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Examining changes in income-related oral health inequality in Canada: A population-level perspective

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ABSTRACT

Introduction: Monitoring trends in oral disease is essential to identifying population needs and informing policies to improve the oral health status of Canadians. At present, effort to examine income-related inequalities in untreated dental disease, such as dental decay, and their changes over time has been minimal in Canada. This article examines and compares income-related inequalities in decayed teeth in Canada between the 1970s and 2000s. **Methods:** A secondary data analysis using the Nutrition Canada National Survey 1970–1972 and the Canadian Health Measures Survey 2007–2009 was performed in order to examine individual- and population-level income-related inequalities in dental decay. Income quintiles and concentration indices for the presence of one or more decayed teeth were derived using indirect standardization and multivariate logistic regression. **Results:** Results highlight that income gradients in decayed teeth have persisted over time, with higher income groups experiencing greater reductions in the prevalence of decayed teeth than those of lower income. Higher concentration indices exhibited in more recent surveys suggest an increase in income-related inequality in decayed teeth over time. **Conclusion:** Our findings provide a foundation for measuring changes to income-related inequalities in oral disease in the Canadian population and reveal that inequalities in decayed teeth have persisted despite overall reductions in the presence of dental decay over time.

RÉSUMÉ

Contexte : La surveillance des tendances en matière des maladies buccodentaires permet de cerner les besoins de la population et d'influencer la politique en vue d'améliorer l'état de santé buccodentaire des Canadiens. À ce jour, les efforts pour examiner les inégalités liées au revenu en matière des maladies dentaires non traitées et leurs changements au fil du temps ont été minimes au Canada. Nos objectifs étaient d'examiner et de comparer les inégalités liées au revenu au Canada, en matière de dents cariées, entre les années 1970 et les années 2000. **Méthodes :** Une analyse de données secondaires à l'aide de l'Enquête nationale sur la nutrition au Canada 1970–1972 et l'Enquête sur la santé canadienne 2007–2009 a été réalisée afin d'examiner les inégalités en matière de santé buccodentaire liées au revenu individuel et à celui de la population. Les quintiles de revenus et les indices de concentration concernant la présence d'une ou de plusieurs dents cariées ont été obtenus à l'aide de la standardisation indirecte et de la régression logistique multivariée. **Résultats :** Les gradients de revenu en matière de santé buccodentaire ont persisté à travers le temps, se traduisant en une plus importante réduction de dents cariées dans les quintiles de revenu plus élevés que dans les quintiles de revenu plus faibles. Des indices de concentration plus élevés ont été exposés dans des enquêtes plus récentes, ce qui suggère qu'il existe une augmentation des inégalités liées au revenu en matière de dents cariées au fil du temps. **Conclusion :** Nos résultats fournissent un indice de référence pour mesurer les variations des inégalités liées au revenu en matière de santé buccodentaire de la population canadienne et ils révèlent que les inégalités sur le plan des maladies dentaires non traitées ont persisté au fil du temps malgré la réduction du taux de caries.

Key words: concentration index, dental caries, dental disease, health inequalities, population health

INTRODUCTION

Monitoring trends in oral disease is essential to identifying population needs and informing policies to improve the oral health status of Canadians. With oral health care predominantly privately financed in Canada, it is essential to monitor trends and inequalities related to the affordability of care. Income gradients in oral health and disease are well recognized internationally; they are described as poorer oral health status and access to care with diminishing income.[1] At present, effort to examine income-related inequalities in oral health and disease outcomes in Canada and their changes over time has been minimal.

Indeed, only one study has examined changes to oral health inequalities in Canada. Elani and colleagues measured the difference in the prevalence of one or more decayed, filled, and missing teeth outcomes by income and concluded a narrowing of inequality among income groups since the 1970s.[2] Although these results provide insight into the changes in the level of oral health and disease by income group, they do not accurately depict changes to the

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level of inequality experienced in the Canadian population, as income group size and the distribution of income across the population were not taken into account.[3] Fortunately, a number of summary measures of health inequalities have emerged to address this issue. One popular measure is known as the concentration index method, as it measures the size of inequality in oral health or disease from a population-level perspective and accounts for these limitations.[4] The concentration index describes how equally or unequally an oral health or disease outcome is distributed across a population and can be used to examine and compare inequality over time or between regions.[4]

Using the concentration index method, researchers have identified income-related inequalities in access to dental care and clinical outcomes in Canada. Allin found that dental visits within the past year were more concentrated among higher income individuals in all provinces, indicating income as a predictor of inequalities in dental care visits.[5] Moreover, income-related inequality in preventive dental care was found to be unequally concentrated among higher income groups, indicating that the rich had a greater share of reported preventive dental visits within the past year than the poor.[6] Clinical outcomes have also been used to examine inequalities in treated (filled teeth) and untreated (decayed teeth) dental disease as well as endpoints of disease (missing teeth).[7] Indeed, Ravaghi and colleagues identified higher income-related inequalities in decayed and missing teeth than in filled teeth, concluding that lower income groups share a greater burden of disease than higher income groups.[7] Their results suggest that the poor often receive less preventive treatment and postpone curative treatments, potentially leading to the development of more severe oral health problems and more untreated disease in adult Canadian populations.

While there has been significant interest in monitoring trends in health inequalities in Canada, oral health outcomes are rarely identified in these reports.[8,9] Importantly, examining changes to the level of income-related inequality in preventable dental disease, such as dental decay, provides insight for dental professionals into potential affordability barriers to timely care. Although there have been improvements in the overall prevalence of oral disease in the Canadian population since the 1970s, it is not known if this has translated to a reduction in inequality at the population level.[10] As such, this article examines and compares income-related inequalities in decayed teeth in Canada between the 1970s and 2000s.

METHODOLOGY

A secondary data analysis of 2 Canadian cross-sectional national surveys was performed in order to examine individual- and population-level income-related inequalities in dental decay. Analysis focused on individuals ages 20 to 74 years; those who were younger than 20 or over 75 years of age, did not complete household questionnaires and/or clinical examinations, and/or had missing data were excluded.

Data sources

Data come from 2 Canadian sources: 1) the Nutrition Canada National Survey 1970–1972 (NCNS); 2) the Canadian Health Measures Survey 2007–2009 (CHMS). The NCNS was accessed through Statistics Canada's Data Liberation Initiative (DLI). The CHMS was accessed through the Statistics Canada Research Data Centre (RDC) at the University of Toronto.

The NCNS was conducted between October 1970 and September 1972. The survey collected information from 19,590 individuals ages 0 to over 100. The survey attempted to estimate the prevalence of nutritional diseases in the Canadian population and determine food type and quantity consumed by Canadians by collecting representative estimates from metropolitan, urban, and rural residents and from low and other income groups. The following 5 regions were represented in the sampling: Atlantic (Newfoundland, Prince Edward Island, New Brunswick, and Nova Scotia); Quebec; Ontario; Prairie (Manitoba, Saskatchewan, and Alberta); and British Columbia. Aboriginal groups living on reserves or Crown lands in the following regions were also sampled: Maritime (PEI, New Brunswick, and Nova Scotia); Quebec; Ontario; Prairie (Manitoba, Saskatchewan, and Alberta); British Columbia; Yukon and Northwest Territories, as were Inuit living in 4 settlements in the Northwest Territories. With the exception of the samples of expectant women and phase I of the youth survey, the survey was statistically designed to produce probability samples. Data were collected in two phases: 1) household interview; 2) clinical examination at the Nutrition Canada Clinic. Household interviews captured general demographic, socioeconomic, food handling, and food preparation information. Several clinical measures were used in the Nutrition Canada Clinic, including oral health measures. The final NCNS produced a nationally representative sample of 14,245 dental records.[11]

The CHMS was conducted by Statistics Canada between March 1, 2007, and March 31, 2009, and collected information from household residents ages 6 to 79 years. Collection occurred in 2 stages: 1) household interview; 2) clinical examination. The household interview collected information on respondents' demographic characteristics, socioeconomic status, and health behaviours. The clinical examination collected clinical measures of respondents' physical health (including an oral health examination). The clinical examination was conducted in a CHMS mobile examination centre. The oral health examination involved direct physical measurements of oral health by calibrated dentists/examiners using a mouth mirror and explorer. Of the 8,772 households selected for the CHMS, 69.6% agreed to participate; 88.3% of them responded to the household interview, and of those, 84.9% visited the mobile examination centre. The overall response rate was

51.7%. A comprehensive consent process was employed. The final CHMS sample size was 5,604 respondents, which is representative of approximately 96.3% of the Canadian population.

Data variables

The presence of decayed teeth—a measure of untreated dental disease—was clinically recorded in both surveys. The concentration index method requires a ranked measure of socioeconomic status; income is the measure of socioeconomic status in our analysis, and was recoded into quintile groups based on each survey's income distribution. Sociodemographic variables of sex, age, and education were used as controls for analysis of income-related oral health inequalities. For consistency between surveys, respondents were categorized into the following age groups: young adults (20–39), middle-aged adults (40–59), and older adults (60–74). Education was reported as the highest level of education achieved by the head of household and dichotomized to "less than high school" and "high school" due to differences in reporting between surveys.

Description of the concentration index

The concentration index (CI) is a method adapted from the concepts of the Lorenz curve and Gini index. As identified in Figure 1a, the Lorenz curve plots the cumulative proportion of individuals by level of health, ranked in increasing order on the x-axis, against the cumulative total proportion of health within these individuals on the y-axis. The diagonal line identifies an equal distribution of health across a population. A Lorenz curve deviating from the diagonal line indicates that health is unequally distributed across individuals because some individuals are healthier than others.[3] The Gini index measures the distance of the Lorenz curve from the diagonal line. The Gini index is represented as a value ranging from 0 (diagonal line) to 1 (health is concentrated in a single person).

Similarly, the CI measures the distribution of a health outcome across socioeconomic levels within a population. The CI is derived from a concentration curve (CC) that plots the cumulative proportion of the population ranked by socioeconomic status from lowest to highest against the cumulative proportion of the health outcome (Figure 1b). Again, a diagonal line represents the line of equality. Deviations of the CC above or below the diagonal line indicate inequality, where the farther the CC is from the diagonal, the greater the degree of inequality. If the CC falls under the diagonal line, as exhibited in Figure 1b, the outcome is concentrated in those with higher socioeconomic status; if the CC is above the diagonal line, the outcome is concentrated in those with lower socioeconomic status.

The CI measures the distance of the CC from the diagonal line. The CI can take a value ranging from –1 to +1. If all health is concentrated in the person with the highest socioeconomic level, the CI will have a value of

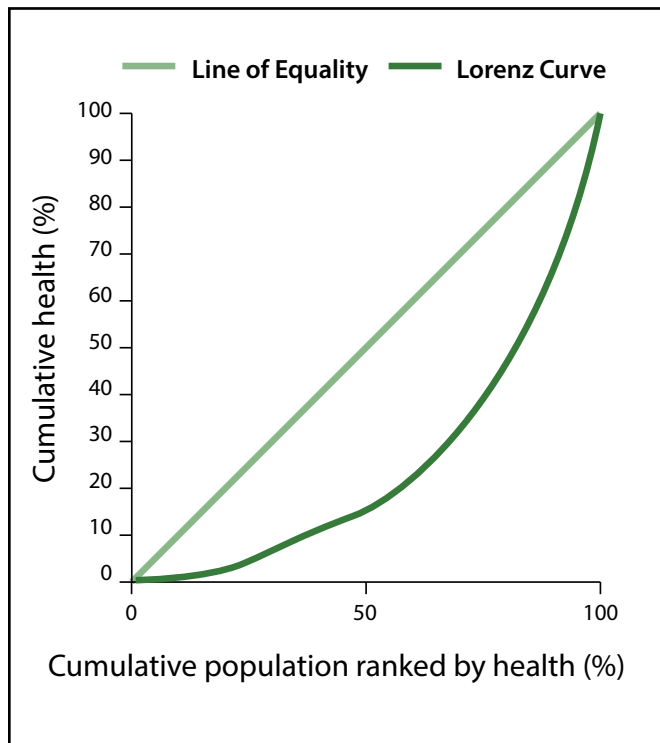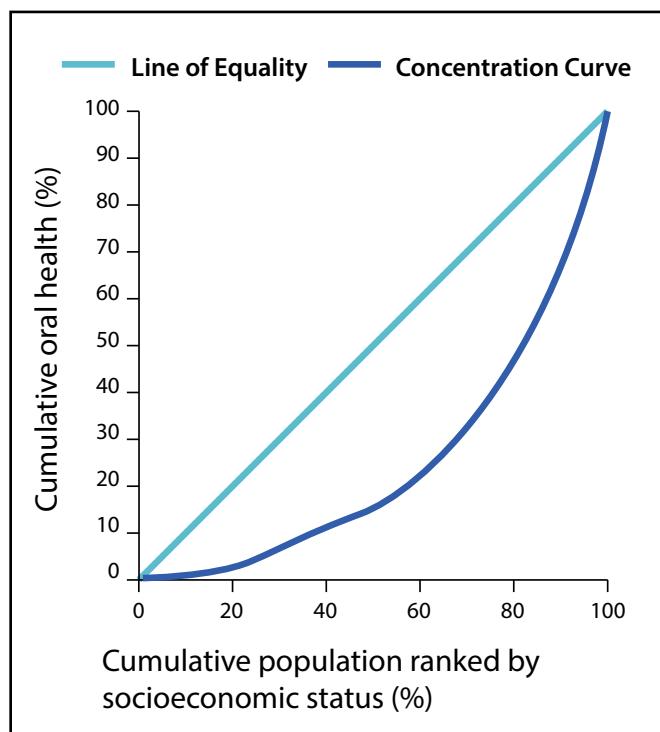**Figure 1a.** *Lorenz curve*

Figure 1b. *Concentration curve*

+1. If health is concentrated in the person with the lowest socioeconomic level, the CI will have a value of −1. Therefore, the closer the CC is to the diagonal line and the closer the CI is to 0, then the greater the equality in that outcome.

For binary outcomes the possible values of the CI are limited by the mean (p) of the distribution and are equal to p-1 and 1-p, respectively.[12] As the mean increases, the range of possible values of the CI shrinks, which has implications for judging the outcomes of binary variables. Therefore, to permit comparison of the concentration index for binary outcomes, the CI can be normalized so that the bounds will be between −1 and +1.[12]

Using convenient linear regression methods, observed and expected CIs were derived and normalized for the presence of one or more decayed teeth for each survey. Observed CIs indicate the magnitude of inequality in decayed teeth experienced in the population, whereas expected CIs reflect the predicted magnitude of inequality in decayed teeth taking into account confounding variables. To produce expected CIs, we controlled for age, sex, education, and income through indirect standardization using multivariate logit models.[4] The difference between the observed and expected CIs was subsequently calculated in order to measure avoidable inequality in decayed teeth, which is interpreted as the level of inequality remaining after accounting for confounding variables.[4] The independent samples t-test was used to determine statistical significance of differences in avoidable inequality between surveys.[13,14] To account for complex survey design and probability sampling, survey weights in each dataset were included in all analyses.

Variations in survey design and methodology between the NCNS and CHMS were limitations of our analyses. Although each survey collected demographic, socioeconomic, and oral health information to produce nationally representative estimates, the degree and availability of comparable outcome and explanatory variables were limited. For example, outcome variables, such as access to dental care and treatment needs, and explanatory variables, such as dental insurance, type of dental insurance, rural/remote location, occupational status, oral hygiene behaviours, were not consistently reported. In addition, because of differences in reporting educational attainment between surveys, our analyses were limited to adult populations. The NCNS reported education based on participants interviewed rather than head of household. As a result, individuals who were ineligible, due to age, to complete high school education were excluded.

RESULTS

Descriptive statistics for the analysis samples are presented in Table 1. The majority of the participants in both surveys fell into the young adult and middle-aged adult categories (20–59), with equal representation between sexes and across income quintiles. There was greater representation of participants with higher educational attainment (high school graduate) in the 2000s compared to the 1970s. As well, there was no statistically significant difference between survey samples.

Table 1. Summary statistics for analysis sample (%)

		Canada 1970–1972 (n = 10,411)	Canada 2007–2009 (n = 3,313)
Age	20–39 years	55.8	39.3
	40–59 years	31.9	42.8
	60–74 years	12.3	17.9
Sex	Female	53.2	49.4
	Male	46.8	50.6
Income	Lowest	10.6	23.8
	Lower middle	23.6	18.9
	Middle	19.7	16.8
	Upper middle	27.5	12.5
	Highest	18.4	28.0
Education	<High school	69.2	8.9
	>High school	30.8	91.1

The overall prevalence of decayed teeth has declined over time (Figure 2). Income gradients in one or more decayed teeth are well defined, with higher rates reported in lower income quintiles in both years and greater reductions in the prevalence of decayed teeth exhibited in higher income quintiles over time.

Table 2 provides the CIs for both surveys, where negative CIs reveal that the presence of decayed teeth is concentrated among the poor. The observed CIs show greater inequality in Canada over time. When standardizing for the characteristics of the population, the expected CIs exhibit a more equal distribution of disease (value closer to 0) across income groups over time. The difference between the actual (observed) distribution of decayed teeth across income and distribution that would be expected given the distribution of need is also shown in Table 2. Thus, our findings reveal a small but statistically significant increase in avoidable inequalities in the presence of one or more decayed teeth in Canada since the 1970s (−0.158 to −0.164).

Table 2. Concentration indices for one or more decayed teeth (weighted)[a]

	Canada 1970–1972			Canada 2007–2009		
	CI	SE	p value[b]	CI	SE	p value[b]
Observed	–0.160	0.037	0.001	–0.167	0.024	<0.001
Expected	–0.002	0.031	0.644	–0.003	0.015	0.809
Avoidable inequality[c] [Observed – Expected]	–0.158	0.008	[d]	–0.164	0.008	[d]

[a]CI=Concentration index, SE=Standard error
[b]p value < 0.05 indicates significant difference from equality (CI = 0)
[c]t-value for independent samples t-test for difference in avoidable inequality in Canada over time (37.60)
[d]Not reported

DISCUSSION

This study identified the persistence and magnitude of income-related inequalities in the presence of decayed teeth in Canada since the 1970s. Our results provide estimates and report on changes to individual-level (prevalence estimates by income quintile) and population-level (concentration index) income-related inequality in the presence of one or more decayed teeth over time.

First, this study revealed that the overall prevalence of one or more decayed teeth in the Canadian population has decreased over time. This finding is consistent with existing reports that indicate reductions in the prevalence of oral diseases, such as dental caries, periodontal disease, and edentulism.[10] Our findings also showed that income gradients in oral health have persisted, with greater reductions in the presence of decayed teeth in higher

income quintiles than lower quintiles. Indeed, over time the presence of one or more decayed teeth in highest income quintile decreased by more than two thirds, whereas in the lowest income quintile the presence decreased by almost half. These findings corroborate those of Mejia and colleagues, who found that, as the overall prevalence of decayed teeth declines in a population, groups with higher socioeconomic status often experience the sharpest decline compared to lower socioeconomic groups.[15]

Of important note, our results stratified by income show less narrowing of inequality than the study by Elani and colleagues, who examined absolute differences in oral health outcomes by income groups in Canada during the same time period.[2] This discrepancy may be due to different

Figure 2. Income gradients in one or more decayed teeth in Canada
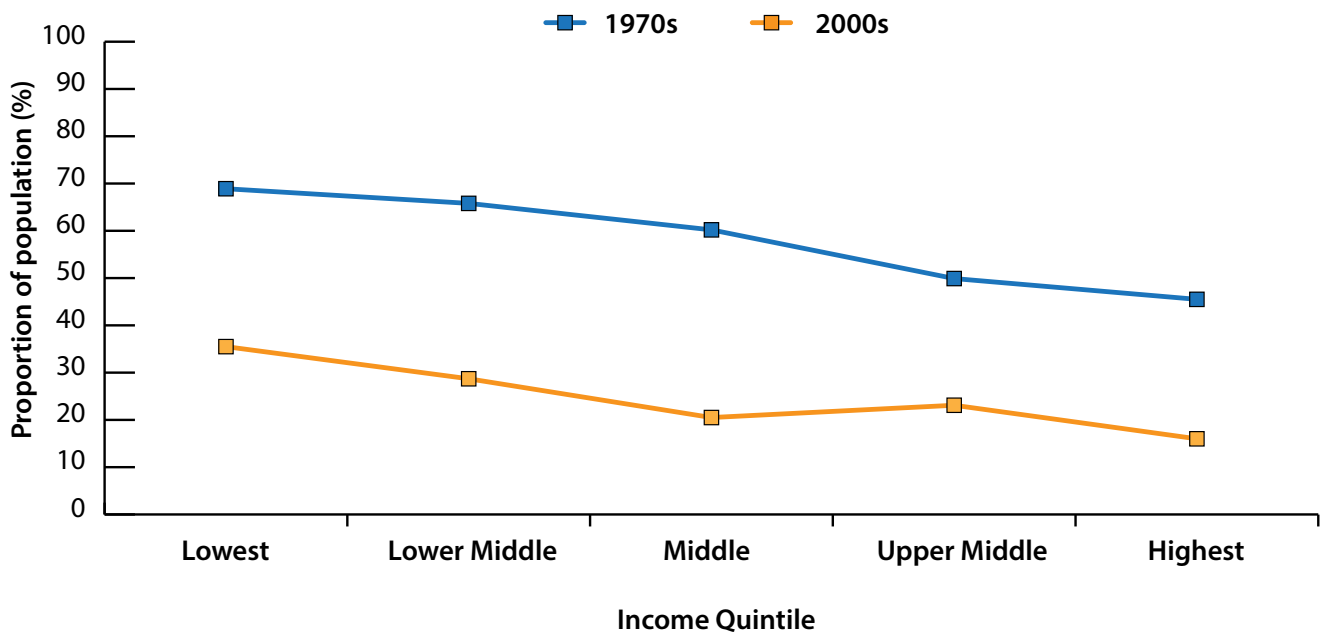
classification methods for income groups (3 groups vs. 5 groups) and differences in confounding variables and methods used to produce prevalence estimates.[2]

Results from our analyses revealed that population-level inequality in one or more decayed teeth has increased over time. This coincides with trends in income-related inequalities in health outcomes in Canada. A report by the Canadian Institute for Health Information (CIHI) revealed persistence and widening of inequalities in health between the rich and the poor over time.[8] The outcomes in the CIHI report included hospitalization associated with chronic obstructive pulmonary disease, heart attacks, and obesity, but did not include oral health. When comparing oral health and general health, Ravaghi and colleagues found greater income-related inequalities in oral health in the Canadian population, which may suggest that, when access to care is dependent on individual financial circumstances, greater income-related inequalities exist.[16] Similar trends were also noted in a study by Allin, who compared physician and dental visits in Canada.[5] Unfortunately, due to lack of information and data collection on access to dental care and oral health outcomes, longitudinal analyses of these inequalities and comparisons to health in Canada are near to impossible.

Our findings also highlight the importance of understanding changes and potential contributors to income-related inequalities in decayed teeth. One explanation for increases in inequality may be changes in the distribution of income in Canada. By using the Gini coefficient, a measure of distribution of income in a population, economists have revealed increases in income-related inequality in Canada since the 1970s; for both before- and after-tax measures of family income, inequality has increased in Canada during that period.[17] In addition, changes in the costs associated with dental care in relation to the amount of disposable income, as well as quality and extent of dental insurance coverage in the Canadian population, may also contribute to these inequalities.[18]

Since the 1970s, public financing of dental care in Canada has declined. While in the 1970s, nearly 20% of dental expenditures were attributed to public funding, that figure has now decreased to 5.6%.[19] Low- and middle-income individuals are often ineligible for employment-based or public dental insurance given their type of employment or level of income,[20] especially when public dental coverage for adults is often limited to recipients of social assistance programs or to the few who meet restrictive low-income eligibility thresholds.[19] Moreover, with shifts towards non-standard precarious employment (such as temporary and part-time work), which has predominantly affected low- and middle-income individuals over the past few decades, the ability to finance dental care depends heavily on individual financial circumstances.[21,22] Therefore, changes in enrollment criteria and eligibility standards for public dental programs, as well as reductions in the costs of private insurance plans and dental services, should be further explored.

As dental care in Canada is predominantly financed through out-of-pocket or private insurance payments, and with cost being reported as a common barrier to accessing dental care, it is critical for public health and dental professionals to explore mechanisms to improve affordability of care. These mechanisms may include changing eligibility requirements for and coverage of dental insurance, increasing salaries and wages, and improving access to a broader range of providers. Alternative care settings, such as community-based dental clinics and mobile dental clinics, or better access to dental hygiene services may help to reduce the costs of care, increase access to preventive services, and ultimately improve oral health.[23]

Merely reducing cost barriers to accessing dental care may not eliminate income-related inequalities. Oral health is the product of a complex interaction between societal and individual factors, over and above access and financial considerations. Therefore, a reduction or elimination of oral health inequalities within a population requires a multifaceted approach that addresses the social determinants of health.

Further research is needed to better understand contributors and approaches to reducing inequality. In 2012, the International Association of Dental Research Global Oral Health Inequalities Steering and Task Group outlined a research agenda on generating evidence to aid in reducing oral health inequalities.[24] Initiatives that align with these research priorities will be valuable for addressing and reducing inequalities; these include exploration into contributors to individual risk for oral disease, components within dental care systems such as the financing, organization, and delivery of dental care in Canada, and their social and political environments.[24]

In conclusion, our findings provide a foundation for monitoring income-related inequalities in decayed teeth in Canada. Ongoing monitoring of oral health outcomes within populations will enable researchers and policy makers to evaluate changes and uncover contributors to inequalities.

REFERENCES

1. Devaux M, de Looper M. Income-related inequalities in health service utilisation in 19 OECD countries, 2008–2009. *OECD Health Working Papers No. 58.* Paris: OECD Publishing; 2012 Jul 10.

2. Elani HW, Harper S, Allison PJ, Bedos C, Kaufman JS. Socio-economic inequalities and oral health in Canada and the United States. *J Dent Res.* 2012 Sep 1;91(9):865–70.

3. Regidor E. Measures of health inequalities: part 2. *J Epidemiol Community Health.* 2004;(11):900–3.

4. O'Donnell OA, van Doorslaer E, Wagstaff A, Lindelow M. *Analyzing health equity using household survey data: A guide to techniques and their implementation.* Washington, DC: World Bank Publications; 2008.

5. Allin S. Does equity in healthcare use vary across Canadian provinces? *Healthc Policy.* 2008;3(4):83–99.

6. Grignon M, Hurley J, Wang L, Allin S. Inequity in a market-based health system: Evidence from Canada's dental sector. *Health Policy.* 2010 Nov 30;98(1):81–90.

7. 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 Dec 1;41(6):490–8.

8. Harvey J, Hynes G, Pichora E. Trends in income-related health inequalities in Canada. *Healthc Q.* 2016;18(4):12.

9. Public Health Agency of Canada. *Reducing health inequalities: A challenge for our times.* Ottawa, ON: PHAC; 2011.

10. Health Canada. *Report on the findings of the oral health component of the Canadian Health Measures Survey 2007–2009.* Ottawa, ON: Health Canada; 2010.

11. Canada, Bureau of Nutritional Sciences. *Nutrition Canada dental report: A report from Nutrition Canada by the Bureau of Nutritional Sciences, Food Directorate Health Protection Branch, Department of National Health and Welfare.* Ottawa, ON: Bureau of Nutritional Sciences; 1977.

12. Wagstaff A. The bounds of the concentration index when the variable of interest is binary, with an application to immunization inequality. *Health Econ.* 2005 Apr 1;14(4):429–32.

13. Wagstaff A, Watanabe N. Socioeconomic inequalities in child malnutrition in the developing world. *Policy Research Working Paper 2434.* Washington, DC: World Bank; 1999.

14. Lindelow M. Sometimes more equal than others: How health inequalities depend on the choice of welfare indicator. *Health Econ.* 2006 Mar 1;15(3):263–79.

15. Mejia G, Jamieson LM, Ha D, Spencer AJ. Greater inequalities in dental treatment than in disease experience. *J Dent Res.* 2014 Oct 1;93(10):966–71.

16. Ravaghi V, Quiñonez C, Allison PJ. Comparing inequalities in oral and general health: findings of the Canadian Health Measures Survey. *Can J Public Health.* 2013 Oct 31;104(7):e466–71.

17. Rajotte J. Income inequality in Canada: an overview. *Report of the Standing Committee on Finance.* Ottawa, ON: The Office of the Speaker of the House of Commons; 2013.

18. Sanmartin C, Hennessy D, Lu Y, Law MR. Trends in out-of-pocket health care expenditures in Canada, by household income, 1997 to 2009. *Health reports.* 2014;25(4):13.

19. Quiñonez C, Grootendorst P, Sherret L, Azarpazhooh A, Locker D. *An environmental scan of provincial and territorial public dental programs in Canada.* Toronto, ON: Community Dental Health Services Research Unit, University of Toronto; 2007.

20. Ramraj C, Weitzner E, Figueiredo R, Quiñonez C. A macroeconomic review of dentistry in Canada in the 2000s. *J Can Dent Assoc.* 2014;80:e55.

21. Muirhead VE, Quiñonez C, Figueiredo R, Locker D. Predictors of dental care utilization among working poor Canadians. *Community Dent Oral Epidemiol.* 2009;37(3):199–208.

22. Quiñonez C, Grootendorst P. Equity in dental care among Canadian households. *Int J Equity Health.* 2011 Dec 1;10(1):1–9.

23. Shaefer HL, Miller M. Improving access to oral health care services among underserved populations in the US: Is there a role for mid-level dental providers? *J Health Care Poor Underserved.* 2011 Aug;22(3):740–4.

24. Sgan-Cohen HD, Evans RW, Whelton H, Villena RS, MacDougall M, Williams DM, et al. IADR Global Oral Health Inequalities Research Agenda (IADR-GOHIRA(R)): A call to action. *J Dent Res.* 2013;92(3):209–11.