting positive social and emotional development and a focus on the more "upstream" factors that lie within the social and living environment.[37] Previous studies have shown that several factors are at interplay in determining the oral health of adolescents.[38,39] Despite the plethora of evidence on the potentially modifiable behavioural factors that serve as risk and protective factors across various oral health outcomes, there remains a lack of research on its contribution to oral health inequalities in Canadian adolescents and young adults.[40]Additionally, the psychosocial perspective suggests that differences in psychosocial stress levels among socioeconomic groups contribute to oral health inequalities.[41,42] Lower socioeconomic backgrounds often face more stress due to various factors, impacting oral health directly or indirectly through unhealthy behaviours.[34,42]

Despite the existing research on adolescent oral health and related oral health inequalities, there are still significant gaps in knowledge.[24,25,38] One key gap is the lack of comprehensive descriptive studies specifically focusing on the Canadian context. While studies from other countries provide valuable insights, it is essential to understand the unique factors and challenges that Canadian adolescents and young adults face regarding oral health. Additionally, little is known on the specific contributions of material, psychological, behavioural, and health system factors to adolescent oral health in Canada. Filling these knowledge gaps will enhance our understanding of the social determinants of adolescent oral health in Canada and may inform interventions and policies that can improve oral health outcomes for this population.

3.2.1 Aims and Objectives

This study aimed to assess the associations between social and living conditions and each of oral health and dental care utilization in adolescents and young adults in Ontario, and to further explore the contribution of individual behaviours, psychosocial and access to dental care factors to these relationships. Importantly, given the well-known changes in social and living conditions from adolescents to young adults, the study will also assess whether there are differences in these associations between these two age groups.[33]

The specific objectives of this study are to:

1. Measure the extent of the association between social and living factors with self-reported oral health (SROH), stratified by age group, and further assess the contribution of health behaviours, psychosocial and access to dental care factors to any observed relationships.
2. Measure the extent of the association of social and living factors with dental care utilization, stratified by age group, and further assess the contribution of health behaviours, psychosocial and access to dental care factors to any observed relationships.

3.3 Methods

3.3.1 Data source and study population

This study utilized data from the Canadian Community Health Survey (CCHS) conducted by Statistics Canada. The CCHS is a large, cross-sectional survey that provides information on the health status, health behaviours, and socio-demographic characteristics of Canadians. We used the most recent CCHS cycle (2017-2018) for which data was publicly available. This CCHS cycle included 113,290 respondents. Data were accessed through the de-identified Public Use Microdata File (PUMF).[43] The sampling design of the CCHS followed a complex, multistage approach to obtain a representative sample of the Canadian population. The survey employed a stratified, two-phase design. In the first phase, clusters were selected from a master sample of geographic areas in Canada using probability proportional to size (PPS) sampling. This approach ensured that larger clusters had a higher probability of selection, improving the representativeness of the sample. In the second phase, households were selected within each selected cluster using systematic sampling. All eligible individuals within the selected households were invited to participate in the survey. To account for the complex survey design, the CCHS provides survey weights that adjust for differential probabilities of selection, non-response, and post-stratification to known population totals. These weights are calculated separately for each province and territory and consider factors such as the probability of selection at cluster and household levels, response rates, and post-stratification adjustments.

The target population for the 2017-2018 CCHS cycle included the non-institutionalized population of Canada aged 12 years and older, residing in private dwellings or other types of

dwellings. However, certain groups were excluded, such as residents of institutions, full-time members of the Canadian Armed Forces, individuals living on Indigenous reserves or settlements, and some remote regions. For our study, the sample was restricted to individuals aged 12 to 24 years, residing in Ontario. Only respondents with complete information on the oral health module, which captured data on the frequency of dental care visits, reason for dental visit, and oral health habits, were included. After applying these inclusion criteria, the final sample size (unweighted) for this study was 4,316 respondents (Figure 3.1).

3.3.2 Variables

Conceptual Diagram

A conceptual framework was constructed to depict the relationship between annual household income, self-reported oral health (SROH), dental care utilization and covariates in adolescents and young adults (Figure 3.2).

Outcome variables

Self-reported oral health (SROH)

The answers to the following question were utilized for determining SROH during the previous 12 months in the CCHS: "In general, would you say the health of your mouth is...?" There were five answer categories that ranged from excellent to poor on a Likert scale. For this current study, we dichotomized this variable into 'good' (excellent, very good and good) and 'poor' (fair and poor). We used good oral health as the reference category.

Dental Care Utilization

The following question was used to determine dental care utilization: "When was the last time you saw a dental professional?" The answer categories for the question were less than 1 year to 1 year ago, more than 1 year to 2 years ago, more than 2 years to 3 years ago, more than 3 years to 4 years ago, more than 4 years to 5 years ago, more than 5 years ago and never. The answers were dichotomized into visited a dental professional in past 12 months and did not visit a dental professional in the past 12 months. We used visiting a dental professional in past 12 months as our reference category.

Exposure Variables

Socioeconomic position (SEP)

SEP was indicated by annual household income. Annual household income was collected by CCHS in $20,000 increments and was categorized into three groups for the purpose of this study: less than $39,999, $40,000 to $79,999, and greater than $80,000. The Low Income Measure (LIM), based on relative low income, was used to create low, middle, and high income categories.[44]

Explanatory variables

Age, sex, race/ethnicity, immigration status and household education were used as covariates. Two age categories were created to represent adolescence (12 – 17 years) and young adulthood (18 – 24 years). Sex assigned at birth (male, female). Race/ethnicity (White, non-White) and immigration status (immigrants/Canadian-born) were included as covariates. Household education was categorized as less than secondary school, secondary school, and post-secondary.

Oral health behaviours

Tooth-brushing frequency was assessed by asking respondents how often they usually brush their teeth and was categorized into once a day or less and twice a day or more. Smoking status was determined by asking participants if they smoke cigarettes every day, occasionally, or not at all. The categories were dichotomized into yes (every day and occasionally) and no (not at all). Alcohol use was examined through questions about past and current drinking habits, resulting in four categories: regular drinker, occasional drinker, former drinker, and never drank. These categories were also dichotomized into yes (regular drinker and occasional drinker) and no (former drinker and never drank).

Psychosocial stress

Perceived stress was measured in CCHS by asking participants to rate the stress in their lives as being not at all stressful, somewhat stressful, and extremely stressful.

Dental insurance status

Dental insurance status was assessed by asking respondents if they had dental insurance through employment or a government program that covers their dental expenses. These categories were dichotomized into insured and uninsured.

3.3.3 Statistical Analysis

First, we applied descriptive statistics and used bootstrap weights to account for the survey's complex design and sample weights to ensure our sample was representative of the Ontario population. Cases with any missing data were excluded from further analysis. The distribution of the variables was examined using frequencies and percentage distributions were computed. We applied Chi-squared test to assess the bivariate association between each of our dependent variables (SROH and dental care utilization) and independent variables, and further stratified by age group (12-17 and 18-24 years of age) to further assess any differences between adolescents and young adults.

To examine the relationship between SEP, indicated by annual household income and each of SROH and dental care utilization, four logistic regression models were constructed in which explanatory variables were added in a block-wise method. Model 1 controlled for age, sex, race/ethnicity and immigration status. Model 2 additionally adjusted for the covariates smoking status, alcohol use, and tooth-brushing frequency. Model 3 additionally controlled for psychosocial stress. Finally, Model 4 additionally adjusted for the availability of dental insurance. Prevalence ratios (PR) and 95% confidence intervals (CI) were used to estimate the strength and direction of the association between the exposure and outcome. Percent attenuation between models was calculated to assess the contribution of health behaviours, psychosocial stress and the availability of dental insurance to the relationship between the annual household income and SROH and dental care utilization. All statistical analyses were conducted using STATA V.17 (College Station, Texas).[45]

3.4 Results

3.4.1 Characteristics of Study Sample

The study included a total of 4,316 participants, of whom 92.8% reported good SROH (Table 3.1). Younger participants (aged 12-17 years) reported better SROH than their older counterparts (aged 18-24 years). Males were more likely to report poor SROH than females (8.2% and 3.7% respectively). Good oral health behaviours were generally common in this sample where the majority of participants reported being non-smokers (89.9%), brushing their teeth twice a day or more (79.3%). The majority also had a form of dental insurance (76.3%). Respondents from households of lower education (less than secondary school) and those reporting a household income of less than $39,000 per annum also reported poor SROH (8.3% and 9.2%, respectively) compared to their higher education and household income counterparts. The majority of participants with poor SROH were smokers, brushed their teeth less frequently, reported experiencing extreme stress in their lives, and had no dental insurance.

Upon stratifying by age (Table 3.2), we found most adolescents (12–17 years of age) to have good oral health (n=2210, 94%). Those who reported poor SROH (6 %) were mostly male, non-White individuals, who reported being from households of lower education and lower household income (less than $39,000 per annum). They also reported being current smokers, brushed their teeth less frequently and reported experiencing extreme overall life stress. We had similar observations for the young adults group (18 – 24 years of age), where the majority also reported having good oral health (n=1797, 91%).

More dental visits were reported among individuals aged 12-17 years of age reported visiting the dental professional more often (92.7%) compared to those aged 18-24 years (77.9%) (Table 3.3) More White individuals had visited the dentist in the past year (86.0%) while immigrants, those from households of lower income and education had fewer dental visits (73.9%). Likewise, those reporting less dental visits had no dental insurance. Additionally, those individuals who reported being current smokers, alcohol users, brushed their teeth less frequently and reported experiencing extreme overall life stress had lower visit rates. When stratified by age categories (Table 3.4), the majority of adolescents, aged 12 to 17 years, had visited the dentist within the

past year (n=2124, 93%). Those who had not visited the dentist within the past year were predominantly male, were from non-White racial/ethnic backgrounds, immigrants, came from households where the highest level of education was below the post-secondary level, and had an annual household income of less than $39,000 per year. Additionally, this group tended to be current smokers, practiced less frequent tooth brushing, and had no dental insurance. Similar patterns were observed among young adults, aged 18 to 24, where the majority also reported having good oral health, with (n=1953,75%) falling into this category.

3.4.2 Association of SEP with SROH by age group

Annual household income had a protective association with SROH (Table 3.5). Respondents in the middle ($40,000 to $79,999) and higher annual household income ($80,000 and above) categories had lower odds of reporting poor SROH than their lower annual household income counterparts (less than $39,999 per annum) with PR=0.56, 95% CI 0.35,0.89; and PR=0.45, 95% CI 0.31,0.67, respectively. In sequential models, adjusting for sociodemographic covariates (age, sex, immigration status and highest household level of education) did not explain the observed protective association between annual household income and SROH. Meanwhile, adjusting for health behaviours (smoking, alcohol, and tooth-brushing frequency) explained the difference between the middle and lowest income category (the reference group). However, the difference between the highest and the lowest income category remained significant. This remained significant after controlling for all other covariates (psychosocial stress and dental insurance status) in fully adjusted models.

When further stratified by age group, we found that the protective association between annual household income and SROH was significant for the young adults age group (aged 18-24 years) but not adolescents (aged 12-17 years of age) after controlling for all covariates in sequential models (Table 3.6). In those aged 18 and above, middle and higher household income categories were associated with a lower prevalence of reporting poor oral health than their lower income counterparts (PR=0.34, 95%CI 0.21,0.57). This association was partly attenuated by psychosocial factors (PR=0.50, 95%CI 0.29,0.86).

3.4.3 Association of SEP with dental care utilization by age group

For the second objective, we aimed to assess the extent of the association of SEP with dental care utilization. Annual household income was significantly associated with whether respondents had visited the dentist in the past year. Respondents in the higher annual household income ($80,000 and above) category had a lower prevalence of reporting infrequent dental visits than their middle ($40,000 to $79,999) and lower annual household income counterparts (less than $39,999 per annum) with PR=0.40, 95% CI 0.28,0.58 and PR=0.79, 95% CI 0.53, 1.19, respectively (Table 3.7). Adjusting for covariates did not attenuate the observed association between annual household income and dental visits. When further stratified by age group, we found that the protective association between annual household income and the frequency of dental visits was significant in both adolescents (aged 12-17 years old) and young adults (aged 18-24 years) after controlling for covariates in sequential models (Table 3.8).

3.5 Discussion

The aim of this study was to assess the associations between social and living conditions and self-reported oral health (SROH) and dental care utilization in adolescents and young adults in Ontario, Canada's most populated province, while exploring the contribution of health behaviours, psychosocial factors, and dental insurance status in these relationships. The findings provide insights into the multifaceted nature of the social differences in oral health and dental care utilization among adolescents. Our study findings indicate that SROH and dental care utilization are associated with social and living conditions and partly influenced by individual behaviours, psychosocial and access to dental care factors such as the availability of dental insurance. When stratified by age, there was a protective association between social and living conditions with SROH for young adults but not for adolescence. Furthermore, there was a protective association between social and living conditions and dental utilization for both age groups, adolescence and young adults.

Our results are consistent with previous research showing associations between social and living conditions and oral health outcomes in adolescents.[46,47] Importantly, we observed a social gradient in oral health, whereby lower SEP, defined by household income, was associated with

poorer oral health. Specifically, as SEP decreased, there was a corresponding increase in poor SROH. These findings highlight the presence of socioeconomic inequalities in oral health among adolescents and indicate that social factors play a crucial role in shaping oral health outcomes for adolescents in Ontario. Furthermore, our study demonstrated the association of SEP on dental care utilization among adolescents. We found that as SEP decreased, there was a corresponding decrease in dental care utilization, including fewer dental visits leading to potentially delayed dental treatment. During this transitional phase, young adults may no longer be covered by their parents' dental insurance plans, and they often face financial constraints as they begin to manage their own expenses.[16] In lower SEP households, these financial challenges can be particularly daunting, making it difficult for them to prioritize preventive dental care or seek treatment for dental issues when they arise, further contributing to inequalities in dental care utilization. Our findings are consistent with those of a recent study that was conducted in a clinical sample from Southwest Ontario which showed young adults to have significantly worse oral health than adolescents.[48] Our findings further underscore the importance of addressing the structural and social factors such as household income to tackle oral health inequalities among adolescents and young adults.

Our study also explored the contribution of health behaviours, psychosocial factors, and access to dental care in the relationships between social and living conditions and each of oral health and dental care utilization. Interestingly, we found that health behaviours, such as oral hygiene practices, smoking tobacco and alcohol consumption significantly affected the associations between social gradients and oral health outcomes. Unfavorable oral health behaviours were more common in adolescents from lower SEP backgrounds which only partially explained the socioeconomic differences in SROH and dental care. Therefore, interventions aimed at improving oral health among adolescents should target the upstream social factors determinants while continuing to target individual behaviours to effectively address the oral health inequalities. Additionally, psychosocial factors also played a role in the relationship between SEP and each of SROH and dental care utilization, aligning with previous studies on the role of psychosocial factors in oral health.[11,42]

Access to dental care has emerged as a potential mediator in the associations between SEP and dental care utilization. Adolescents from lower SEP backgrounds may be facing greater challenges in accessing dental services due to lack of insurance coverage. These barriers to accessing dental care contribute to the oral health inequalities in dental care utilization, indicating a need for interventions that focus on improving access to dental care services for disadvantaged populations. Expanding insurance coverage, implementing school-based dental programs, and increasing the number of dental professionals in underserved areas are potential strategies to address these barriers.[49] The Canadian government is attempting to increase dental care accessibility by introducing the Canadian Dental Care Plan (CDCP) which will offer financial assistance to support the costs of dental care for children under 12 years old that is to be expanded to other groups of the population by 2025.[50] Therefore, efforts to enhance dental care accessibility, including initiatives like the newly introduced Canadian Dental Care Plan, are promising initiatives that may help address oral health inequalities among adolescents and young adults from lower socioeconomic backgrounds.

3.5.1 Strengths, Limitations and Future Directions

Our study has several strengths. It addresses a significant knowledge gap by assessing the oral health of adolescents and young adults in Ontario, a largely understudied group of the population. Our large, provincially representative sample allows us to extrapolate our findings. We also assess a wide range of factors that may contribute to oral health inequalities in our analyses. While we provide important insights into the associations between social and living conditions, oral health outcomes, and dental care utilization in adolescents and young adults in Ontario, our study is not without limitations. The cross-sectional design of the study restricts our ability to establish causal relationships. Future longitudinal studies would be valuable in elucidating the temporal relationships between these factors. Additionally, the use of self-reported measures introduces the possibility of recall and social desirability biases, although SROH is a validated measure that correlates well with clinical oral health. Future studies could benefit from incorporating objective clinical assessments and administrative data to strengthen the validity of the findings. Finally, the study sample was limited to Ontario which, although is Canada's most populated province, may limit the generalizability of the findings to other provinces and populations.

3.6 Conclusion

In conclusion, our study highlights the presence of a social gradient in oral health outcomes and dental care utilization among adolescents and young adults in Ontario. Our findings emphasize the importance of addressing the social determinants of oral health, including social and living conditions in comprehensive oral health promotion efforts targeting adolescents. By recognizing and targeting oral health inequalities, interventions can strive to reduce inequalities and promote equitable oral health outcomes and dental care utilization among adolescents and young adults.

Figure 3.1: Sample size after the inclusion and exclusion criteria.

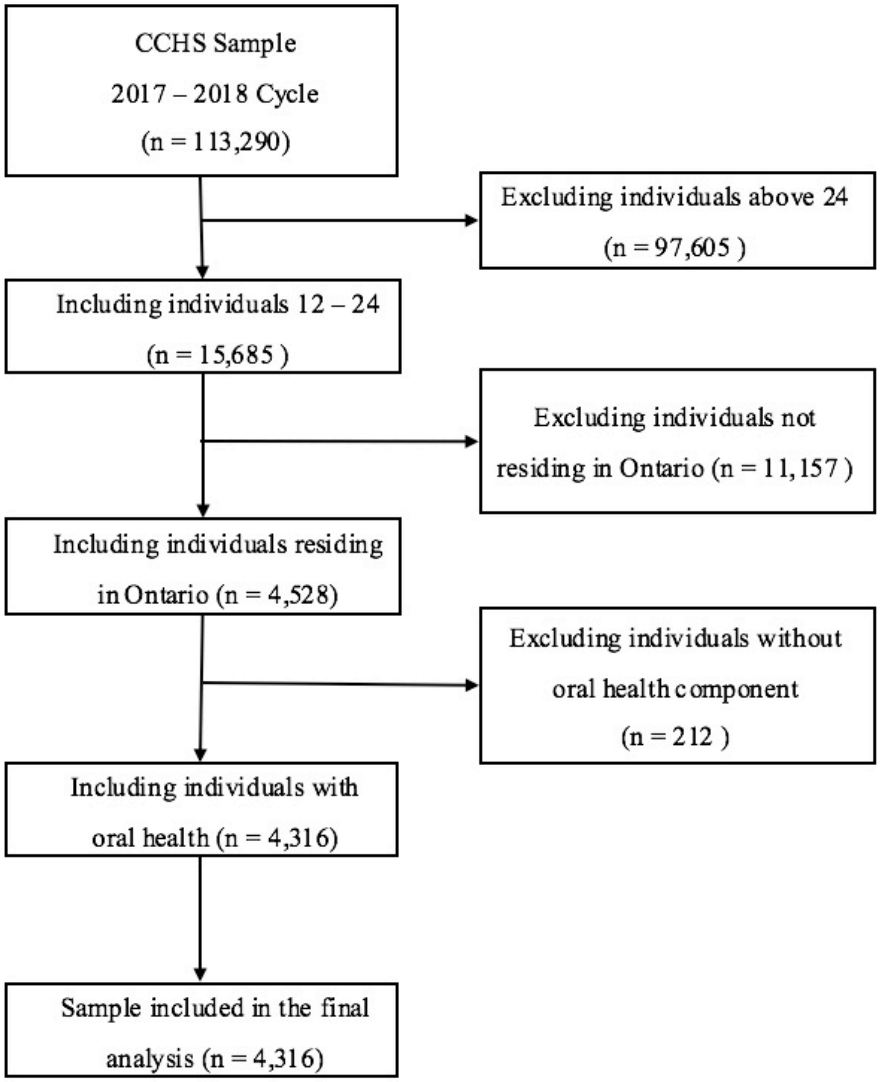


Figure 3.2: Conceptual diagram for the relationship between annual household income, self-reported oral health and dental care utilization in adolescents and young adults.

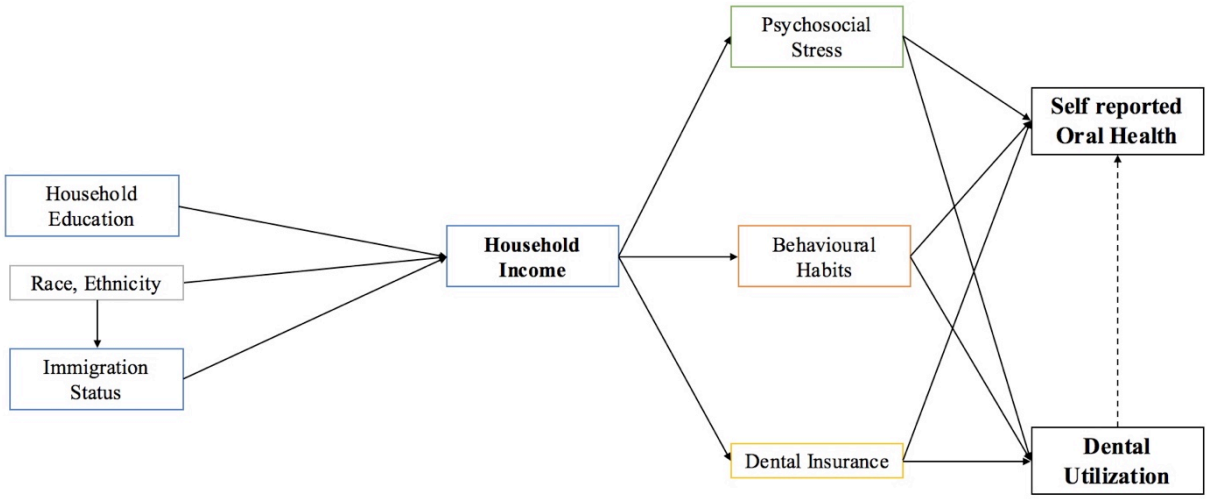


Table 3.1: Characteristics of study sample by SROH categories, CCHS, 2017-2018 (n=4,316).

Variables	SROH			P-values
	n	Good n (%)	Poor n (%)	
Socio-Demographic Factors				
Age (years)				**<0.001**
12-17	2347	2210 (94.4)	137 (5.6)	
18-24	1969	1797 (93.7)	172 (6.3)	
Sex				**<0.001**
Female	2175	2060 (96.3)	115 (3.7)	
Male	2141	1947 (91.8)	194 (8.2)	
Cultural / racial background				0.905
White	2980	2779 (93.3)	201 (6.7)	
Non-white (Aboriginal or Other Visible Minority)	1009	942 (93.4)	67 (6.6)	
Missing	327	286 (87.5)	41 (12.5)	
Immigration Status				0.575
Immigrant	526	491 (95.1)	35 (4.9)	
Non-immigrant	3696	3425 (93.6)	271 (6.4)	
Missing	94	91 (97.5)	3 (2.5)	
Household Education Level				**<0.001**
Less than secondary school	105	93 (91.7)	12 (8.3)	
Secondary school graduation	638	558 (90.4)	80 (9.6)	
Post-secondary certificate diploma or univ degree	3402	3202 (94.7)	200 (5.3)	
Missing	171	154 (92.7)	17 (7.3)	
Household Income				**<0.001**
Less than $39,999	862	752 (90.8)	110 (9.2)	
$40,000 to $79,999	874	808 (94.2)	66 (5.8)	
$80,000 and above	2558	2428 (95.0)	130 (5.0)	
Missing	22	19 (95.0)	3 (5.0)	
Access to dental care				
Dental Insurance				**<0.001**
No insurance	927	822 (91.8)	105 (8.2)	
Government/Employer-sponsored/ private plan	2979	2802 (94.7)	177 (5.4)	
Missing	410	383 (94.5)	27 (5.5)	
Health behaviours				
Smoking Status				**<0.001**
No	3878	3643 (94.8)	235 (5.1)	
Yes	434	360 (86.2)	74 (13.8)	
Missing	4	4 (100.0)	0	
Alcohol Use				**0.025**
No	2025	1903 (94.3)	122 (5.7)	
Yes	2280	2094 (93.7)	186 (6.3)	
Missing	11	10 (93.3)	1 (6.7)	
Tooth-brushing frequency				**<0.001**
Twice a day or more	3354	3165 (95.4)	189 (4.6)	
Once a day or less	876	773 (88.8)	103 (11.2)	
Missing	86	9 (8.8)	77 (91.2)	
Psychosocial Factors				

Stress in life				**<0.001**
Not at all stressful	1876	1777 (95.3)	99 (4.7)	
Somewhat stressful	2349	2152 (93.3)	197 (6.7)	
Extremely Stressful	82	70 (85.8)	12 (14.2)	

Table 3.2: Characteristics of the sample by SROH categories, stratified by age, CCHS, 2017- 18 (n=4,316).

Age	**12 – 17 years**				**18 – 24 years**			
Variables	**SROH**			**P-values**	**SROH**			**P-values**
	n	**Good(%)**	**Poor(%)**		**n**	**Good(%)**	**Poor(%)**	
Socio-Demographic Factors								
Sex				**0.005**				**<0.001**
Female	1148	1097 (96.9)	51(3.9)		1027	963 (96.5)	64 (3.5)	
Male	1199	1113 (92.9)	86 (7.1)		942	834 (91.0)	108 (9.0)	
Cultural / racial background				**0.024**				**0.006**
White	1626	1540 (94.7)	86 (5.3)		1354	1239 (91.5)	115 (8.5)	
Non-white (Aboriginal or Other Visible Minority)	523	492 (94.1)	31 (5.9)		486	450 (92.6)	36 (7.4)	
Missing	198	178 (89.9)	20 (10.1)		129	108 (83.7)	21 (16.3)	
Immigration Status				0.242				0.659
Immigrant	213	204 (96.0)	9 (4.0)		313	287 (94.7)	26 (5.3)	
Non-immigrant	2080	1953 (94.0)	127 (6.0)		1616	1472 (93.3)	144 (6.7)	
Missing	54	53 (98.3)	1 (1.7)		40	38 (96.7)	2 (3.3)	
Household Education Level				**0.011**				**<0.001**
Less than secondary school	51	45 (90.3)	6 (9.7)		54	48 (93.3)	6 (6.7)	
Secondary school graduation	256	233 (91.5)	23 (8.5)		382	325 (89.9)	57 (10.1)	
Post-secondary certificate/ diploma or univ degree	1934	1835 (95.0)	99 (5.0)		1468	1367 (94.4)	101 (5.6)	
Missing	106	97 (92.7)	9 (7.3)		65	57 (92.8)	8 (7.2)	
Household Income				**0.026**				**<0.001**
Less than $39,999	318	290 (93.5)	28 (6.5)		544	462 (89.4)	82 (10.6)	
$40,000 to $79,999	476	445 (94.4)	31 (5.6)		398	363 (94.1)	35 (5.9)	
$80,000 and above	1538	1462 (94.7)	76 (5.3)		1020	966 (95.2)	54 (4.8)	
Missing	15	13 (94.5)	2 (5.5)		7	6 (95.9)	1 (4.1)	
Dental Insurance				0.199				**<0.001**
No insurance	315	291 (92.7)	24 (7.3)		612	531 (91.5)	81 (8.5)	
Government/Employer-sponsored/ private plan	1677	1588 (95.0)	89 (5.0)		1302	1214 (94.4)	88 (5.6)	
Missing	355	331 (93.4)	24 (6.6)		55	52 (97.4)	3 (2.6)	
Health Behaviours								
Smoking Status				**0.055**				**<0.001**
No	2269	2141 (94.5)	128 (5.5)		1609	1502 (95.2)	107 (4.8)	
Yes	74	65 (91.0)	9 (9.0)		360	295 (85.5)	65 (14.5)	
Missing	4	4 (100.0)	0		0	0	0	
Alcohol Use				0.785				0.274

No	1676	1579 (94.3)	97 (5.7)		349	324 (94.4)	25 (5.6)	
Yes	664	624 (94.6)	40 (5.4)		1616	1470 (93.5)	146 (6.5)	
Missing	7	7 (100.0)	0		4	3 (78.0)	1 (22.0)	
Teeth brushing frequency				**<0.001**				**<0.001**
Twice a day or more	1804	1721 (95.7)	83 (4.3)		1550	1444 (95.2)	106 (4.8)	
Once a day or less	490	443 (89.7)	47 (10.3)		386	330 (88.0)	56 (12.0)	
Missing	53	50 (95.0)	3 (5.0)		33	28 (88.2)	5 (11.8)	
Psychosocial Factors								
Stress in life				**<0.001**				**0.010**
Not at all stressful	1169	1126 (96.2)	43 (3.8)		707	651 (94.5)	56 (5.4)	
Somewhat stressful	1143	1051 (92.8)	92 (7.2)		1206	1101 (93.5)	105 (6.5)	
Extremely Stressful	28	26 (87.6)	2 (12.4)		54	44 (85.1)	10 (14.9)	
Missing	7	7 (100.0)	0		2	1 (64.5)	1 (35.5)	

Table 3.3: Characteristics of study sample by to dental care utilization (n=4,226).

Variables	Frequency of Dental Visits			P-values
	n	Dental Visits <1year (%)	Dental Visits >1 year (%)	
Socio-Demographic Factors				
Age (years)				**<0.001**
12-17	2273	2124 (92.7)	149 (7.3)	
18-24	1953	1466 (77.9)	487 (22.1)	
Sex				**0.038**
Female	2134	1837 (82.6)	297 (17.4)	
Male	2092	1753 (85.2)	339 (14.8)	
Cultural / racial background				**0.003**
White	2923	2515 (86.0)	408 (14.0)	
Non-white (Aboriginal or Other Visible Minority)	984	802 (81.5)	182 (18.5)	
Missing	319	273 (85.6)	46 (14.4)	
Immigration Status				**<0.001**
Immigrant	513	379 (73.7)	134 (26.3)	
Non-immigrant	3623	3139 (86.7)	484 (13.3)	
Missing	90	72 (79.0)	18 (21.0)	
Household Education Level				**<0.001**
Less than secondary school	100	70 (71.9)	30 (28.1)	
Secondary school graduation	622	461 (75.1)	161 (24.9)	
Post-secondary certificate diploma or univ degree	3339	2930 (86.2)	409 (13.8)	
Missing	165	129 (75.6)	36 (24.4)	
Household Income				**<0.001**
Less than $39,999	837	600 (72.5)	237 (27.5)	
$40,000 to $79,999	858	698 (81.2)	160 (18.8)	
$80,000 and above	2511	2273 (88.6)	238 (11.4)	
Missing	20	19 (98.4)	1 (1.6)	
Access to dental care				
Dental Insurance				**<0.001**
No insurance	908	604 (68.8)	304 (31.2)	
Government/Employer-sponsored/ private plan	2941	2666 (89.7)	279 (10.3)	
Missing	387	330 (78.1)	53 (21.9)	
Health Behaviours				
Smoking Status				**<0.001**
No	3791	3285 (85.6)	506 (14.4)	
Yes	431	301 (68.9)	130 (31.1)	
Missing	4	4 (100.0)	0	
Alcohol Use				**<0.001**
No	1957	1745 (95.7)	212 (14.3)	
Yes	2258	1837 (82.6)	421 (17.4)	
Missing	11	8 (76.3)	3 (23.7)	
Teeth brushing frequency				**<0.001**
Twice a day or more	3298	2853 (85.2)	445 (14.8)	
Once a day or less	846	674 (78.4)	172 (21.6)	
Missing	82	74 (89.0)	8 (11.0)	
Psychosocial Factors				
Stress in life				**0.029**
Not at all stressful	1830	1577 (85.6)	253 (14.4)	

Somewhat stressful	2306	1945 (82.8)	361 (17.2)	
Extremely Stressful	82	62 (77.9)	20 (22.1)	
Missing	8	6 (93.6)	2 (6.4)	

Table 3.4: Characteristics of the sample according to dental utilization, stratified by age, CCHS, 2017- 18 (n=4,226).

Age	**12 – 17 years**				**18 – 24 years**			
Variables	**Frequency of Dental Visits**			**P-values**	**Frequency of Dental Visits**			**P-values**
	n	**Dental Visits <1year (%)**	**Dental Visits >1 year (%)**		**n**	**Dental Visits <1year (%)**	**Dental Visits >1 year (%)**	
Socio-Demographic Factors								
Sex				0.123				**0.027**
Female	1115	1051 (94.3)	64 (5.7)		1019	786 (77.1)	233 (22.9)	
Male	1158	1073 (92.7)	85 (7.3)		934	680 (72.8)	254 (27.2)	
Cultural / racial background				**0.008**				0.178
White	1582	1495 (94.5)	87 (5.5)		1341	1020 (76.1)	321 (23.9)	
Non-white (Aboriginal or Other Visible Minority)	500	454 (90.8)	46 (9.2)		484	348 (71.9)	136 (28.1)	
Missing	191	175 (91.6)	16 (8.4)		128	98 (76.6)	30 (23.4)	
Immigration Status				**<0.001**				**<0.001**
Immigrant	2022	1908 (94.4)	114 (5.6)		1601	1231 (76.9)	370 (23.1)	
Non-immigrant	200	172 (86.0)	28 (14.0)		313	207 (66.1)	106 (33.9)	
Missing	51	44 (86.3)	7 (13.7)		39	28 (71.8)	11 (28.2)	
Household Education Level				**<0.001**				**<0.001**
Less than secondary school	48	41 (85.4)	7 (14.6)		52	29 (55.8)	23 (44.2)	
Secondary school graduation	244	218 (89.3)	26 (10.7)		378	243 (64.3)	135 (35.7)	
Post-secondary certificate/ diploma or univ degree	1881	1778 (94.5)	103 (5.5)		1458	1152 (79.0)	306 (21.0)	
Missing	100	87 (87.0)	13 (13.0)		65	42 (64.6)	23 (35.4)	
Household Income				**<0.001**				**<0.001**
Less than $39,999	299	259 (86.6)	40 (13.4)		538	341 (63.4)	197 (36.6)	
$40,000 to $79,999	462	412 (89.2)	50 (10.8)		396	286 (72.2)	110 (27.8)	
$80,000 and above	1499	1440 (96.1)	59 (3.9)		1012	833 (82.3)	179 (17.7)	
Missing	13	13 (100.0)	0		7	6 (85.7)	1 (14.3)	
Dental Insurance				**<0.001**				**<0.001**
No insurance	300	241 (80.3)	59 (19.7)		608	363 (59.7)	245 (40.3)	
Government/Employer-sponsored/ private plan	1652	1590 (96.3)	62 (3.8)		1293	1076 (83.2)	217 (16.8)	
Missing	321	293 (91.3)	28 (8.7)		52	27 (51.9)	25 (48.1)	
Health Behaviours								
Smoking Status				**<0.001**				**<0.001**
No	2194	2059 (93.9)	135 (6.2)		1597	1226 (76.8)	371 (23.2)	
Yes	75	61 (81.3)	14 (18.7)		356	240 (67.4)	116 (32.6)	

Missing	4	4 (100.0)	0		0	0	0	
Alcohol Use				0.782				**0.001**
No	1613	1507 (93.4)	106 (6.6)		344	238 (69.2)	106 (30.8)	
Yes	653	610 (93.4)	43 (6.6)		1605	1227 (76.5)	378 (23.5)	
Missing	7	7 (100.0)	0		4	1 (25.0)	3 (75.0)	
Teeth brushing frequency				**0.010**				**<0.001**
Twice a day or more	1758	1658 (94.3)	100 (5.7)		1540	1195 (77.6)	345 (22.4)	
Once a day or less	465	421 (90.5)	44 (9.5)		381	253 (66.4)	128 (33.6)	
Missing	31	30 (96.8)	1 (3.2)		19	15 (78.9)	4 (21.1)	
Psychosocial Factors								
Stress in life				0.362				0.069
Not at all stressful	1129	1055 (93.5)	74 (6.5)		701	522 (74.5)	179 (25.5)	
Somewhat stressful	1110	1039 (93.6)	71 (6.4)		1196	906 (75.8)	290 (24.2)	
Extremely Stressful	28	24 (85.7)	4 (14.3)		54	38 (70.4)	16 (29.6)	
Missing	6	6 (100.0)	0		2	0	2 (100.0)	

Table 3.5: Associations between SEP, indicated by annual household income and SROH, CCHS, 2017-2018 (n=4,316).

	Model 1			Model 2			Model 3			Model 4		
	PR (SE)	**95%CI**	**P-value**	**PR (SE)**	**95%CI**	**P-value**	**PR (SE)**	**95%CI**	**P-value**	**PR (SE)**	**95%CI**	**P-value**
Household Income <$39,999 (Ref.)	1.00											
$40,000 to $79,999	0.556 (0.135)	0.35 – 0.89	**0.015**	0.663 (0.168)	0.40 – 1.09	0.105	0.669 (0.172)	0.40 – 1.11	0.118	0.614 (0.171)	0.36 – 1.06	0.079
$80,000 and over	0.454 (0.092)	0.31 – 0.67	**<0.001**	0.572 (0.122)	0.38 – 0.87	**0.009**	0.596 (0.129)	0.39 – 0.91	**0.017**	0.581 (0.128)	0.38 – 0.90	**0.014**

Model 1: Adjusting for age, sex, race and immigration status, household level of education
Model 2: Additionally, adjusting for smoking status, alcohol use, and tooth-brushing frequency (health behaviours).
Model 3: Additionally, adjusting for psychosocial stress (psychosocial factors).
Model 4 Additionally, adjusting for dental insurance status (access to dental care factors).

Table 3.6: Associations between SEP, indicated by annual household income and SROH, stratified by age, CCHS, 2017-2018 (n=4,316).

	Model 1			Model 2			Model 3			Model 4		
	PR (SE)	95%CI	P-value	PR (SE)	95%CI	P-value	PR (SE)	95%CI	P-value	PR (SE)	95%CI	P-value
12 – 17 years												
Household Income <$39,999 (Ref.)	1.00											
$40,000 to $79,999	0.827 (0.302)	0.40 – 1.69	0.604	0.944 (0.348)	0.46 – 1.94	0.876	0.944 (0.350)	0.46 – 1.95	0.877	0.794 (0.355)	0.33 – 1.91	0.605
$80,000 and over	0.752 (0.254)	0.39 – 1.46	0.398	0.836 (0.296)	0.42 – 1.67	0.612	0.865 (0.311)	0.43 – 1.75	0.687	0.792 (0.351)	0.33 – 1.89	0.600
18 – 24 years												
Household Income <$39,999 (Ref.)	1.00											
$40,000 to $79,999	0.455 (0.152)	0.24 – 0.87	**0.018**	0.550 (0.202)	0.27 – 1.13	0.103	0.550 (0.205)	0.27 – 1.14	0.108	0.554 (0.206)	0.27 – 1.15	0.113
$80,000 and over	0.346 (0.089)	0.21 – 0.57	**<0.001**	0.461 (0.125)	0.27 – 0.79	**0.004**	0.477 (0.132)	0.28 – 0.82	**0.007**	0.501 (0.138)	0.29 – 0.86	**0.012**

Model 1: Adjusting for sex, race and immigration status, highest household level of education
Model 2: Additionally, adjusting for smoking status, alcohol use, and tooth-brushing frequency (health behaviours)
Model 3: Additionally, adjusting for psychosocial stress (psychosocial factors).
Model 4 Additionally, adjusting for dental insurance status (access to dental care factors).

Table 3.7: Associations between SEP, indicated by annual household income and frequency of dental visits (n=4,226).

	Model 1			Model 2			Model 3			Model 4		
	PR (SE)	**95%CI**	**P-value**	**PR (SE)**	**95%CI**	**P-value**	**PR (SE)**	**95%CI**	**P-value**	**PR (SE)**	**95%CI**	**P-value**
Household Income <$39,999 (Ref.)	1.00											
$40,000 to $79,999	0.795 (0.165)	0.53 – 1.19	0.268	0.869 (0.184)	0.57 – 1.32	0.508	0.870 (0.185)	0.57 – 1.32	0.511	0.863 (0.193)	0.56 – 1.34	0.510
$80,000 and over	0.406 (0.073)	0.28 – 0.58	**<0.001**	0.448 (0.082)	0.31 – 0.64	**<0.001**	0.451 (0.083)	0.31 – 0.65	**<0.001**	0.546 (0.105)	0.37 – 0.80	**0.002**

Model 1: Adjusting for age, sex, race and immigration status, highest household level of education
Model 2: Additionally, adjusting for smoking status, alcohol use, and tooth-brushing frequency (health behaviours)
Model 3: Additionally, adjusting for psychosocial stress (psychosocial factors).
Model 4 Additionally, adjusting for dental insurance status (access to dental care factors).

Table 3.8: Associations between SEP, indicated by annual household income and frequency of dental visits, stratified by age (n=4,226).

	Model 1			Model 2			Model 3			Model 4		
	PR (SE)	**95%CI**	**P-value**	**PR (SE)**	**95%CI**	**P-value**	**PR (SE)**	**95%CI**	**P-value**	**PR (SE)**	**95%CI**	**P-value**
12 – 17 years												
Household Income <$39,999 (Ref.)	1.00											
$40,000 to $79,999	0.788 (0.285)	0.39 – 1.60	0.510	0.822 (0.299)	0.40 – 1.68	0.590	0.787 (0.284)	0.39 – 1.60	0.507	0.562 (0.217)	0.26 – 1.20	0.135
$80,000 and over	0.265 (0.089)	0.14 – 0.51	**<0.001**	0.281 (0.098)	0.14 – 0.56	**<0.001**	0.274 (0.095)	0.14 – 0.54	**<0.001**	0.302 (0.107)	0.15 – 0.61	**0.001**
18 – 24 years												
Household Income <$39,999 (Ref.)	1.00											
$40,000 to $79,999	0.779 (0.191)	0.48 – 1.26	0.308	0.850 (0.213)	0.52 – 1.39	0.518	0.862 (0.217)	0.53 – 1.41	0.555	0.983 (0.253)	0.59 – 1.63	0.946
$80,000 and over	0.448 (0.093)	0.30 – 0.67	**<0.001**	0.500 (0.106)	0.33 – 0.76	**0.001**	0.506 (0.108)	0.33 – 0.77	**0.001**	0.626 (0.136)	0.41 – 0.96	**0.032**

Model 1: Adjusting for sex, race and immigration status, highest household level of education
Model 2: Additionally, adjusting for smoking status, alcohol use, and tooth-brushing frequency (health behaviours)
Model 3: Additionally, adjusting for psychosocial stress (psychosocial factors).
Model 4 Additionally, adjusting for dental insurance status (access to dental care factors).

3.7 References

1. World Health Organization. Oral health. https://www.who.int/health-topics/oral-health (accessed May 25, 2023).

2. Guarnizo-Herreño CC, Wehby GL. Children's Dental Health, School Performance and Psychosocial Well-Being. *J Pediatr* 2012; **161**: 1153-1159.e2.

3. Schroeder K, Gurenlian JR. Recognizing Poor Sleep Quality Factors During Oral Health Evaluations. *Clin Med Res* 2019; **17**: 20–8.

4. Jackson SL, Vann WF, Kotch JB, Pahel BT, Lee JY. Impact of Poor Oral Health on Children's School Attendance and Performance. *Am J Public Health* 2011; **101**: 1900–6.

5. Lawal FB, Fagbule OF, Lawal TA, Oke GA. "Oral health as an important milieu for social and mental health": Perspectives of adolescents emerging from a qualitative study. *Front Oral Health* 2022; **3**: 879144.

6. World Health Organization. Closing the gap in a generation: health equity through action on the social determinants of health - Final report of the commission on social determinants of health. https://www.who.int/publications-detail-redirect/WHO-IER-CSDH-08.1 (accessed May 24, 2023).

7. Crall JJ, Forrest CB. A Life Course Health Development Perspective on Oral Health. In: Halfon N, Forrest CB, Lerner RM, Faustman EM, eds. Handbook of Life Course Health Development. Cham (CH): Springer, 2018. http://www.ncbi.nlm.nih.gov/books/NBK543698/ (accessed May 25, 2023).

8. Heilmann A, Tsakos G, Watt RG. Oral Health Over the Life Course. In: Burton-Jeangros C, Cullati S, Sacker A, Blane D, eds. A Life Course Perspective on Health Trajectories and Transitions. Cham (CH): Springer, 2015. http://www.ncbi.nlm.nih.gov/books/NBK385369/ (accessed May 25, 2023).

9. Slade GD, Sanders AE. Two decades of persisting income-disparities in dental caries among U.S. children and adolescents. *J Public Health Dent* 2018; **78**: 187–91.

10. Hensel ALJ, Gomaa N. Social and economic capital as effect modifiers of the association between psychosocial stress and oral health. *PloS One* 2023; **18**: e0286006.

11. American Psychological Association. Children, Youth, Families and Socioeconomic Status. https://www.apa.org. https://www.apa.org/pi/ses/resources/publications/children-families (accessed June 6, 2023).

12. Braveman P, Gottlieb L. The Social Determinants of Health: It's Time to Consider the Causes of the Causes. *Public Health Rep* 2014; **129**: 19–31.

13. Ryu S, Fan L. The Relationship Between Financial Worries and Psychological Distress Among U.S. Adults. *J Fam Econ Issues* 2023; **44**: 16–33.

14. Perez FP, Perez CA, Chumbiauca MN. Insights into the Social Determinants of Health in Older Adults. *J Biomed Sci Eng* 2022; **15**: 261–8.

15. Viner RM, Ozer EM, Denny S, *et al.* Adolescence and the social determinants of health. *Lancet Lond Engl* 2012; **379**: 1641–52.

16. Northridge ME, Kumar A, Kaur R. Disparities in Access to Oral Health Care. *Annu Rev Public Health* 2020; **41**: 513–35.

17. Pahel BT, Rowan-Legg A, Quinonez RB. A Developmental Approach to Pediatric Oral Health. *Pediatr Clin North Am* 2018; **65**: 885–907.

18.World Health Organization. Adolescent health. https://www.who.int/health-topics/adolescent-health (accessed May 24, 2023).

19. Arain M, Haque M, Johal L, *et al.* Maturation of the adolescent brain. *Neuropsychiatr Dis Treat* 2013; **9**: 449–61.

20. Jaworska N, MacQueen G. Adolescence as a unique developmental period. *J Psychiatry Neurosci JPN* 2015; **40**: 291–3.

21. Zaura E, ten Cate JM. Towards understanding oral health. *Caries Res* 2015; **49 Suppl 1**: 55–61.

22. World Health Organization. Sugars and dental caries. https://www.who.int/news-room/fact-sheets/detail/sugars-and-dental-caries (accessed May 25, 2023).

23. Dye BA, Mitnik GL, Iafolla TJ, Vargas CM. Trends in dental caries in children and adolescents according to poverty status in the United States from 1999 through 2004 and from 2011 through 2014. *J Am Dent Assoc 1939* 2017; **148**: 550-565.e7.

24. Mathur MR, Tsakos G, Millett C, Arora M, Watt R. Socioeconomic inequalities in dental caries and their determinants in adolescents in New Delhi, India. *BMJ Open* 2014; **4**: e006391.

25. da Mata LL, Azevedo A, Pereira M de L. Socioeconomic Inequalities in Oral Health-related Behaviors in 18-Year-Old Adolescents: A Cross-sectional Study. *J Int Soc Prev Community Dent* 2021; **11**: 703–11.

26. Golkari A, Sabokseir A, Sheiham A, Watt RG. Socioeconomic gradients in general and oral health of primary school children in Shiraz, Iran. *F1000Research* 2016; **5**: 767.

27. López R, Fernández O, Baelum V. Social gradients in periodontal diseases among adolescents. *Community Dent Oral Epidemiol* 2006; **34**: 184–96.

28. Patrick DL, Lee RSY, Nucci M, Grembowski D, Jolles CZ, Milgrom P. Reducing Oral Health Disparities: A Focus on Social and Cultural Determinants. *BMC Oral Health* 2006; **6**: S4.

29. Petersen PE, Baez RJ, Ogawa H. Global application of oral disease prevention and health promotion as measured 10 years after the 2007 World Health Assembly statement on oral health. *Community Dent Oral Epidemiol* 2020; **48**: 338–48.

30. Thomson WM, Poulton R, Kruger E, Boyd D. Socio-economic and behavioural risk factors for tooth loss from age 18 to 26 among participants in the Dunedin Multidisciplinary Health and Development Study. *Caries Res* 2000; **34**: 361–6.

31. Gomaa N. Social Epigenomics: Conceptualizations and Considerations for Oral Health. *J Dent Res* 2022; **101**: 1299–306.

32. Bernabé E, Sheiham A, Sabbah W. Income, income inequality, dental caries and dental care levels: an ecological study in rich countries. *Caries Res* 2009; **43**: 294–301.

33. Oral Health Across the Lifespan: Adolescents. In: Oral Health in America: Advances and Challenges [Internet]. National Institute of Dental and Craniofacial Research(US), 2021. https://www.ncbi.nlm.nih.gov/books/NBK578291/ (accessed May 25, 2023).

34. Sisson KL. Theoretical explanations for social inequalities in oral health. *Community Dent Oral Epidemiol* 2007; **35**: 81–8.

35. Macintyre S. The Black Report and beyond: what are the issues? *Soc Sci Med 1982* 1997; **44**: 723–45.

36. Watt R, Sheiham A. Inequalities in oral health: a review of the evidence and recommendations for action. *Br Dent J* 1999; **187**: 6–12.

37. Northridge ME, Schrimshaw EW, Estrada I, Greenblatt AP, Metcalf SS, Kunzel C. Intergenerational and social interventions to improve children's oral health. *Dent Clin North Am* 2017; **61**: 533–48.

38. Guracho TT, Atomssa EM, Megersa OA, Tolossa T. Determinants of dental caries among adolescent patients attending Hospitals in West Wollega Zone, Western Ethiopia: A case-control study. *PLoS ONE* 2021; **16**: e0260427.

39. Do LG, Song YH, Du M, Spencer AJ, Ha DH. Socioecological determinants of child oral health-A scoping review. *Community Dent Oral Epidemiol* 2022; published online Nov 28. DOI:10.1111/cdoe.12819.

40. Ravaghi V, Quiñonez C, Allison PJ. The magnitude of oral health inequalities in Canada: findings of the Canadian health measures survey. *Community Dent Oral Epidemiol* 2013; **41**: 490–8.

41. Kawachi I, Subramanian SV, Almeida-Filho N. A glossary for health inequalities. *J Epidemiol Community Health* 2002; **56**: 647–52.

42. Gomaa N, Glogauer M, Nicolau B, *et al.* Stressed-Out Oral Immunity: A Gateway From Socioeconomic Adversity to Periodontal Disease. *Psychosom Med* 2020; **82**: 126–37.

43. Statistics Canada. Canadian Community Health Survey, 2017-2018: Annual Component [Public use microdata file] Ottawa, Ontario: Health Statistics Division, Statistics Canada [producer] Ottawa, Ontario: Data Liberation Initiative, Statistics Canada [distributor].

44. Government of Canada SC. Dictionary, Census of Population, 2021 – Low-income measure, after tax (LIM-AT). 2021; published online Nov 17. https://www12.statcan.gc.ca/census-recensement/2021/ref/dict/az/Definition-eng.cfm?ID=fam021 (accessed May 24, 2023).

45. StataCorp. 2023. Stata Statistical Software: Release 18. College Station, TX: StataCorp LLC.
46. Schmidt J, Vogel M, Poulain T, *et al.* Association of Oral Health Conditions in Adolescents with Social Factors and Obesity. *Int J Environ Res Public Health* 2022; **19**: 2905.

47. Vettore MV, Ahmad SFH, Machuca C, Fontanini H. Socio-economic status, social support, social network, dental status, and oral health reported outcomes in adolescents. *Eur J Oral Sci* 2019; **127**: 139–46.

48. Abouseta N, Gomaa N, Dixon SJ, Pani SC. Neighborhood-Level Inequalities in Dental Care of Adolescents and Young Adults in Southwestern Ontario. *Child Basel Switz* 2022; **9**: 183.

49. Vasiliou A, Shankardass K, Nisenbaum R, Quiñonez C. Current stress and poor oral health. *BMC Oral Health* 2016; **16**: 88.

50. Canadian Dental Care Plan. Ont. Dent. Assoc. https://www.oda.ca/visiting-the-dentist/government-dental-programs/canadian-dental-care-plan/ (accessed Sept 12, 2023).

Chapter 4

4 Integrated Discussion

This thesis aimed to conduct a comprehensive review of the literature on oral health in adolescence and synthesize research findings related to the social determinants of oral health, thereby enhancing our understanding of the socioeconomic factors associated with oral health and dental care utilization. Furthermore, by analyzing cross-sectional data from the CCHS, this thesis contributes with valuable insights into the specific social determinants linked to oral health and dental care utilization in the Canadian context, with a particular focus on the province of Ontario. This research sheds light on the complex interplay of social factors, behavioral influences, and psychosocial stress in explaining oral health inequalities among adolescents and young adults. Ultimately, our study addresses critical knowledge gaps in the field of oral epidemiology, offering leads to the development of targeted interventions and policies aimed at improving oral health outcomes.

By examining oral health and related inequalities in access to dental care within Ontario, we have not only highlighted the pressing need for interventions but also underscored the socioeconomic factors that contribute to these inequalities. In particular, our analysis of private dental insurance coverage has revealed the complex landscape of access to dental care, emphasizing the importance of developing policies that bridge these gaps to ensure equitable oral health outcomes. Additionally, our focus on the province of Ontario has provided a more granular understanding of these issues, potentially informing local policymakers on the importance of decisions that target this group of the population.

Adolescence and young adulthood are pivotal stages for establishing lifelong oral health habits.[1,2] Effective oral care practices learned during this period can have long-lasting effects on an individual's dental health.[3] Failure to address oral health concerns in these formative years can lead to long-term issues, including tooth decay, gum disease, and other oral health problems.[2,4]

The oral health of adolescents and young adults is closely linked to their future oral health outcomes.[2] Individuals who experience oral health problems during this period are more likely to face dental issues in adulthood.[5] Additionally, research has shown a strong connection between oral health and systemic health, including cardiovascular and metabolic conditions.[6] Thus,

addressing oral health issues in these formative years can contribute to overall well-being and reduce the risk of future health complications. Understanding the unique challenges and determinants of oral health in this demographic is essential to develop targeted interventions and policies that can promote healthier outcomes and reduce health disparities among adolescents and young adults. Thus, the findings of these studies will contribute to evidence-based strategies for enhancing oral health outcomes in Canada and Ontario, potentially reducing the economic burden associated with oral diseases. By identifying the factors that influence oral health inequalities in adolescents and young adults, the study can inform the development of more equitable healthcare policies, educational initiatives, and access to dental care. This research is a step in improving oral health for a substantial portion of the population but also aligns with the broader objectives of promoting overall health and well-being for future generations.

4.1 Synthesis of Key Findings

4.1.1 Health inequalities in Adolescents and Young Adults: A Scoping Review

This study aimed to investigate the existing literature on social determinants of oral health inequalities among adolescents and young adults in the United States and Canada. To accomplish this, we conducted a comprehensive literature search in four major databases (CINAHL, Embase, MEDLINE, Cochrane Library), focusing on studies published after 2000 and centered on individuals aged 12 to 24 years old in these two countries. The inclusion criteria encompassed empirical studies examining the relationships between social factors, primarily socioeconomic position and race/ethnicity, and oral health outcomes. Non-English studies and those published before 2000 were excluded. The analysis encompassed a total of 21 studies with diverse study designs, including 16 cross-sectional, 2 longitudinal, and 3 retrospective cohort studies. The primary oral health outcome investigated in these studies was dental caries. The findings from these studies underscored the multifaceted nature of oral health inequalities in this age group, shaped by a complex interplay of factors. These factors included unhealthy behaviors, psychosocial stressors such as racial discrimination, and limited access to dental care for disadvantaged individuals. In conclusion, the scoping review highlighted the existence of oral health inequalities among adolescents and young adults in the United States and Canada, driven

by a complex interplay of behavioral, psychosocial, and access to dental care factors. The study suggests that future research should consider employing longitudinal studies to establish causality and interventional studies to evaluate the effectiveness of oral health interventions in addressing these inequalities.

4.1.2 The Social Determinants of Oral health of Adolescents and Young Adults in Ontario: A Cross-sectional Analysis of the Canadian Community Health Survey

The study conducted a cross-sectional analysis of the relationships between social and economic factors, particularly annual household income, and key oral health indicators in adolescents and young adults residing in Ontario. We did this by curating data from the CCHS 2017-2018 cycle and employing weighted descriptive statistics to ensure population representation. First, the study demonstrated that a higher annual household income was linked to better SROH, indicating a protective association. This implies that individuals from families with higher annual household income were less likely to report poor oral health. Importantly, this protective association varied significantly with age, with young adults (aged 18-24years) benefiting from higher household income in terms of SROH, but not among adolescents (aged 12-17 years). Furthermore, the study noted that this protective effect of income on SROH was partially diminished by psychosocial stress factors, suggesting that psychosocial stress contributes to oral health inequalities. Regarding dental care utilization, individuals from higher income households exhibited a lower prevalence of infrequent dental visits compared to their lower-income counterparts, highlighting a protective association of income on dental care utilization. This held true for both adolescents and young adults, emphasizing the importance of SEP in accessing dental care across these age groups. In conclusion, this study underlines the existence of socioeconomic inequalities in oral health and dental care utilization among adolescents and young adults in Ontario. The findings stress the importance of policies aimed at reducing these social inequalities and improving access to oral health care, which may enhance oral health outcomes for this vulnerable age group.

4.2 Policy Implications

A key policy implication of this work is addressing oral health inequalities in adolescents and young adults. Policymakers should focus on upstream social factors such as house income that has been shown in this study to be a major determinant of oral health and dental care utilization for adolescents and young adults, controlling for other contributing factors. Policies that explore income-based subsidies and sliding scale fees to make dental care affordable for those with limited resources may be helpful.[11] Additionally, embracing digital health solutions, including teledentistry and telehealth services, can further enhance access, particularly for those residing in remote or underserved regions.[12] These technologies allow adolescents and young adults to receive dental advice, consultations, and guidance remotely, potentially bridging geographical barriers.[12] By incorporating digital solutions and expanding insurance coverage, policymakers can make oral health care more accessible and affordable for this age group.

Public health education campaigns specifically targeting adolescents and young adults can raise awareness about the importance of oral health and empower them to take control of their oral health well-being. Advocacy for addressing the psychosocial aspects of oral health, recognizing the impact of stress on oral health, self-esteem and overall well-being is also implicated by our findings. While the transition from adolescence to young adulthood is a critical period, policies should be designed to address the unique needs and challenges during this phase, including changes in insurance status and shifts in self-care responsibilities. Furthermore, by involving young adults in policy development, policymakers can ensure a holistic approach to oral health that considers the transitional aspects of care. These multifaceted policies aim to promote oral health equity and overall well-being among adolescents and young adults in Canada and Ontario. Overall, these policy recommendations are intended to build upon and complement the existing dental programs and initiatives available in Ontario and Canada. By bridging the gaps and expanding the scope of existing programs, policymakers can better address oral health inequalities among adolescents and young adults.

4.3 Future Directions

Future research should emphasize the importance of longitudinal studies to gain a deeper understanding of the oral health trajectories of adolescents as they transition into young adulthood. These studies can help identify critical periods of risk and uncover the specific factors that contribute to oral health disparities during this life stage. By following individuals over time, researchers can examine how the various social determinants, access to dental care, and individual behaviors impact oral health outcomes. This longitudinal approach will provide valuable insights into the evolution of oral health disparities and inform the development of targeted interventions that consider the unique needs of adolescents and young adults. Additionally, there is a need for research that evaluates the effectiveness of these interventions in reducing oral health disparities among young adults.

The future of oral epidemiology for adolescents and young adults should involve active advocacy for policies that support equitable access to dental care. Researchers can play a pivotal role in advocating for policy changes and ensuring that these policies address the specific needs of this age group. Collaboration between oral health professionals, primary care providers, educators, and policymakers should be encouraged to develop interdisciplinary care models that better address the needs of adolescents and young adults. Targeted outreach strategies should be explored to raise awareness about oral health among this age group, using platforms like social media, peer education, and community-based campaigns. By focusing on these areas, future research and initiatives can work towards reducing oral health inequalities and promoting lifelong oral health among adolescents and young adults in Canada and Ontario.

4.4 Conclusion

Overall, both studies included in this thesis collectively underscore the critical importance of addressing oral health inequalities in adolescents and young adults. These inequalities are influenced by a complex interplay of behavioral, psychosocial, and health system factors, creating a distinct social gradient in oral health outcomes and dental care utilization. To rectify these imbalances, it is imperative to adopt comprehensive strategies that account for the social determinants affecting oral health. By integrating the principles of the WHO Social Determinants

of Health framework into both policy and practice, we can take meaningful steps towards reducing inequalities and promoting equitable oral health outcomes for all individuals and communities. Moreover, future research should consider longitudinal and interventional studies to establish causality and assess the effectiveness of targeted interventions. Achieving health equity in oral health necessitates a collaborative effort involving policymakers, healthcare providers, communities, and individuals, all working in unison to tackle the socioeconomic and structural factors contributing to these inequalities.

4.5 References

1. Arain M, Haque M, Johal L, *et al.* Maturation of the adolescent brain. *Neuropsychiatr Dis Treat* 2013; **9**: 449–61.

2. Oral Health Across the Lifespan: Adolescents. In: Oral Health in America: Advances and Challenges [Internet]. National Institute of Dental and Craniofacial Research(US), 2021. https://www.ncbi.nlm.nih.gov/books/NBK578291/ (accessed May 25, 2023).

3. Tadin A, Guberina RP, Domazet J, Gavic L. Oral Hygiene Practices and Oral Health Knowledge among Students in Split, Croatia. *Healthcare* 2022; **10**. DOI:10.3390/healthcare10020406.

4. Jackson SL, Vann WF, Kotch JB, Pahel BT, Lee JY. Impact of Poor Oral Health on Children's School Attendance and Performance. *Am J Public Health* 2011; **101**: 1900–6.

5. Oral Health Across the Lifespan: Working-Age Adults. In: Oral Health in America: Advances and Challenges [Internet]. National Institute of Dental and Craniofacial Research(US), 2021. https://www.ncbi.nlm.nih.gov/books/NBK578294/ (accessed Oct 19, 2023).

6. Meurman JH, Bascones-Martinez A. Oral Infections and Systemic Health - More than Just Links to Cardiovascular Diseases. *Oral Health Prev Dent* 2021; **19**: 441–8.

7. Gargano L, Mason MK, Northridge ME. Advancing Oral Health Equity Through School-Based Oral Health Programs: An Ecological Model and Review. *Front Public Health* 2019; **7**: 359.

8. Services covered by Healthy Smiles Ontario | ontario.ca. http://www.ontario.ca/page/services-covered-by-healthy-smiles-ontario (accessed Oct 17, 2023).

9. Society CP. Meeting the health care needs of street-involved youth | Canadian Paediatric Society. https://cps.ca/en/documents/position/health-care-needs-of-street-involved-youth (accessed Oct 19, 2023).

10. Song J, Kim JN, Tomar S, Wong LN. The Impact of the Affordable Care Act on Dental Care: An Integrative Literature Review. *Int J Environ Res Public Health* 2021; **18**: 7865.

11. Etemadi M, Hajizadeh M. User fee removal for the poor: a qualitative study to explore policies for social health assistance in Iran. *BMC Health Serv Res* 2022; **22**: 250.

12. Haleem A, Javaid M, Singh RP, Suman R. Telemedicine for healthcare: Capabilities, features, barriers, and applications. *Sens Int* 2021; **2**: 100117.

Appendices

Appendix 3. 1: Study variables by name and type.

	Variable type and name	*Type*	*Measure*	*Categories*	*Unweighted Frequencies [%]*
Independent variables					
Material	Household income (CCHS code INCG015)	Categorical	Total household income - all sources	No income or less than $20,000 (CCHS code 01)	380 [8.44]
				$20,000 to $39,999 (CCHS code 02)	523 [11.61]
				$40,000 to $59,999 (CCHS code 03)	459 [10.19]
				$60,000 to $79,999 (CCHS code 04)	480 [10.66]
				$80,000 or more (CCHS code 05)	2662 [59.10]
				Not stated (CCHS code 09)	24
	Household education (CCHS code EHG2DVH3)	Categorical	Highest level of education - household	Less than secondary school graduation (CCHS code 01)	116 [2.67]
				Secondary school graduation, no post-secondary education (CCHS code 02)	667 [15.36]
				Post-secondary certificate diploma or univ degree (CCHS code 03)	3560 [81.97]
				Not stated (CCHS code 09)	185
Behavioural	Brushing teeth frequency (CCHS codes DEN_010 DEN_010A)	Categorical	How often do you usually brush your teeth?	Less than 2 times per day	997 [23.41]
				2 times per day	2939 [69.01]
				More than 2 times per day	323 [7.58]

				Refusal (CCHS code 998) Not stated (CCHS code 999)	269
	Smoking status (CCHS code SMK_005)	Categorical	At the present time, do you smoke cigarettes every day, occasionally or not at all?	Daily (CCHS code 01)	238 [5.26]
				Occasionally (CCHS code 02)	215 [4.75]
				Not at all (CCHS code 03)	4069 [89.98]
				Don't know (CCHS code 07) Refusal (CCHS code 08)	6
	Alcohol use (CCHS codes ALCDVTTM)	Binary	Type of drinker - 12 months	Regular drinker (CCHS code 01)	1498 [33.00]
				Occasional drinker (CCHS code 02)	834 [18.00]
				Did not drink in the last 12 months (CCHS 03)	2184 [48.00]
				Not stated (CCHS code 09)	12
Psychosocial factors	Perceived stress (CCHS code GEN_020)	Categorical	Thinking about the amount of stress in your life, would you say that most of your days are...?	Not at all stressful (CCHS code 01)	541 [11.99]
				Not very stressful (CCHS code 02)	1403 [31.10]
				A bit stressful (CCHS code 03)	1821 [40.37]
				Quite a bit stressful (CCHS code 04)	649 [14.39]
				Extremely stressful (CCHS code 05)	97 [2.15]
				Don't know (CCHS code 07) Refusal (CCHS code 08)	17
Health system factors	Dental insurance (CCHS Code	Binary YES or NO	Do you have insurance or a government	Yes (CCHS code 01)	2979 [76.27]
				No (CCHS code 02)	927 [23.73]

	DEN_045)		program that covers all or part of your dental expenses?	Valid skip (CCHS code 06) Don't know (CCHS code 07) Refusal (CCHS code 08) Not stated (CCHS code 09)	622
	Type of insurance (CCHS Codes DEN_050A DEN_050B DEN_050C DEN_050D DEN_050E DEN_050F)	Categorical	Type of insurance - dental – employer/govt (children / seniors)/ private plan/ govt (social service clients)/ govt (First Nations and Inuit)/other	Employer DEN_050A	2115 [79.72]
				Govt. (children/seniors)	87 [3.28]
				Private plan	158 [5.96]
				Govt. (social service clients)	126 [4.75]
				Govt. (First nations and Inuit)	24 [0.90]
				Other	171 [6.45]
				Valid skip (CCHS Code 06) Don't know (CCHS Code 07) Refusal (CCHS Code 08) Not stated (CCHS Code 09)	1875
Socio-demographics	Age (CCHS Code DHHGAGE)	Categorical	What is your age?	Age between 12 and 14 (CCHMS code 01)	1303 [28.78]
				Age between 15 and 17 (CCHMS code 02)	1194 [26.37]
				Age between 18 and 19 (CCHMS code 03)	575 [12.70]
				Age between 20 and 24 (CCHMS code 04)	1456 [32.16]
	Sex (CCHS Code DHH_SEX)	Binary	Is [respondent name] male or female?	Male (CCHMS code 01)	2255 [49.80]
				Female (CCHMS code 02)	2273 [50.20]
	Race (CCHS Code SDCDGCGT)	Binary			

	Immigration status (CCHS Code SDCDVIMM)	Binary (Presented as Categorical in CCHMS)	Immigration status	Landed immigrant / non-permanent resident (CCHMS code 1)	534 [12.05]
				Non-immigrant - Canadian born (CCHMS code 2)	3896 [87.94]
				Not stated (CCHMS code 09)	98
Dependent Variable	Self- reported oral health (CCHS Code OHT_005)	Binary	In general, would you say the health of your mouth is...?	Excellent (CCHMS code 01)	1094 [25.35]
				Very good (CCHMS code 02)	1836 [42.54]
				Good (CCHMS code 03)	1077 [24.95]
				Fair (CCHMS code 04)	261 [6.05]
				Poor (CCHMS code 05)	48 [1.11]
				Valid skip (CCHMS code 06) Don't know (CCHMS code 07) Refusal (CCHMS code 08) Not stated (CCHMS code 09)	212
	Dental Care Utilization – Visit dental professionals frequency (CCHS Code DEN_030)	Binary (check-ups or emergency visits)	How often do you usually see a dental professional, such as a dentist, a dental hygienist or a denturologist ?	More than once a year for check-ups or treatment (CCHMS code 01)	2422 [56.43]
				About once a year (for check-ups or treatment) (CCHMS code 02)	1293 [30.13]
				Less than once a year (for check-ups or treatment) (CCHMS code 03)	216 [5.03]
				Only for emergency care (CCHMS code 04)	273 [6.36]
				Never (CCHMS code 05)	88 [2.05]
				Valid skip (CCHMS code 06) Don't know (CCHMS code 07)	236

				Refusal (CCHMS code 08) Not stated (CCHMS code 09)	
	Dental Care Utilization – Visit dental professionals (last time visit) (CCHS Code DEN_035)	Binary (<1 year which is regular or ≥1 year which is irregular)	When was the last time you saw a dental professional?	Less than 1 year to 1 year ago (CCHMS code 01)	3590 [84.95]
				More than 1 year to 2 years ago (CCHMS code 02)	352 [8.33]
				More than 2 years to 3 years ago (CCHMS code 03)	96 [2.27]
				More than 3 years to 4 years ago (CCHMS code 04)	39 [0.92]
				More than 4 years to 5 years ago (CCHMS code 05)	36 [0.85]
				More than 5 years ago (CCHMS code 06)	90 [2.13]
				Never (CCHMS code 07)	23 [0.54]
				Valid skip (CCHMS code 06) Don’t know (CCHMS code 07) Refusal (CCHMS code 08) Not stated (CCHMS code 09)	302

Appendix 3.2: Characteristics of study sample according to SROH categories and dental care utilization.

	SROH			Type of Dental Visit			Frequency of Dental Visit		
	Odds Ratio (SE)	**95%CI**	**P-value**	**Odds Ratio (SE)**	**95%CI**	**P-value**	**Odds Ratio (SE)**	**95%CI**	**P-value**
Age									
12 – 17 years (Ref.)	1.00								
18 – 24 years	1.141 (0.195)	0.82 – 1.59	0.440	0.340 (0.078)	0.22 – 0.53	<0.001	0.279 (0.044)	0.21 – 0.38	**<0.001**
Sex									
Males (Ref.)	1.00								
Females	0.429 (0.079)	0.30 – 0.61	**<0.001**	1.212 (0.244)	0.82 – 1.80	0.340	1.211 (0.172)	0.92 – 1.60	0.177
Race									
White (Ref.)	1.00								
Non-white	0.900 (0.171)	0.62 – 1.30	0.569	2.120 (0.440)	1.41 – 3.18	**<0.001**	1.356 (0.203)	1.01 – 1.82	**0.042**
Immigration Status									
Immigrant (Ref.)	1.00								
Non-immigrant	0.744 (0.183)	0.46 – 1.20	0.229	0.310 (0.067)	0.20 – 0.47	**<0.001**	0.430 (0.072)	0.31 – 0.60	**<0.001**
Household Education Level									
< Secondary school	1.00								
Secondary school graduation	1.163 (0.527)	0.48 – 2.83	0.738	1.146 (0.426)	0.55 – 2.37	0.714	1.183 (0.402)	0.61 – 2.30	0.622
Post-secondary and higher	0.617 (0.259)	0.27 – 1.40	0.250	2.942 (1.015)	1.50 – 5.78	**0.002**	2.438 (0.770)	1.31 – 4.53	**0.005**
Household Income									
<$20,000 to $39,999 (Ref.)	1.00								
$40,000 to $79,999	0.603 (0.139)	0.38 – 0.95	**0.028**	1.762 (0.456)	1.06 – 2.93	**0.029**	1.636 (0.315)	1.12 – 2.39	**0.011**
$80,000 and over	0.523 (0.101)	0.36 – 0.76	**0.001**	4.535 (1.057)	2.87 – 7.16	**<0.001**	2.954 (0.493)	2.13 – 4.10	**<0.001**
Dental Insurance									
Uninsured (Ref.)	1.00								
Insured	0.636 (0.119)	0.44 – 0.92	**0.016**	4.404 (0.962)	2.87 – 6.76	**<0.001**	3.966 (0.619)	2.92 – 5.38	**<0.001**
Smoking Status									
No (Ref.)	1.00								
Yes	2.969 (0.637)	1.95 – 4.52	**<0.001**	0.347 (0.081)	0.22 – 0.55	**<0.001**	0.372 (0.071)	0.26 – 0.54	**<0.001**

Alcohol Use									
No (Ref.)	1.00								
Yes	1.112 (0.195)	0.80 – 1.57	0.515	0.856 (0.172)	0.58 – 1.27	0.441	0.791 (0.114)	0.60 – 1.05	0.104
Teeth brushing frequency									
Once a day or less (Ref.)	1.00								
Twice a day or more	0.380 (0.072)	0.26 – 0.55	**<0.001**	2.014 (0. 454)	1.29 – 3.14	**0.002**	1.577 (0.254)	1.15 – 2.16	**0.005**
Stress in life									
Not stressed (Ref.)	1.00								
Moderately stressed	1.471 (0.273)	1.02 – 2.12	**0.037**	0.732 (0.143)	0.50 – 1.07	0.111	0.808 (0.113)	0.61 – 1.06	0.130
Really stressed	3.382 (1.491)	1.43 – 8.02	**0.006**	0.346 (0.159)	0.14 – 0.85	**0.021**	0.592 (0.237)	0.27 – 1.30	0.191

Appendix 3.3: Characteristics of the sample, stratified by sex, CCHS, 2017- 18.

Sex	Female				Male			
Variables	SROH			P-values	SROH			P-values
	n	Good(%)	Poor(%)		n	Good(%)	Poor(%)	
Socio-Demographic Factors								
Age (years)				0.063				**0.001**
12-17	1148	1097 (96.1)	51 (3.9)		1199	1113 (92.8)	86 (7.2)	
18-24	1027	963 (96.5)	64 (3.5)		942	834 (91.0)	108 (9.0)	
Cultural / racial background				**0.005**				**0.033**
White	1523	1446 (94.9)	77 (5.1)		1457	1333 (91.5)	124 (8.5)	
Non-white (Aboriginal or Other Visible Minority)	480	460 (95.8)	20 (4.2)		529	482 (91.1)	47 (8.9)	
Missing	172	154 (89.5)	18 (10.5)		155	132 (85.2)	23 (14.8)	
Immigration Status				0.789				0.323
Immigrant	248	236 (95.8)	12 (4.2)		278	255 (94.5)	23 (5.5)	
Non-immigrant	1871	1770 (96.4)	101 (3.6)		1825	1655 (90.9)	170 (9.1)	
Missing	56	54 (98.2)	2 (1.8)		38	37 (96.5)	1 (3.5)	
Household Education Level				**<0.001**				**<0.001**
Less than secondary school	68	59 (90.9)	9 (9.1)		37	34 (93.4)	3 (6.7)	
Secondary school graduation	305	273 (92.9)	32 (7.1)		333	285 (88.1)	48 (11.9)	
Post-secondary certificate/ diploma or univ degree	1722	1651 (96.9)	71 (3.1)		1680	1551 (92.6)	129 (7.4)	
Missing	80	77 (97.6)	3 (2.4)		91	77 (89.5)	14 (10.5)	
Household Income				**<0.001**				**<0.001**
Less than $39,999	450	403 (94.1)	47 (5.9)		412	349 (87.3)	63 (12.7)	
$40,000 to $79,999	454	431 (97.1)	23 (2.9)		420	377 (91.5)	43 (8.5)	
$80,000 and above	1258	1216 (96.8)	42 (3.2)		1300	1212 (93.2)	88 (6.8)	
Missing	13	10 (87.1)	3 (12.9)		9	9 (100.0)	0	
Dental Insurance				0.082				**<0.001**
No insurance	466	432 (96.2)	34 (3.8)		461	390 (93.2)	71 (6.8)	
Government/Employer-sponsored/ private plan	1510	1437 (96.9)	73 (3.1)		1469	1365 (87.0)	104 (13.0)	
Missing	199	191 (95.5)	8 (4.5)		211	192 (93.6)	19 (6.4)	
Health behavior Factors								
Smoking Status				**<0.001**				**<0.001**
No	1989	1901 (96.8)	88 (3.2)		248	1742 (92.9)	147 (7.1)	
Yes	186	159 (90.5)	27 (9.5)		1889	201 (83.7)	47 (16.3)	
Missing	0	0	0		4	4 (100.0)	0	
Alcohol Use				0.673				**0.010**

No	999	950 (96.0)	49 (4.0)		1026	953 (92.8)	73 (7.2)	
Yes	1172	1106 (96.5)	66 (3.5)		1108	988 (91.0)	120 (9.0)	
Missing	4	4 (100.0)	0		7	6 (90.6)	1 (9.4)	
Teeth brushing frequency				**<0.001**				**0.002**
Twice a day or more	1829	1752 (97.2)	77 (2.8)		1525	1413 (93.5)	112 (6.5)	
Once a day or less	313	277 (90.0)	36 (10.0)		563	496 (88.1)	67 (11.9)	
Missing	33	32 (97.8)	1 (2.2)		53	45 (84.4)	8 (15.6)	
Psychosocial Factors								
Stress in life				0.081				**<0.001**
Not at all stressful	791	761 (97.4)	30 (2.6)		1085	1016 (94.0)	69 (6.1)	
Somewhat stressful	1322	1242 (95.7)	80 (4.3)		1027	910 (90.4)	117 (9.6)	
Extremely Stressful	57	52 (95.3)	5 (4.7)		25	18 (67.4)	7 (32.6)	
Missing	5	5 (100.0)	0		4	3 (84.8)	1 (15.2)	

Appendix 3.4: Characteristics of the study sample and type of dental visits for adolescents in Ontario (n=4,204).

Variables	Type of Dental Visits			P-values
	n	Check-up (%)	Emergency visits (%)	
Socio-Demographic Factors				
Age (years)				**<0.001**
12-17	2298	2241 (96.5)	57 (3.5)	
18-24	1906	1690 (90.4)	216 (9.6)	
Sex				0.174
Female	2081	1996 (93.6)	127 (6.4)	
Male	2123	1935 (92.3)	146 (7.7)	
Cultural / racial background				**<0.001**
White	2911	2759 (94.8)	152 (5.2)	
Non-white (Aboriginal or Other Visible Minority)	977	882 (90.3)	95 (9.7)	
Missing	316	290 (91.8)	26 (8.2)	
Immigration Status				**<0.001**
Immigrant	501	425 (85.3)	76 (14.7)	
Non-immigrant	3616	3428 (94.9)	188 (5.1)	
Missing	87	78 (91.8)	9 (8.2)	
Household Education Level				**<0.001**
Less than secondary school	99	78 (84.8)	21 (15.2)	
Secondary school graduation	603	520 (86.4)	83 (13.6)	
Post-secondary certificate diploma or univ degree	3338	3185 (94.2)	153 (5.8)	
Missing	164	148 (91.2)	16 (8.8)	
Household Income				**<0.001**
Less than $39,999	814	686 (84.9)	128 (15.1)	
$40,000 to $79,999	846	776 (90.9)	70 (9.1)	
$80,000 and above	2523	2450 (96.2)	73 (3.8)	
Missing	21	19 (95.3)	2 (4.7)	
Access to dental care				
Dental Insurance				**<0.001**
No insurance	876	720 (84.0)	156 (16.0)	
Government/Employer-sponsored/ private plan	2941	2846 (95.9)	95 (4.1)	
Missing	387	365 (93.4)	22 (6.6)	
Health behavior				
Smoking Status				**<0.001**
No	3781	3573 (93.9)	208 (6.1)	
Yes	419	354 (84.3)	65 (15.7)	
Missing	4	4 (100.0)	0	
Alcohol Use				**<0.001**
No	1957	1864 (93.5)	93 (6.5)	
Yes	2237	2058 (92.5)	179 (7.5)	
Missing	10	9 (97.9)	1 (2.1)	
Teeth brushing frequency				**<0.001**
Twice a day or more	3282	3106 (94.1)	176 (5.9)	
Once a day or less	842	757 (88.7)	85 (11.3)	
Missing	80	75 (92.3)	5 (7.7)	
Psychosocial Factors				
Stress in life				**0.001**
Not at all	1819	1716 (94.2)	103 (5.8)	

stressful				
Somewhat stressful	2300	2143 (92.3)	157 (7.7)	
Extremely Stressful	78	65 (84.9)	13 (15.1)	
Missing	7	7 (100.0)	0	

Appendix 3.5: Associations between Household Income on child/adolescent and type of dental visits (emergency visits versus checkup visits to the dentist).

	Model 1			Model 2			Model 3			Model 4		
	Odds Ratio (SE)	**95%CI**	**P-value**	**Odds Ratio (SE)**	**95%CI**	**P-value**	**Odds Ratio (SE)**	**95%CI**	**P-value**	**Odds Ratio (SE)**	**95%CI**	**P-value**
Household Income												
<$20,000 to $39,999 (Ref.)	1.00											
$40,000 to $79,999	0.750 (0.208)	0.43 – 1.29	0.300	0.881 (0.254)	0.50 – 1.56	0.661	0.892 (0.261)	0.50 – 1.58	0.696	0.891 (0.277)	0.48 – 1.64	0.711
$80,000 and over	0.278 (0.071)	0.17 – 0.46	**<0.001**	0.320 (0.084)	0.19 – 0.53	**<0.001**	0.327 (0.086)	0.19 – 0.55	**<0.001**	0.379 (0.110)	0.21 – 0.67	**0.001**

Appendix 3.6: Percent Attenuation of health behaviours, psychosocial factors and access to dental care factors on the relationship between SROH and dental visits with SEP among adolescents.

	SROH % Attenuation			Dental Visits % Attenuation		
	Model 2	**Model 3**	**Model 4**	**Model 2**	**Model 3**	**Model 4**
12 – 17 years						
Household Income						
<$39,999 (Ref.)						
$40,000 to $79,999	14	14	4	4	0.1	29
$80,000 and over	11	15	5	6	3	14
18 – 24 years						
Household Income						
<$39,999 (Ref.)						
$40,000 to $79,999	21	21	22	9	11	26
$80,000 and over	33	38	45	2	13	40

%= (model 1 PR – model 2 PR) / model 1 PR*100.

%= (model 1 PR – model 3 PR) / model 1 PR*100.

%= (model 1 PR – model 4 PR) / model 1 PR*100.

Curriculum Vitae

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