Association between caregiver’s and child’s oral health status and Oral Health Related Quality of Life

By

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A thesis submitted in conformity with the requirements for the degree of Master of Science Graduate Department of Dentistry Faculty of dentistry University of Toronto

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Abstract

Objectives: To investigate associations between caregivers and children’s oral health, as well as the perceptions of the impact of oral diseases on oral health.

Methods: Cross-sectional study with 149 child-caregiver dyads from a convenience sample in Toronto. Objective and subjective data about oral health and quality of life were collected from both children and caregivers groups.

Results: Decay in permanent and primary teeth in children was moderately with missing teeth in caregivers, as well as with most of the Parental-Caregiver Perceptions Questionnaire (P-CPQ). Mostly weak associations were observed between the Oral Health Impact Profile (OHIP-14) scores and missing teeth in caregivers.

Conclusion: Significant associations emphasize the influence of caregivers on children’s oral health outcomes and raise awareness about dental care coverage to disadvantaged families. Despite the questionable findings with some subjective measures, policymakers may still consider the use of patient-centered information to analysing disease trends in the population.
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<table>
<thead>
<tr>
<th>TABLE OF CONTENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT ............................................................................................................... ii</td>
<td></td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT ................................................................................................. iii</td>
<td></td>
</tr>
<tr>
<td>TABLE OF CONTENTS ............................................................................................... v</td>
<td></td>
</tr>
<tr>
<td>LIST OF TABLES AND FIGURES ................................................................................ vii</td>
<td></td>
</tr>
<tr>
<td>LIST OF APPENDICES .............................................................................................. viii</td>
<td></td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS AND ACRONYMS ................................................................... ix</td>
<td></td>
</tr>
</tbody>
</table>

CHAPTER 1 - Introduction ......................................................................................... 1

  Thesis overview ...................................................................................................... 1
  Statement of the problem ....................................................................................... 2
  Relevance of the Study .......................................................................................... 3
  Research Questions ............................................................................................... 4
  Objectives ............................................................................................................. 5
  Literature review .................................................................................................. 5
  The concepts of vulnerability and the life-course in health .................................. 5
  Dental caries - General concepts ......................................................................... 7
  Risk factors for dental caries ................................................................................ 8
  The impact of oral conditions on daily activities .................................................. 11
  Oral Health Related Quality of Life (OHRQOL) ..................................................... 13
  OHRQOL Measurement Tools ............................................................................... 13
  Health care system strategies and the role of primary health care providers .......... 18

CHAPTER 2 ................................................................................................................ 21

  Manuscript 1: “A cross-sectional assessment of the oral health status of children and caregivers” ............................................................. 22
  Manuscript 2: “Children’s oral health: parents’ perception versus clinical findings” ..... 38
  Manuscript 3: “Performance of the Oral Health Impact Profile-14 as a potential tool for patient-centered oral health assessment in systematic surveys” ............................... 59
# LIST OF TABLES AND FIGURES

<table>
<thead>
<tr>
<th>Manuscript 1:</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>35</td>
</tr>
<tr>
<td>Table 2</td>
<td>36</td>
</tr>
<tr>
<td>Figure 1</td>
<td>37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manuscript 2:</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>51</td>
</tr>
<tr>
<td>Table 2</td>
<td>52</td>
</tr>
<tr>
<td>Table 3</td>
<td>53</td>
</tr>
<tr>
<td>Table 4</td>
<td>54</td>
</tr>
<tr>
<td>Table 5</td>
<td>55</td>
</tr>
<tr>
<td>Figure 1</td>
<td>56</td>
</tr>
<tr>
<td>Figure 2</td>
<td>57</td>
</tr>
<tr>
<td>Figure 3</td>
<td>58</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manuscript 3:</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>71</td>
</tr>
<tr>
<td>Table 2</td>
<td>72</td>
</tr>
<tr>
<td>Table 3</td>
<td>73</td>
</tr>
<tr>
<td>Table 4</td>
<td>74</td>
</tr>
<tr>
<td>Figure 1</td>
<td>75</td>
</tr>
<tr>
<td>Figure 2</td>
<td>76</td>
</tr>
<tr>
<td>Appendix</td>
<td>Title</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Appendix 1</td>
<td>Scientific Merit of the Study</td>
</tr>
<tr>
<td>Appendix 2</td>
<td>Ethics Approval – The Hospital for Sick Children</td>
</tr>
<tr>
<td>Appendix 3</td>
<td>Administrative Review Approval Letter</td>
</tr>
<tr>
<td>Appendix 4</td>
<td>Delegated Review Approval Letter</td>
</tr>
<tr>
<td>Appendix 5</td>
<td>Consent Form</td>
</tr>
<tr>
<td>Appendix 6</td>
<td>Study’s questionnaires</td>
</tr>
<tr>
<td>Appendix 7</td>
<td>Clinical examination form</td>
</tr>
<tr>
<td>Appendix 8</td>
<td>Clinical examination manual</td>
</tr>
<tr>
<td>Appendix 9</td>
<td>Mouth/Teeth Examination Report</td>
</tr>
<tr>
<td>Appendix 10</td>
<td>Lift the Lip Pilot Study</td>
</tr>
</tbody>
</table>
LIST OF ABBREVIATIONS AND ACRONYMS

AAP: American Academy of Paediatrics
AS: Adam Sgro
CHMS: Canadian Health Measures Survey
CI: Confidence Interval
COHQOL: Child Oral Health Quality of Life
COHF: Canadian Oral Health Framework 2013-18
CPQ: Child Perceptions Questionnaire
DK: Don’t Know
DMFT: Decayed, Missing and Filled Teeth (permanent dentition)
dmft: decayed, missing and filled teeth (primary dentition)
dmft+DMFT: Decayed, Missing and Filled Teeth (mixed dentition)
DT: Decayed Teeth (permanent dentition)
dt: Decayed Teeth (primary dentition)
dt+DT: Decayed Teeth (primary and permanent dentition)
EC: Elaine Cardoso
ECC: Early Childhood Caries
et: primary teeth indicated for extraction or extracted due to caries
et+MT: primary teeth indicated for extraction or extracted and missing permanent teeth
due to caries
FIS: Family Impact Scale
FPTDDWG: Federal, Provincial, Territorial Dental Directors Working Group
FT: Filled Teeth due to caries (permanent teeth)
ft: Filled Teeth due to caries (primary teeth)
ft+FT: Filled Teeth due to caries (primary and permanent teeth)
GTA: Greater Toronto Area
HR: Hazard Ratio
HRQOL: Health Related Quality of Life
IADR: International Association for Dental Research
IDR: Incidence Density Ratio
MT: Missing Teeth due to caries (permanent teeth)
NA: Non-applicable
OIDP: Oral Impact on Daily Performance
OHIP: Oral health Impact profile
OHRQOL: Oral Health Related Quality of Life
OR: Odds Ratio
P-CPQ: Parental-Caregiver Perception Questionnaire
PHP: Primary Healthcare providers
PR: Prevalence Ratio
Quality of Life (QoL)
RR: Relative Risk
S-ECC: Severe Early Childhood Caries
SAS: Statistical Analysis System
SD: Standard Deviation
TARGGet Kids! Toronto Area Research Group for Kids
US: United States
WHO: World Health Organization
CHAPTER 1

1. Introduction

1.1. Thesis Overview

This thesis consists of four chapters: Chapter 1: This introduction; Chapter 2: Three manuscripts; Chapter 3: A general discussion; and Chapter 4: Conclusion. Chapter 1 comprises the thesis overview, the statement of the problem, the relevance of the study, the research questions and objectives, and a literature review, including the concepts of vulnerability and the life-course approach; dental caries under the perspective of such concepts; caregivers’ influences on the complex nature of dental caries; and the role of the primary health care providers in dental health care strategies. Given that the health care strategies have adopted the broader concept of health, the final section will review the Oral Health-Related Quality of Life (OHRQOL) concepts and measurement instruments, including a review of the three instruments that were used in this study.

Chapter 2: The body of this thesis, comprising the sum of three manuscripts, each one assessing a specific research question and its objective Manuscript 1: A cross-sectional assessment of the oral health status of children and caregivers; Manuscript 2: Children’s oral health: parents’ perception versus clinical findings; Manuscript 3: Performance of the Oral Health Impact Profile-14 as a potential tool for patient-centered oral health assessment in systematic surveys. Corresponding tables and figures are placed after the body of each manuscript. References are placed at the end of the thesis. Additional findings that were not included in the manuscripts are shown in chapter 3 (Discussion).


1.2. Statement of the problem

Dental caries is the most common chronic childhood disease, the outcomes of which may lead to serious impacts on the children’s quality of life, and hence, on their productivity over a lifetime\(^1,2\). Over the past decade, dental research has been studying chronic oral diseases under a life-course perspective, seeking to understand the influence of early life adverse events on oral health outcomes\(^3\). For instance, it is argued that children's susceptibility to dental caries and the resulting oral health status is influenced by early life factors associated with caregivers’ oral health-related behaviours, because children rely on their caregivers to take care of their oral health needs\(^4,5\). On the other hand, caregivers’ ability to recognize and respond to adverse experiences is influenced by their own internal standards and beliefs\(^6\) within the socioeconomic environment in which they live\(^4\). A well-balanced family environment may help children find their bearings, develop self-awareness and make independent and positive choices in life\(^6\). Thus, although clearly undervalued\(^7\), evidence suggests a strong link between the onset of dental caries and the familial environment\(^8\).

Once left untreated, dental caries may lead to pain, infection and tooth loss\(^2\), along with psychosocial issues, such as loss of school days or days with restricted activity\(^9\). Measuring such impacts by the collection of patient-centered information has been advocated as a means for identifying a sub-group of the population whose dental conditions would justify further public investments\(^10\). Considering the potential of primary health care providers (PHP) to positively impact oral health\(^11\), the publicly funded net of professionals may become a viable alternative to support dental strategies regarding caries prevention and dental data collection.
Therefore, this cross sectional study intends to evaluate the association of the oral health status between caregivers and their children, taking into consideration certain behaviours and demographic influences. Owing to this presumed association, information gathered from this population by means of two validated OHRQOL questionnaires intends to additionally investigate whether a patient-based oral health report provides useful information about the oral health status of adult patients and of those to whom they are held responsible.

1.3. Relevance of the study

In an environment of economic and health care challenges, access to dental care is a major issue. In Canada, dental public insurance is granted to families considered to be in social need\textsuperscript{12}, for instance, those who are unemployed. Although jobs are considered a ladder out of poverty, data from 2005 show that 113,000 people in the Greater Toronto Area (GTA) are living in poverty, despite having a job, hence, being working poor\textsuperscript{13}. These families live under the radar of the government's social welfare programs and suffer an increasing deterioration of their oral health due to a lack of dental care\textsuperscript{12}. Once it is observed the association of the oral health statuses between children and caregivers, and its impact on the quality of life of the family members, it may raise the awareness about the importance of extending dental public health initiatives to low-income families. This rationale is based on the concept that the familial environment influences the development of the child’s self-oral health-promoting skills, which will help them cope with the chronic nature of most oral diseases\textsuperscript{14}. 
Accordingly, the potential use of OHRQOL tools to measuring the burden of oral conditions on people’s quality of life may additionally justify allocating public resources to those individuals that would most benefit from appropriate dental care. The control of the progression of oral conditions in such groups may alleviate the large impact of social inequality on health\textsuperscript{15}, the consequences of which may change the oral health trajectory of a significant number of people whose oral health status affects their quality of life.

It is an opportunity to capitalize on the potential strength of validated OHRQOL questionnaires as a means of collecting oral health information in epidemiology surveys. These information may be used as baseline data for oral health care planning, since using only normative methods to assess the population’s dental status often provide a non-realistic estimate of oral health care needs\textsuperscript{16-19}.

1.4. Research Questions

This research aims to answer the following questions:

I. Is there an association between a caregiver and their child’s oral health status?

II. Are caregivers’ perceptions about the impact of oral diseases on the oral health status of their children a valid proxy measure to identify children’s oral health conditions?

III. Are caregivers’ perceptions about the impact of oral diseases on their oral health status a valid proxy measure to identify adult’s oral health conditions?
1.5. Objectives

The study objectives are:

I. To investigate the association between caregivers and children’s oral health status.

II. To investigate the association between proxy perceptions of the impact of oral diseases in children and their oral health status.

III. To investigate the association between self-perceptions of the impact of oral diseases in adults and their oral health status.

2. Literature review

2.1. The concepts of vulnerability and the life-course in health

The most common definition of the concept of vulnerability states: “It means not lack or want, but defencelessness, insecurity, and exposure to risk, shocks and stress”\(^{20}\). To be vulnerable is to be susceptible to damage by exposure to contingencies with no coping mechanisms\(^{20}\). The concept of vulnerability in the health related literature applies to certain groups with limited resources and at a high risk for morbidity and premature mortality\(^{6}\). Children are considered a vulnerable population because of their immature cognitive skills\(^{14}\). They rely on their caregivers to limit their exposure to adverse environments and to provide them with a sound environment for optimal growth of their mind and body\(^{11}\). The caregivers’ own state of vulnerability along with misinterpreted personal standards and beliefs also influence the development of habits, the consequences of which can inadvertently affect a child’s overall health\(^{6, 21}\). In essence, children’s habits, beliefs, attitudes, and behaviours, to name a few, are positively or negatively modeled by
the regular, active and continuing influence of their caregivers and the socioeconomic environments in which they live.

Another concept associated with maintaining children’s health and welfare is the Life Course Approach which is defined as "the study of the long-term effects of physical and social exposures during gestation, childhood, adolescence, young adulthood and later adult life on chronic disease risk"³. Such an approach includes a temporal analysis of the impact of the biological, behavioural and psychosocial influences in the progress of chronic diseases during the person’s lifetime, and even in a wider perspective across generations³,¹⁵.

Dental caries is in accordance with both theoretical approaches¹¹,²², since it is the most common chronic childhood disease with an early onset and a strong bonding to the caregiver²³. However, the way adverse early life events affects dental caries onset and course throughout life is still poorly understood²⁴, which makes the course of the disease unpredictable²⁵.

The aforementioned discussion is in line with the argument that the prevention of dental caries should follow models of chronic disease management. By way of explanation, strategies that aim to manage various risk factors should focus earlier in life on the individual, family and community levels.
2.2. Dental caries

2.2.1. General concepts

Dental caries is classically defined as a specific bacterial infection characterized by a reversible multifactorial process of tooth demineralization and remineralization\(^{26}\). It is five times more prevalent than asthma and four times more prevalent than early-childhood obesity\(^{23}\). Once established, dental caries can lead to pain, infection and tooth loss\(^{2}\), which increase public treatment costs due to emergency room visits and hospitalizations\(^{27}\).

The prevalence of dental caries increases as children age and varies from 30% to 91% worldwide in 5-6 year-olds\(^{28}\). In Canada, although there are no national data available for preschoolers\(^{29}\), 56.8% of 6-11 year-old children are affected by dental caries with a mean DMFT (Decayed, Missing, Filled teeth) of 2\(^{30}\). Data from 2006/2007 in Ontario show that 52% and 42.5% of children are affected by dental caries (mean DMFT of 2.5 and 1.21) for the 7 and 13 age groups, respectively. In Toronto, data from the same period show a prevalence of 44.6% and 36.5% (mean DMFT of 1.8 and 1.09) for the same age groups\(^{31}\).

Dental caries in infants and toddlers follows a peculiar pattern and is called Early Childhood Caries (ECC). It is an aggressive form of the disease that affects children 71 months of age or younger\(^{32}\). ECC is initially recognized as a dull white demineralized enamel surface, which quickly cavitates along the gingival margin of upper anterior primary teeth of very young children. If left untreated, it progresses to the maxillary first molars, culminating with the destruction of the whole primary dentition\(^{33}\). When a smooth surface is affected, and if the child is under the age of three, it represents an even
more aggressive form of the disease: Severe Early Childhood Caries (S-ECC), which usually requires extensive rehabilitative treatment possibly under general anaesthesia (GA). From ages three through five years, caries history is taken into consideration when diagnosing S-ECC, using the decayed, missing, filled surface (DMFS) score. Within this age group, one smooth surface in the primary upper anterior teeth or a dmfs score of \( \geq 4 \) (age 3), \( \geq 5 \) (age 4), or \( \geq 6 \) (age 5) in any teeth constitutes S-ECC\(^{32}\).

The prevalence of ECC varies from 28% to 85% in different populations\(^{34,35}\). Prevalence of all ECC has increased from 9.8% to 11.6% in Toronto between 1999 and 2006 and from 28.6% to 30.4% with a mean deft+DMFT of 1.3, if only the 5 year-old group is considered\(^{36}\). In Canada, ECC data range from less than 5% of the population\(^{37}\) to 80%\(^{38}\) if only the high-risk population is considered, such as children of immigrants from ethnic minorities and aboriginal children\(^{39}\).

2.2.2. Risk factors for dental caries

The identification of Streptococcus mutans (S. mutans) as the principal aetiological agent of human dental caries precipitately led to the inference that dental caries is both a preventable and treatable infection\(^{40}\). However, despite the irrefutable association with S. mutans, dental caries is not a classical infectious disease\(^{41}\), since there is not a simple causation pathway for treatment or prevention, such as elimination of a microorganism or increasing tooth resistance. Notwithstanding the claim of its microbially induced onset, the disease occurs due to an imbalance in the physiologic equilibrium between endogenous bacteria – unlike the exogenous ones found in common infections - within the dental biofilm\(^{41}\). It is important to note that this biological imbalance within the
biofilm results from the intricate and complex interplay among specific microbial overgrowth, saliva composition, flow rate and buffer capacity; dietary composition and frequency; and fluoride presence, to list but a few\textsuperscript{41-43}, along with the time necessary for interaction of the factors and disease to occur\textsuperscript{44}.

Due to its unique and complex nature, dental caries is extremely difficult to prevent. There are invariably developing new or recurrent lesions, which must be controlled by a variety of interventions during one's lifetime, if the objective is to maintain a functional dentition\textsuperscript{41}. Therefore, interest in a more comprehensive approach to predicting dental caries has moved dental researchers to study the psychosocial and behavioural factors related to the familial environment, along with the biological factors at the individual level\textsuperscript{45}.

Dental caries experience is strongly related to diverse influences during the first year of life, which account for its multifactorial nature\textsuperscript{46}. Measures to retard the transmission of cariogenic bacteria have been effective in preventing dental caries early in life and the strength of the association is directly related to the period of bacterial acquisition. For instance, early biofilm colonization by S. mutans is reported as a predictor for disease severity, since children identified as harboring S. mutans by the age of 2 have a mean dmfs score of 10.6 at age 4, compared to 3.4 of those whose colonization occurred later\textsuperscript{47}. When in association with clinical parameters, infection by S. mutans was associated longitudinally with sharing of utensils at 9 months (OR=4.6; 95% CI=2.3, 9.5), 15 months (OR=15.5; 95% CI=4.1, 58.4) and 21 months (OR=15.2; 95% CI=3.9, 58.7)\textsuperscript{48} and the latter with high rates of caries in children (OR=7.4; 95% CI=1, 56.9)\textsuperscript{49}. 
Concurrently to the infection process, bacteria need substrate in order to colonize the oral cavity and the teeth. The development of dietary habits and food preferences appears to be established by 6–12 months of age. Timing along with frequency and types of food introduced are linked to a susceptibility to bacterial colonization, and the impact of a carbohydrate-rich diet on children’s oral health is unequivocal. Prevalence and severity of dental caries were associated with the frequency of sugar ingestion, since consumption of sugar-containing drinks between meals (1/day: OR=2.60; 95% CI=1.16–5.8 and >1/day: OR=3.2; 95% CI=1.4–7.3) or at night (OR=8; 95% CI=1.6–40.5) was linked to the disease in preschool children. An association was also observed between feeding behaviours such as sleeping with the bottle (OR=1.9; 95% CI=1.5-2.4) and continual sucking from the bottle during the day (OR=1.6; 95% CI=1.2-2.0) and dental caries severity.

Caregivers’ beliefs about oral hygiene and its influence on children’s oral health are well documented in the literature. Poor oral hygiene and carious teeth were observed in children whose caregivers considered primary tooth brushing unnecessary (OR=2.1; 95% CI=1.1–4.1), since primary teeth will ‘just fall out anyway’. Caregivers’ lack of awareness about the importance of good oral hygiene is related to decreased brushing frequency in children, although high tooth brushing frequency does not necessarily mean good oral hygiene or effective plaque removal (IDR=1.2; 95% CI=1.10-1.4). Nevertheless, poor oral hygiene has been correlated with dental caries incidence on occlusal surfaces (OD=1.4; CI=1.3, 1.8; p=0.003) and buccal surfaces (OD=1.4; CI=1.1, 1.68; p=0.007) in molars, while regular tooth brushing habits exert a protective role in reducing caries risk (IDR=0.83; 95% CI=0.7, 1).
Parents' knowledge and attitudes in regard to the importance of the primary dentition are identified as barriers to preventive oral health care access and dental treatment\(^7\), while lower literacy is associated with poor oral health outcomes in children (OR=1.1; 95% CI=1.1, 1.3\(^7\))\(^\text{57}\), more bedtime bottle use (OR=1.7; 95% CI = 1.3-2.3) and lower knowledge scores (OR=1.9; 95% CI=1.4-2.5\(^7\))\(^\text{58}\).

Caregivers’ educational level has been associated with caries experience risk in children. For instance, low-income children whose primary caregivers had less than high school education are more likely to have no preventive dental visits than children whose caregivers had completed high school (OR=0.71; 95% CI=0.6, 0.9), or were college-educated (OR=0.7; 95% CI=0.5, 0.8). An analogous pattern is observed for unmet dental needs. Low-income children whose parents had less than high school education are more likely to have unmet dental needs than children whose parents had completed high school (OR=1.2; 95% CI=0.86, 1.7) or were college-educated (OR=1.6; 95% CI=1, 2.4\(^\text{59}\)).

Children from low-SES populations have higher dental caries experience, higher dental treatment needs, a higher prevalence of incisor trauma and a lower prevalence of dental sealants than children from higher SES status population\(^60,61\). Therefore, the analysis of the impact of social-economic influences on the oral health of parents and children is of capital importance for understanding dental caries epidemiology within the family environment.

2.2.3. The impact of oral conditions on daily activities

Despite all efforts and oral health strategies that have been implemented, dental public health approaches have been struggling to reduce the impact of oral conditions on the
population. Dental caries may lead to an increased loss of workdays, school days or days with restricted activity and it seems that those who cannot afford dental care are the most affected\(^6\). It was observed that oral diseases impact academic performance and school attendance in disadvantaged populations\(^62\) and the lower the quality of life, the greater the number of cases of untreated dental decay\(^63\), missing teeth and periodontal diseases\(^64\).

The impact of oral diseases on the quality of life of vulnerable populations other than children has also been investigated. In elders, tooth loss may compromise chewing ability, which affects their quality of life\(^65\) because it bears on a perceived need for dental treatment, poor self-rated health, reduced mental health, fewer teeth, and relatively poor cognitive status, especially for elderly persons with disabilities\(^66\). The US Surgeon General stated that oral conditions may “…undermine self-image and self-esteem, discourage normal social interaction, and cause other health problems and lead to chronic stress and depression as well as incur great financial cost. They may also interfere with vital functions such as breathing, what foods to eat, swallowing and speaking, and with activities of daily living such as work, school, and family interactions”\(^2\).

The treatment of chronic conditions such as dental caries has emerged as a considerable public health problem in developed countries due to the imposed costs, the burdens of ill health and disability, which affects not only people's quality of life but also the country’s economy. Changing this scenario requires an extension of the existing clinical oral health approach by incorporating aspects of OHRQOL to prevent and treat dental diseases\(^67\), taking into account the patient’s perspectives about their own oral health status, since they are as legitimate as that of the clinician’s when evaluating the impact of diseases and desired treatment outcomes\(^68\).
2.2.4. Oral Health Related Quality of Life (OHRQOL)

The importance of OHRQOL was supported in the WHO Global Oral Health Programme strategies once it was recognized that oral health is part of general health and both are associated with the quality of life. It assesses positive and negative awareness of oral health outcomes, based on the life-course perspective.

Gift and Atchison (1995) state that assessing health-related quality of life allows "the trade-off between how long and how well people live". Its measure may influence policy makers, health service researchers, epidemiologists, health program managers, since both the traditional clinical measures of disease and the person’s self-reported impact of health experience would be taken into consideration for oral health outcomes evaluation.

2.2.5. OHRQOL Measurement Tools

The concept of OHRQOL is increasingly being used in oral health surveys and clinical trials, and several OHRQOL measures have been developed to date. At the population level, it is a powerful tool for health promotion program planning, working as baseline assessments of focus areas from the patients’ perspectives. At the individual level, assessing the impact of oral health/diseases on one’s life status gives a broader perspective of the person’s social, emotional and physical functioning, which may help guide the appropriate treatment toward favorable health outcomes.

Since they were first advocated, a variety of instruments were developed and implemented to measure OHRQOL. Three categories of measures are described below: social indicators, global self-rated questions and multiple-item questionnaires.
OHRQOL tools measure the functional and psychological outcomes that emerge from oral disorders.

In 1979, Nikias et al. defined socio-dental indicators in the progress report of the committee on sociodental indicators of the behavioral science group of IADR-WHO/Oral research advisory group as “measures of the extent to which dental and oral disorders disrupt normal role functioning”\(^7^6\). They are usually used in large epidemiological studies at the community level since their design assesses a broad aspect of the health of the population. For instance, data about work loss, school absences or days of restricted activities due to oral conditions are systematically collected to monitor trends in the oral health of the population of interest\(^7^7\).

The single item OHRQOL measure, also known as global self-evaluation, global self-ratings or simply global questions, is one of the most frequently chosen measures to evaluate the health related quality of life\(^7^8\).

It is recommended that at least one global self-rated question about overall health be included in all HRQOL instruments\(^7^9\), and that it should be used to evaluate a patient’s wellbeing when a detailed HRQOL measure cannot be used or is unnecessary\(^7^8\).

Multiple-item questionnaires are popular OHRQOL instruments that were specifically designed to measure the social impact of oral diseases on the population, and thus may be used across all dental specialties\(^7^0\). They document the functional and psychosocial outcomes of oral disorders in a hierarchy of outcomes, and are intended to supplement clinical indicators to provide a comprehensive account of the health of individuals and populations\(^8^0\).
The Oral Health Impact Profile (OHIP) is one of the numerous dental scales developed to measure the social effects of oral health disorders on a person’s quality of life. It was based on the WHO classification of Impairments, Disabilities and Handicaps\(^\text{81}\), and on a theoretical framework to specifically measure oral health\(^\text{77}\). Conceptually, impairment is defined as “…any anatomical loss, structural abnormality or disturbance in physical or psychological processes, either present at birth or arising out of disease or injury”\(^\text{77}\). Any measure of tooth loss, malocclusion or periodontal disease may estimate oral health impairments. The functional limitation domain also measures the physical consequences of the disease in the oral cavity by the presence of functional restrictions, for example, in the chewing ability or in the temporomandibular joint movements (TMJ). Discomfort refers to a broader physical or psychological distress that includes symptoms such as pain in the presence or absence of oral conditions. Disability measures the impact of diseases on the individual’s behaviour that limits the ability to perform daily life activities. Lastly, handicap refers to the social consequences of the oral conditions. For instance, loss of job opportunities or negative impacts on self-esteem and self-image\(^\text{77}\). The model proposes a hierarchy of impacts of oral disease on oral health outcomes, from impairment due to tooth loss, to the influence of the outcome at the social level. Although it was based on theoretical approaches to the quality of life, the scale was developed from a clinical study in which patients answered questions about oral diseases and quality of life. The most important factors raised by the patients were evaluated and included in the final questionnaire, which comprises 49 items grouped in seven conceptually formulated domains or subscales. To measure the impact of oral diseases in each item, a 5-point Likert scale is used with the following categories and response codes: *Never* (0), *hardly ever* (1), *occasionally* (2), *fairly often* (3) and *very often* (4). A *Don’t know* option was
also provided, and scored as 0.

The comprehensive nature of the OHIP-49 has been validated and its application recommended for clinical settings to establish an objective baseline of data about the impact of oral diseases on the patient’s quality of life to complement the clinical measures made on the disease. On the other hand, although reliable, valid, and responsive to clinically meaningful change, it is too lengthy to be used in epidemiological studies that involve a broader set of questions. For this purpose, a shorter form of the OHIP-49 was developed, including its seven subscales but with only two items for each domain, and 14 questions in total.

The OHIP-14 was based on a combination of subjective judgement and statistical methods. For this purpose, items with high nonresponse rates, such as don’t know or unanswered questions and items specific to denture wearing were eliminated. Next, internal reliability analysis, principal components factor analysis, and least squares regression were all used to identify questions with good prevalence and severity distribution. Finally, the validity of the questionnaire was assessed, and corroborated by numerous studies that support high internal consistency and content validity for OHIP-14 as a measure especially developed to be used in adults. Despite the principle that the psychometric properties of a measure decreases as the number of items decreases, OHIP-14 questions are as effective as those from the OHIP-49 in detecting the impact of oral health on the quality of life. Its use is indicated in large epidemiological surveys where other demographic and medical questions need to be asked since it is able to provide a
basic overall measure of the impact of oral health at the population level without compromising the comprehensiveness of the scale\textsuperscript{82, 83}.

The P-CPQ is one of the components of the Child Oral Health Quality of Life (COHQOL) questionnaire that is designed to measure the impact of different oral diseases on the child’s wellbeing from their caregivers’ perspective\textsuperscript{84}. The COHRQOL was developed to fill a pre-existing lack of measures to evaluate OHRQOL in children due to the complex methodological issues involved\textsuperscript{85}. In addition to the P-CPQ, the COHQOL questionnaire consists of two Child Perceptions Questionnaires (CPQ) for different age groups (6–10 and 11–14 years)\textsuperscript{86, 87} and the Family Impact Scale (FIS)\textsuperscript{88}. Both P-CPQ and CPQ address the child’s oral health-related quality of life from the parents’ and children’s perspective, respectively, whereas FIS evaluates the impact of the child’s condition on the family\textsuperscript{85}. Items in the P-CPQ and CPQ questionnaires are included in different dimensions or subscales, such as oral symptoms, functional limitations, emotional and social wellbeing, which are conceptually equivalent to those from the OHIP-14, comprising a biological, a behavioural and a social dimension\textsuperscript{71, 84}. On the other hand, dimensions included in the FIS questionnaire evaluate the impact of the child’s oral diseases on parental and family activities, parental emotions, family conflict and family finances; because of the content of the questions, it is administered along with the P-CPQ\textsuperscript{88}. The frequency of adverse events related to oral health in a given period of time are scored by means of a five-point Likert scale with the following response options: never (0); once or twice (1); sometimes (2); often (3); everyday or almost everyday (4)\textsuperscript{88}. A Don’t know option is also provided, and scored as 0. The choice of using don’t know responses prevents valuable information from being missed due to the exclusion of
patients with nonresponses and has been reported not to alter overall findings significantly. At this time, measures of validity and reliability were assessed and demonstrated satisfactory levels. The subjective information gathered from the OHRQOL questionnaires are analysed as measures of prevalence (the proportion of subjects with one or more items coded as 3 and 4), severity (simple sum of ordinal response codes to all items) and extent (the number of items coded as 3 or 4).

2.2.6. Health care system strategies and the role of primary health care providers

Nonetheless, planning and strategizing for the collection of subjective dental information becomes a challenge since dental offices have been demonstrated to be costly from the epidemiological point of view, especially in Canada, due to its predominant private sector funding. Notwithstanding this environment of economic austerity often defined by the mantra of “no new dollars” for dental public health, PHP have arisen as a viable alternative to support dental strategies considering their potential to positively impact oral health. PHP are referred as health care professionals such as doctors, physician assistants and nurse practitioners who see people that have common medical problems. Therefore, the identification of the population most at risk for dental diseases would be performed by non-dental primary care providers’ staff during elective medical visits in the already structured and publicly funded net of medical offices.

The American Academy of Pediatrics (AAP) supports this multidisciplinary approach and released two policy statements about oral health risk assessment in 2003, the Oral Health Risk Assessment Timing and Establishment of the Dental Home, and the Preventive Oral Health Intervention for Pediatricians. According to these policies, every child...
should receive a systematic and comprehensive oral health examination based on an Oral Health Risk Assessment Tool and, in case of oral health abnormalities or risk factor identification, the child should be referred to a dental care provider\textsuperscript{95}. Therefore, PHP are deemed an option to reduce children's susceptibility to oral diseases since such professionals can work on parent education, community awareness and policy changes\textsuperscript{11}. When access to a dentist is difficult, PHPs should consider administering risk-based oral health measures\textsuperscript{93}. Accordingly, they must be knowledgeable about the basic concepts and prevention of dental caries, as well as available interventions available at the medical level, since infants and toddlers visit medical offices more often than the dental offices\textsuperscript{94}. 

Data from the United States show that 87\% of infants and 1-year-olds have had office-based physician visits annually while with only 2\% have had dental visits. Eighty-seven percent or 6.8 million children have visited office-based physicians but not dentists in a year’s time. Physician office visits are 190-fold more prevalent than visits to general dentists\textsuperscript{96}. Differences were also found in parents' attitudes regarding general health care and dental health care for young children.\textsuperscript{55}. The concept of routine preventive medical care was well accepted as a priority, while dental care was relegated to when there was an obvious problem, as primary teeth will "just fall out anyway"\textsuperscript{55}. Moreover, they felt comfortable with the idea of a pediatrician performing an oral health exam, since they found the medical office a more familiar place than a dental office, and relied on doctors for a dental referral in case of any oral problem\textsuperscript{55}. These data indicate that PHPs have the potential to contribute to dental caries reduction during the well-baby visits, which could have a positive impact on oral health status\textsuperscript{11}. 

In summary, PHPs have an opportunity to play an important role in managing the non-classic infectious process of dental caries along with dental professionals\textsuperscript{94} while recognizing their role as both providers and beneficiaries of good health.
CHAPTER 2

The following three manuscripts will be submitted to peer-reviewed journals for publication and knowledge dissemination. The name and roles of the authors are described as follows:

- Elaine Cardoso: Study design, literature research and thesis report. Also performed all clinical exams, and data management, analysis and report.
- Adam Sgro: Data entry, support on clinical duties, patient management and editorial corrections.
- Marcos Sanches: Statistical support.
- Michael J Sigal: Committee member. Provided expert advice for conducting the study, and comments and editorial suggestions.
- Jonathon Maguire: Committee member. Provided expert advice for conducting the study, and comments and editorial suggestions.
- Amir Azarpazhooh: Principal supervisor. Expert advice for conducting the study, and support on study design and data analysis. Provided comments and editorial suggestions.

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Manuscript 1: A cross-sectional assessment of the oral health status of children and caregivers

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Abstract

**Background:** Evidence suggests a strong link between the onset of dental caries and the familial environment since caregivers decide what their children eat, how to take care of their teeth and when to seek oral care.

**Objective:** The aim of this cross-section study is to investigate the association between the clinical parameters of oral health status of caregivers and those of their children.

**Methods:** An oral examination was performed in 149 children-caregiver dyads. The association of clinical findings between the groups was measured using bivariate and multivariate analyses (P≤ 0.05).

**Results:** The odds of having dental caries in primary and permanent teeth were almost three times greater for children of caregivers with missing teeth than for children of caregivers with no missing teeth (OR=2.8; 95% CI=1.2, 6.2). They also had greater odds of having caries experience in mixed (OR=7.1; 95% CI=2.3, 22.2), primary (OR=6.2; 95% CI=2.3, 16.9) or permanent dentition (OR=3; 95% CI=1.1, 8.4), as well as having fillings in mixed dentitions (OR=4.2; 95% CI=1.8, 10) than children of caregivers with no missing teeth. Children of caregivers with untreated caries also had greater odds of experiencing caries in primary teeth than children of caregivers with no decay (OR=2.5; 95 % CI=1, 6).

**Conclusion:** Poor caregivers’ oral health may increase the risk of poor oral health in their children.. These findings may reinforce current evidence that improving caregivers’ oral health may result in reductions in caries experience across generations.97.

**Keywords:** risk, children-caregiver, oral health, familial environment
INTRODUCTION

Epidemiological studies have emphasized the influence of risk factors on the early development of chronic diseases, such as dental caries, and have focused on preventive approaches related to lifestyle changes. It is argued that the direction of changes in oral health behaviors and living conditions throughout the life course will determine either a deleterious or a protective effect in caries experience. Despite the progress observed in dental research, pathogenesis of dental caries cannot be ascribed to only one etiologic factor, but rather to the interaction of physical characteristics in a conducive environment, and under some risk behaviors. Given this multifactorial nature, the course of the disease is unpredictable and occurs cumulatively in any stage in life, since the teeth are constantly in contact with adverse external influences and internally susceptible to damage. Thus, the natural history of dental caries is ubiquitous in all populations, with a fairly constant incidence of primary and recurrent lesions throughout life that varies greatly between low-risk and high-risk populations. Accordingly, it can be said that dental caries can never be truly prevented but rather controlled by maintaining the equilibrium between risk factors and protective measures throughout life.

Although clearly undervalued, evidence suggests a strong link between the onset of dental caries and the familial environment since caregivers decide what their children eat, how to take care of their teeth and when to seek oral care, based on their own assumptions and perceptions of functional status and health. Caregivers have the potential to protectively or adversely influence children’s dental caries experience since oral health-related habits, beliefs, attitudes and behaviors are modeled by the continuous
influence of caregivers in their children’s lives\textsuperscript{14}. A large number of studies have investigated various parental influences on children’s oral health, such as the vertical transmission of cariogenic bacteria\textsuperscript{40, 48, 49, 102-107}, negative attitudes to diet and feeding behaviours\textsuperscript{51-53, 105, 108-110}, caregivers’ beliefs\textsuperscript{5, 54, 55}, oral hygiene behaviours\textsuperscript{5, 111-114}, caregivers’ literacy\textsuperscript{57, 58} and knowledge/attitudes in regard to oral health and dental care\textsuperscript{7, 55}. However, relatively few studies about the association between caregivers’ and children’s oral health status have been conducted\textsuperscript{7, 102, 115} and the strength of the observed associations is still controversial, since many studies demonstrate circumstantial or only a moderate correlation between caregivers’ and children’s dental caries status\textsuperscript{97}. Therefore, the aim of this study was to evaluate the association between clinical parameters of oral health status in caregivers and prevalence of untreated caries in both primary and permanent teeth (\textit{dt+DT}\textgeq{}1) in their children.

\textbf{METHODS}

This study was part of a larger study that has investigated the oral health status within groups of children and caregivers. The complete methodology was described in manuscripts 2 and 3. In short, the inclusion criteria were: children aged 3 to 11 years old and their caregivers, recruited from two different health care settings comprised. All patients should be in good general health and able to be examined intra-orally. The exams were performed by a single calibrated examiner, who was trained by a gold standard dentist, according to the World Health Organization standards (kappa scores ranged from 0.77 to 1.0). The oral health status of children and caregivers were compared according to the following oral health indices: Gingival Index (GI); Simplified Debris Index (DI-S); Simplified Calculus Index (CI-S); Simplified Oral Hygiene Index (OHI-S); Trauma
Index; Occlusal Status, and DMFT indices comprising the sum of all the Decayed, Missing and Filled permanent teeth (DMFT) and/or primary teeth (dmft+DMFT and dmft, respectively), and also the sum of the respective components: Decayed (D, d, D+d), Missing (M, m, M+m) and Filled (F, f, F+f) teeth. In addition to the clinical data, information about demographic and behavioural characteristics of both caregivers and children were collected by means of a questionnaire.

**Data analysis:** Oral health indices of caregivers were analyzed as independent variables both against the primary outcome (dt+DT≥1) and the exploratory secondary outcomes, such as the oral health indices collected from the clinical oral exam. Potential associations were assessed by the Pearson’s Chi-square test or Fisher’s exact test for contingency tables larger than 2x2. At the final step, multinomial logistic regression models were used to determine whether these associations retained their significance after assessing for potential confounders, such as the child’s age, sex and dental insurance status; the child’s and caregivers’ brushing and flossing frequency, time from the last dental visit and dental care/recommended dental care avoided due to cost; and caregiver’s level of education and marital, employment and smoking statuses, that were collected from the demographic and behavioural characteristics extracted from both questionnaires. Sample size calculation was performed for the larger study using data from Toronto Public Health on the caries prevalence of 7 year-old children. The power calculation allowed detection of an Odds Ratio of 2.55, effect size equivalent of 0.52 with 95% confidence and 80% power in a sample of 150 children-caregivers dyads. All tests were done in two-tailed with the significance level set at 0.05 and analyses were carried out using SAS 9.2 (SAS institute Inc., Cary, NC).
**Ethics considerations:** This cross-sectional study was approved by the Research Ethics Boards of the Hospital for Sick Children (Protocol No 1000032247) and the University of Toronto (Protocol No. 30064).

**RESULTS**

**Participants’ demographic and behavioural characteristics:** Participants’ demographic and behavioural characteristics are described in Table 1. A total of 149 child-caregiver-dyads were included in the final sample, with mean age 7.1±2.6 and 40.3±6.8 years, respectively. Although the majority of caregivers had at least a college degree (69.1%), almost 60% were unemployed. About 77% of the children and 86% of the caregivers brushed their teeth at least twice a day, although daily flossing was observed in only 47% and 42.3%, respectively. Most children (85.2%) and more than half of the caregivers (59.7%) reported having their last dental visit less than a year ago: however, 25.5% of children and 36.9% of caregivers avoided visiting a dentist due to cost (Table 1).

**Participants’ clinical characteristics:** The complete description of the clinical characteristics of the sample was described in manuscript 2 and 3. The majority of children had caries history (79%), and mean caries experience severity scores (±SD) 5±4.1 for the primary dentition, 0.6±1.6 for the permanent dentition and 5.7±4.3 for the mixed dentition. The caregivers’ caries experience prevalence was 93.3% with a mean DMFT=9.02±6.22. The majority of children and their caregivers had no history of trauma (96% and 92.6%, respectively), and acceptable occlusion according to standards from the Canadian Health Measures Survey (CHMS)\textsuperscript{29} (74.5% and 69.1%, respectively). All children but half of the caregivers presented a good oral hygiene index; that said, mild
gingivitis was observed in most of them (99.3% of children and 89.3% of caregivers; Table 1).

**Associations between the oral health status in children and caregivers:** Caregivers’ untreated caries, missing teeth and caries experience were the only independent variables that were significantly associated with oral health outcomes in children. Likewise, only secondary outcomes related to the DMFT index were significantly associated with caregivers’ DMFT, DT and MT scores during the exploratory analysis. The significant unadjusted and adjusted associations between this study’s primary and secondary outcomes are presented below and shown in Table 2:

- Children’s caries experience in both primary and permanent teeth (deft+DMFT) was associated with caregivers’ DT (OR=2.5; 95% CI=1, 1, 6) and MT (OR=6; 95% CI=2.1, 16.6);

- Children’s decayed (dt+DT), missing (et+MT) and filled (ft+FT) teeth in primary and permanent teeth were associated with missing teeth in caregivers (OR=2; 95% CI=1, 4, OR=2.5; 95% CI=1.3, 5, and OR=4.4; 95% CI=2, 9.5, respectively);

- Children’s’ caries experience in permanent teeth (DMFT≥1), missing primary teeth (et) and untreated caries in permanent teeth (DT) were also associated with caregivers’ MT (OR=2.8; 95% CI=1.2, 6.1, OR=2.5; 95% CI=1.3, 5 and OR=4; 95% CI=1, 15.3, respectively);

- Children’s caries experience in primary teeth (deft) was associated with caregivers’ DT (OR=2.3; 95% CI=1.1, 5) and with MT (OR=5.4; 95% CI=2.2, 13.3);
Children’s primary filled teeth (ft) were associated with both caregivers’ DMFT score MT scores (OR=3.6; 95% CI=1.8, 7.4 and OR=4.3; 95% CI=1.1, 17.3, respectively);

Having adjusted for potential confounders, the association between the primary outcome (dt+DT≥1) and MT remained significant (OR=2.8; 95% CI=1.2, 6.2). The observed significant associations between the secondary outcomes in children and clinical findings in caregivers, such as MT and DT are described below. All significant associations are presented in Table 2 and figure 1. Children’s caries experience in the mixed dentition (dmft+DMFT≥1), in the primary dentition (deft≥1), and in the permanent dentition (DMFT≥1); missing teeth (et+MT≥1) and fillings in the mixed dentition (ft+FT≥1); and fillings (ft ≥1) and missing teeth in the primary dentition (et≥1) were associated with caregivers’ MT (OR=7.1; 95% CI=2.3, 22.2, OR=6.2; 95% CI=2.3, 16.9, OR=3; 95% CI=1.1, 8.4, OR=2.3; 95% CI=1.1, 4.8, OR=4.2; 95% CI=1.8, 10, OR=3.6; 95% CI=1.7, 7.9 and OR=2.3; 95% CI=1.1, respectively). Children’s caries experience in the primary dentition (deft≥1) was also associated with caregivers’ untreated caries (DT, OR=2.5; 95% CI=1, 6)

**DISCUSSION**

In this study we identified that decayed and missing teeth in caregivers were associated with caries development in their children. These findings reinforce the current dental literature about the influence of the family environment on the early onset of dental caries, in which it is argued that poor caregivers’ oral health may increase the risk of poor oral health in children. However, some limitations of this study should be commented. Despite the observed significant association, results from this study cannot be generalized
and no causal associations can be drawn, due to its cross-sectional design and convenience sample. Nevertheless, the consecutive nature of the sampling strategy may have minimized volunteerism during the recruitment phase of the study\textsuperscript{116}. Additionally, the low prevalence of some oral conditions may have contributed to an underestimation of the significance and strength of the observed associations.

This study’s primary outcome was moderately associated with tooth loss in caregivers, which is in accordance with a longitudinal study in Norway that observed the development of carious lesions in children whose mothers had missing teeth\textsuperscript{117}. Missing teeth in caregivers were also significantly associated with secondary outcomes in children during the exploratory analysis of data. For instance, strong associations were observed between the presence of missing teeth in caregivers and caries experience in all primary, permanent and mixed dentitions, that is in accordance with a Canadian study, in which edentulous caregivers' children were more likely to experience caries in both primary and permanent dentitions than dentate caregivers' children. The authors argued that caries experience in children of edentulous mothers appears early in life, independently of socio-demographic characteristics of the family or children's oral health-related behaviours\textsuperscript{22}. Another study demonstrated that the odds of caregivers with more than five missing teeth children experiencing dental caries were more than three times greater than the odds of caregivers with no tooth loss children having caries experience. The risk appeared to be lower if the caregiver had only one to four missing teeth, indicating that the more teeth missing, the higher the odds of caries experience in children\textsuperscript{97, 102}. Moreover, prospective cohort studies indicated that caregivers’ self-reported tooth loss may be a predictor for children’s caries experiences later in adulthood\textsuperscript{118}. Also during the
exploratory analysis in this study, it was observed that the odds ratio for caregivers with tooth loss children having permanent or primary teeth extracted due to caries or having fillings in both primary and permanent teeth compared with children of caregivers with no tooth loss was 2.3 and 4.2, which indicates an increasing odds of extractions and fillings in the former group. Moreover, the odds of having fillings only in the primary dentition were 3.6 times greater for these children related to children of caregivers with no tooth loss.

The exploratory analysis of the association between the secondary outcomes in children and missing teeth in caregivers pointed to intriguing questions that were not anticipated. For instance, missing teeth in caregivers were strongly associated with caries experience in the all primary (dmft≥1), mixed (dmft+DMFT≥1) and permanent (DMFT≥1) dentitions. After analysis using each component as the dependent variable, significant associations were observed between missing teeth in caregivers and each component of the mixed dentition, and for the missing and filled components of the primary dentition. However, no significant associations were observed for the DMFT index components in the permanent dentition. It is important to discuss some hypothesis that could explain these results. A first hypothesis is related to sample size, since too small a sample would fail to detect important associations. Nevertheless, this study’s sample was able to detect a significant association between missing teeth in caregivers and the primary outcome. A second hypothesis is related to the confidence interval of some associations and their significance. Results from the bivariate analysis showed strong associations between DT≥1 in children and MT≥1 in caregivers (OR=4; 95% CI=1, 15.3) and between dt+DT≥1 in children and MT≥1 in caregivers (OR=2; 95% CI=1, 4). Since the value of
the lower bound of both CI is 1, the p value is .05, which is very close to a no association. However, it may be argued that the wide confidence interval of the former may indicate some influence of random error and the OR=4 may indicate an important effect, which should be confirmed in further studies with larger sample sizes. On the other hand, the narrower CI of the latter indicates that the OR=2 is more close to the real effect size. After the adjustments for confounders were performed, interesting results were observed. The association between $dt+DT\geq 1$ and $MT\geq 1$ presented an increase in the value of both the estimate and the lower bound, although still within a narrow CI range, while a non-significant association between $DT\geq 1$ and $MT\geq 1$ was observed. It is worth noting that there was an increase in both the point estimate of this association ($OR=5.4$) and in the range of the CI, which reinforces the assumption of a type II error or by way of explanation, that a large effect size was not observed due to the size of the sample.

The aforementioned discussion about changes in point estimates and CI leads to the hypothesis about the influence of socio-demographic factors as confounders. As expected, some significant correlations were not able to retain their significance after the statistical adjustments for demographic and behavioural factors were performed. In contrast, the odds of caregiver with missing teeth children having caries experience increased from 6 to 7 times in mixed dentitions and from 5.4 to 6.2 times in primary dentitions. These findings reinforce the concept that not only were biological factors responsible for the observed associations between children and caregivers, but also the behavioural and social characteristics at the family level.

Lastly, this study observed that the odds of caregivers with decay children having caries experience early in life were more than two times greater than the odds of caregivers with
no decay children being affected. This finding was consistent with a population-based study of American children, in which children of mothers with untreated caries were more than three times as likely to experience dental caries compared with children whose mothers had no decay. In a case-control study, Smith (2002) observed that the presence of active caries in mothers was associated with a four-fold increase in the odds of active caries in their children, along with other maternal factors. This association was also significant in cross-sectional studies, where untreated caries in mothers were associated with untreated caries in the primary teeth of children.

The skewed distribution of clinical findings such as trauma, gingivitis, debris, calculus and oral hygiene precluded any statistical analysis between these observed conditions in children and caregivers. Since similar results have been repeatedly demonstrated in the scientific literature, this study’s findings may support the argument that public strategies to improve children’s oral health should also target their caregivers. Taking into account that the onset of dental caries during childhood is influenced by a complex interplay between oral health behaviours and living conditions, a child from a family with dental caries history is more likely to have more severe disease during childhood and adulthood. This vicious cycle may justify investments in dental public health programs to disadvantaged adults, which may control the progression of oral conditions and alleviate the large impact of social inequity on health.
CONCLUSION

A moderate association was observed between untreated caries in 3 to 12 year-old children and missing teeth in their caregivers. Other dental findings in primary, permanent and mixed dentitions were also associated with tooth loss in caregivers. These findings may reinforce current evidence that improving caregivers’ oral health may result in reductions in dental caries experience across generations\textsuperscript{22}, regardless of whether these associations were biologically or behaviourally based\textsuperscript{97}. Thus, strategies to extend public dental care coverage to disadvantaged families who are at greater caries risk may offer multi-generational benefits.

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Table 1: Demographic and behavioural characteristics of children and caregivers, and clinical characteristics of children (outcome data) and caregivers.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>% Caregivers</th>
<th>% Children</th>
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<td><strong>Demographic Characteristics</strong></td>
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<td>Mean Age (SD) – Years</td>
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<td>7.1±2.6*</td>
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<td>-</td>
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<tr>
<td>Level of Education (&gt;Degree or diploma)</td>
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<td>-</td>
</tr>
<tr>
<td><strong>Behavioural Characteristics</strong></td>
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<td>Brushing ≥2x/day</td>
<td>85.9</td>
<td>76.5</td>
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<td>Flossing ≥5x/week</td>
<td>42.3</td>
<td>47.0</td>
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<td>Insured</td>
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<tr>
<td>Publicly Funded (%)</td>
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<tr>
<td>Privately Funded (%)</td>
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<tr>
<td>Making regular preventive dental visits</td>
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<td>Avoid dental care due to cost</td>
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<td>Avoid recommended dental care due to cost</td>
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<td>Smoker</td>
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<td>-</td>
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<tr>
<td>Time taken away from work</td>
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<td><strong>Clinical Characteristics</strong></td>
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<td>Malocclusion</td>
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<td>25.5</td>
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<td>Oral Hygiene Index – Good</td>
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<tr>
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<td>89.3</td>
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<tr>
<td>Debris Index – Mild</td>
<td>73.2</td>
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<tr>
<td>Calculus Index – Mild</td>
<td>66.4</td>
<td>100</td>
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<td>Decayed, missing, filled teeth:</td>
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<tr>
<td>Primary teeth</td>
<td>93.3</td>
<td>74.5 (5 ± 4.1*)</td>
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<tr>
<td>Permanent teeth</td>
<td>(9 ± 6.2*)</td>
<td>22.8 (0.6 ± 1.6*)</td>
</tr>
<tr>
<td>Total</td>
<td>79 (5.7 ± 4.3*)</td>
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<tr>
<td>Decayed teeth:</td>
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<tr>
<td>Primary teeth</td>
<td>46.3</td>
<td>28.9 (1.1 ± 2.4*)</td>
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<tr>
<td>Permanent teeth</td>
<td>(1.2 ± 2*)</td>
<td>8.1 (0.1 ± 0.6*)</td>
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<tr>
<td>Total</td>
<td>32.9 (1.3 ± 2.5*)</td>
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<tr>
<td>Missing teeth</td>
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<td></td>
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<tr>
<td>Primary teeth</td>
<td>45.6</td>
<td>36.9 (0.8 ± 1.7*)</td>
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<tr>
<td>Permanent teeth</td>
<td>(1.7 ± 2.9*)</td>
<td>2.0 (0.1 ± 0.4*)</td>
</tr>
<tr>
<td>Total</td>
<td>36.9 (0.8 ± 1.8*)</td>
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</tr>
<tr>
<td>Filled teeth:</td>
<td></td>
<td></td>
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<tr>
<td>Primary teeth</td>
<td>84.6</td>
<td>62.4 (3.1 ± 3.2*)</td>
</tr>
<tr>
<td>Permanent teeth</td>
<td>(6.1 ± 5*)</td>
<td>17.4 (0.4 ± 1.3*)</td>
</tr>
<tr>
<td>Total</td>
<td>67.8 (3.6 ± 3.5*)</td>
<td></td>
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</table>

*Mean and standard deviation. Data about the ethnicity of the sample were not collected.
Table 2: Bivariate and multivariate analyses of the association between children’s and caregivers’ oral health status.

<table>
<thead>
<tr>
<th>Children’s Oral Health Status</th>
<th>Caregivers’ Oral Health Status</th>
<th></th>
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<tr>
<td></td>
<td>DMFT</td>
<td>DT</td>
<td>MT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unadjusted</td>
<td>Adjusted</td>
<td>Unadjusted</td>
<td>Adjusted</td>
</tr>
<tr>
<td>deft+DMFT≥1</td>
<td>2.8 (0.7, 10.5)</td>
<td>2.9 (0.6, 13.5)</td>
<td>2.5 (1.1, 6)</td>
<td>2.5 (0.9, 6.6)</td>
</tr>
<tr>
<td>deft+DMFT≥1</td>
<td>0.5 (0.1, 1.7)</td>
<td>0.6 (0.1, 2.5)</td>
<td>1.5 (0.8, 3)</td>
<td>1.6 (0.7, 3.5)</td>
</tr>
<tr>
<td>deft+DMFT≥1</td>
<td>2.5 (0.5, 12.1)</td>
<td>2 (0.4, 10.3)</td>
<td>1.2 (0.6, 2.3)</td>
<td>1.2 (0.6, 2.4)</td>
</tr>
<tr>
<td>deft+DMFT≥1</td>
<td>3.5 (0.9, 12.9)</td>
<td>3.6 (0.8, 15.9)</td>
<td>1.7 (0.8, 3.4)</td>
<td>1.8 (0.8, 4)</td>
</tr>
<tr>
<td>deft+DMFT≥1</td>
<td>1.2 (0.2, 5.9)</td>
<td>1.8 (0.2, 13.7)</td>
<td>0.9 (0.4, 1.9)</td>
<td>0.8 (0.3, 2.3)</td>
</tr>
<tr>
<td>deft+DMFT≥1</td>
<td>0.3 (0.1, 1.7)</td>
<td>0.2 (0.2, 2.2)</td>
<td>0.8 (0.3, 2.7)</td>
<td>0.8 (0.1, 2.2)</td>
</tr>
<tr>
<td>deft+DMFT≥1</td>
<td>3.2 (0.9, 11.8)</td>
<td>3.1 (0.8, 13.1)</td>
<td>2.3 (1.1, 5)</td>
<td>2.5 (1, 6)</td>
</tr>
<tr>
<td>deft+DMFT≥1</td>
<td>2.5 (0.5, 12.1)</td>
<td>2 (0.5, 10.3)</td>
<td>1.2 (0.6, 2.3)</td>
<td>1.2 (0.6, 2.4)</td>
</tr>
<tr>
<td>deft+DMFT≥1</td>
<td>4.3 (1.1, 17.3)</td>
<td>3.8 (0.9, 16.4)</td>
<td>1.8 (0.9, 3.5)</td>
<td>1.8 (0.8, 3.6)</td>
</tr>
</tbody>
</table>

This table shows the findings from the bivariate and multivariate analysis of the association between children’s and caregivers’ oral health status. Unadjusted and adjusted ORs are presented and the significant ones are highlighted. \( *p < 0.001, \) \( ^{*}p = 0.04, \) \( ^{*}p = 0.007, \) \( ^{*}p = 0.011, \) \( ^{*}p = 0.03 \)

ORs adjusted for: child’s age, sex and dental insurance status; child’s and caregivers’ brushing and flossing frequency, time from the last dental visit and dental care/recommended dental care avoided due to cost; and caregiver’s level of education and marital, employment and smoking statuses.
Figure 1: Observed associations between outcome findings in children and missing teeth in caregivers

Figure 1: Forest plot representing a total picture of the various CIs and point estimates of the primary and secondary outcome findings in children representing the overall effect of the observed associations with missing teeth in caregivers.
Manuscript 2: Children’s oral health: parents’ perception versus clinical findings

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Running title: Child’s oral health from caregivers’ perspectives

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Abstract

**Background:** Oral health-related quality of life (OHRQOL) measures based on caregivers’ perceptions have emerged as an alternative for children’s subjective oral health data collection.

**Objective:** This cross-sectional study aimed to investigate the association between proxy perceptions of OHRQOL and clinical findings of oral health status in children.

**Methods:** Caregivers of 149 children completed the Parental-Caregiver Perception (P-CPQ) and the Family Impact Scale (FIS). A clinical dental exam was performed for their children. The associations between the subjective information and the untreated caries (dt+DT) were measured using bivariate and multivariate analyses (P ≤ 0.05).

**Results:** The odds ratio for an impact on family activities and on the general oral health for children with caries experience compared to children without caries experience were 5.7 (95% CI=1.9, 17.3) and 5.4 (95% CI=1.7, 16.9), respectively. Likewise, the odds of children with decay having a daily impact on the social activities or on the emotional domain were (95% CI=1, 15.6) and 7.6 (CI=1.7, 33.8) times greater than the odds for children with no decay.

**Conclusion:** P-CPQ domains such as the emotional and social wellbeing were strongly associated with untreated caries in both primary and permanent teeth, although the large width of the CIs may suggest some uncertainty about the precision of the point estimate. General weak associations were observed between the FIS questionnaire and untreated caries, although caregivers of children with caries experience were almost six times as likely to report that their children’s oral health disturbs family activities when compared to caregivers of caries-free children.

**Keywords:** Oral health, quality of life, children, subjective assessment, oral health status
INTRODUCTION

Dental caries is the most common chronic disease in children; its onset is in early childhood, when adverse biological or psychosocial events may lead to an undetected development of long lasting diseases, including dental caries. Once established, dental caries may lead to pain, infection and tooth loss, and may also lead to psychosocial issues, such as loss of school days or days with restricted daily activities. Measuring such impacts would constitute a powerful epidemiological strategy to identify dental care priorities in the population and more importantly, any potential future burden to the health care system.

Subjective indicators have emerged as a promising alternative for health data collection based on concepts of health and social determinants of health, and a series of validated dental questionnaires are available for this purpose. Although oral health and oral health-related quality of life are considered two different concepts, caregivers’ perceptions have long been associated with children’s caries experience. It is argued that the limited knowledge some caregivers may have concerning their children’s OHRQOL does not lessen the importance of their reports for children’s research, since ultimately they are the ones who decide when to seek care based on their own assumptions and perceptions about the health and functional status of their children.

The parental-caregiver perceptions questionnaire (P-CPQ) and the family impact scale (FIS) were developed to assess the child’s oral health-related quality of life from the parents’ perspective and to evaluate the impact of the child’s condition on the family, respectively. Although their psychometric properties were validated, additional
independent testing of the tools’ potential application has focused on score changes after dental treatment\textsuperscript{126-128} or on comparisons with other OHRQOL tools\textsuperscript{129}, including caregiver-child agreement\textsuperscript{87,130}, and child self-reports\textsuperscript{131,132}, with little attention given to the evaluation of questionnaires using proxy perceptions. The aim of the present study was to investigate the association between proxy perceptions of OHRQOL and untreated dental caries in a cross-section of children as part of a larger study investigating the oral health and quality of life within the family environment.

**METHODS**

**Design and population:** A cross-sectional study was conducted from April to June 2014. Inclusion criteria were: children aged 3 to 11 years old, of both genders, from the Paediatrics Dental Clinic at the Faculty of Dentistry, University of Toronto or from The Applied Research Group for Kids (TARGGet Kids!) primary care practice based research network. Children should be in good general health and able to be examined intra-orally.

**Measurements:** After signing the consent to participate, children’s caregivers completed the P-CPQ\textsuperscript{84} according to the following response options: never (0); once or twice (1); sometimes (2); often (3); everyday/almost everyday (4). Questions about demographic and behavioural characteristics were included at the end of the questionnaire. The children’s oral exam was performed by a single calibrated examiner (EC) following the World Health Organization standards and using a Canadian tool kit for conducting oral health surveys\textsuperscript{30,133-139}. Description of the calibration results and indices collected during the clinical exam was reported in manuscript 3. In short, calibration followed WHO standards and the following dental indices were analysed: Gingival Index (GI);
Simplified Debris Index (DI-S); Simplified Calculus Index (CI-S); Simplified Oral Hygiene Index (OHI-S); Trauma Index; Occlusal Status, and DMFT indices comprising the sum of all the Decayed, Missing and Filled permanent (DMFT) and/or primary teeth (dmft+DMFT and dmft, respectively), and also the respective components: Decayed (D, d, D+d), Missing (M, m, M+m) and Filled (F, f, F+f) teeth.

**Data analysis:** Data from the P-CPQ and FIS were presented as measures of severity (simple sum of ordinal response codes to all items, ranging from 0 to 124), extent (the number of items reported as *often* or *everyday/almost everyday*, ranging from 0 to 31) and prevalence of the impact (percentage of caregivers reporting one or more items as *often* or *everyday/almost everyday*\(^84\). *Don’t know* responses were considered as no impact (value of 0) to prevent the loss of valuable information, as proposed by Jokovic & Locker\(^84\). Questionnaires with missing values >1/7 items were excluded from the study and those with ≤ 1/7 missing responses were replaced with the mean value of valid responses for that item\(^82\). The Wilcoxon rank test, Pearson’s Chi-square test, or Fisher’s exact test for contingency tables larger than 2x2, and multivariate analyses were performed to assess the correlation between the questionnaires’ severity/extent scores as independent variables, with the prevalence of untreated caries in both primary and permanent teeth (dt+DT≥1) as the primary outcome. Exploratory secondary outcomes were the prevalence of other findings from the clinical oral exam. Potential confounders were data collected from demographic and behavioural characteristics, and included: child’s age, sex, brushing and flossing frequency, dental insurance status, time from the last dental visit, and dental care/recommended, dental care avoided for the child due to cost; and the caregiver’s marital status, education and employment status. Sample size
calculation was performed for a larger study using data from Toronto Public Health on the caries prevalence of 7 year-old children\textsuperscript{31}. The power calculation allowed detection of an Odds Ratio of 1.7 for the primary outcome, which is equivalent to a Cohen's d around 0.3 in a sample of 150 children. Statistical significance was set at 5% and analyses were carried out using SAS 9.2 (SAS institute Inc., Cary, NC).

The study’s protocol was approved by the Research Ethics Boards of the Hospital for Sick Children (Protocol No 100032247) and the University of Toronto (Protocol No. 30064).

**RESULTS**

*Participants’ descriptive characteristics:* Caregivers of 149 children agreed to participate in the study. The description of the final sample was previously reported (Manuscript 1) and is outlined in Table 1. The mean age of children was 7.1±2.6 years, 12 of whom from the TARGet Kids! and 137 from the Faculty of Dentistry. Descriptions of the prevalence, extent and severity scores of the global questions and P-CPQ are presented in Table 2. The majority of caregivers (71.8%) rated their children’s teeth, lips, jaws and mouth as either good or excellent and 84.6% of caregivers reported very little or no impact of oral conditions on their children’s general health. According to 36.2% of caregivers, oral diseases in children appeared to influence their quality of life. The average number of chronic impacts was 0.99±1.72, with an average severity score 11.76±11.73. Functional limitation was the most prevalent subscale (26.2%) while the emotional and social wellbeing were the least prevalent subscales (8.1% each).

Data from the FIS questionnaire are also described in Table 2. About one-third (29.5%) of
the caregivers reported that the oral condition of their children impacts the general quality of life of their family, although the mean number of severe impacts and their general severity score were low. Most impacts were reported in the parental/family activity subscale (17.4%), followed by the parental emotions (12.8%), the financial burden (8.7%) and the family conflict (6.7%) domains. The highest mean extent and severity scores (±SD) were also observed in the parental/family activity subscale (0.3±0.7 and 1.7±2.7, respectively), although low scores were observed among the overall FIS and subscales. The prevalence of floor effects were 8.7% in the P-CPQ, while in the subscales they were as follows: oral symptoms 14.8%, functional limitation 29.5%, emotional wellbeing 58.4% and social wellbeing 53%. Prevalence of floor effects in the FIS questionnaire were 47% for the overall FIS, and 61.1% for the parental emotions, 55.7% for the parental/family activity, 79.9% for the family conflict and 82.6% for the financial burden subscales (Table 3). Questionnaires with maximum scores, namely ceiling effects, were not identified.

**Associations between OHRQOL measures and clinical variables:** Tables 4 and 5 present the results of the most important unadjusted and adjusted associations observed between the OHRQOL questionnaires and caries status in children. Significant, although mostly weak, associations were observed between the severity scores of the P-CPQ and FIS, and the oral health outcomes, both on the bivariate and the multivariate levels. However, the emotional and social wellbeing domains of the P-CPQ, the parental/family activity subscale of the FIS and the global question about general oral health were strongly associated with clinical findings even after multivariate analyses were performed. For instance, associations were observed between active caries in primary and permanent
teeth and one or more impacts reported as *often* or *everyday/almost everyday* on the social wellbeing (OR=4; 95% CI=1, 15.6) and on the emotional wellbeing (OR=7.6; 95% CI=1.7, 33.8) domains. Moreover, caries experience also in primary and permanent teeth was associated with a negative impact on children’s family activities (OR=5.7; 95% CI=1.87, 17.3), children’s general oral health (OR=5.4; 95% CI=1.7, 16.9) and with one or more impacts reported as *often* or *everyday/almost everyday* on children’s general oral health (OR=23.9; 95% CI=2.70, 212). Ultimately, fillings in primary and permanent teeth were associated with bad general oral health (OR=4; 95% CI=1.5, 11.1). No significant associations were observed between the extent/severity scores of the P-CPQ, FIS and global questions, and other clinical findings such as trauma, malocclusion, gingivitis, debris, calculus and oral hygiene status, as well as some DMFT indices comprising the sum of all the decayed, missing and filled primary teeth (dmft) and respective components, decayed (d), missing (m) and filled (f) teeth; decayed (D), missing (M) and filled (F) permanent teeth; and the sum of missing primary (m) and permanent (M) teeth. Figure 1 presents the various CIs and point estimates of the overall effect of the observed associations between the P-CPQ scores and untreated decay in both primary and permanent teeth. Figures 2 and 3 present the same information for the association between global questions and FIS, and caries experience in the same population.

**DISCUSSION**

Significant associations were observed between the P-CPQ and FIS scores and the study’s primary outcome (dt+DT≥1). The strongest observed associations were between two P-CPQ extent scores and the caries status in children. Emotional and social impacts on wellbeing were, respectively, seven and four times more frequent in children with
untreated caries in both primary and permanent teeth than in children with no decay. Special attention should be given to these strong associations due to the nominal nature of these variables. Since extent scores represent the presence or absence of frequent impacts, such a dichotomization usually attenuates the significance level of some associations\textsuperscript{140}. Moreover, the adopted threshold to define the frequency of impacts is the most stringent identified in the literature. For instance, the prevalence of positive impacts can be grouped by using different thresholds such as: once or twice, sometimes, often, everyday/almost everyday\textsuperscript{141}; sometimes, often, everyday/almost everyday\textsuperscript{142}; and often, everyday/almost everyday\textsuperscript{90}. The latter was adopted to include only the most severe impacts of oral conditions on the individual’s daily activities\textsuperscript{143}. In populations where the distribution of oral diseases is skewed, it is observed that the majority of individuals report no impact at this threshold\textsuperscript{144}. Thus, those identified as experiencing greater impact may be the ones most likely to benefit from public health strategies. Extent scores were analysed to compensate for the inability of the severity score to identify different profiles, since the number of high-frequency impacts is also indicated in addition to their severity\textsuperscript{90}. For instance, a severity score of eight would be either the sum of eight items marked as one, or two items marked as four. Despite the same total score, the latter has two daily activities everyday/almost everyday affected by oral conditions, while in the former the frequency is only once or twice.

In general, significant, albeit mostly weak associations were observed between the questionnaires’ severity scores and clinical parameters in children. Caregivers of children with caries experience, untreated caries and filled teeth in both primary and permanent teeth, as well as caries experience only in permanent teeth, were more likely to report oral
health-related impacts on their children’s quality of life than caregivers of children with no such conditions. In an Australian study evaluating both CPQ and PPQ, caries experience in both primary and permanent teeth was also weakly associated with scores on the social wellbeing and oral symptoms domains, though no adjustments for confounders were performed\textsuperscript{145}.

Analysis of the FIS questionnaire suggested that caregivers of children with caries experience in both primary and permanent teeth were almost six times as likely to report that their children’s oral health disturbs family activities when compared to caregivers of caries-free children. Likewise, the odds of having a daily impact on the general oral health are 24 times greater for children with caries experience in both primary and permanent teeth compared to children with no decay. It is worth noting that, the 95% CI of the Odds Ratio points to an uncertainty about the precision of the estimate\textsuperscript{146}, although this information does not invalidate the utility of the instrument\textsuperscript{147}. Poor general oral health was four times as likely in children with fillings and five times as likely in children with caries experience in both primary and permanent teeth when compared with children with no such conditions, while children with caries experience only in permanent teeth are almost four times as likely to experience poor general wellbeing than caries-free children. It is important to note that, despite the prevalence of almost 50% of floor effects in the FIS, which may be explained by the chronic nature of dental caries which may not severely impact the individual quality of life\textsuperscript{148}, significant and strong associations were observed.

This study presented an overall P-CPQ mean severity score of 11.8, which is in accordance with an Australian study (11.6) that employed a complex sample strategy.
Therefore, the final sample comprised a diverse and representative sample of the general population\textsuperscript{145}. The mean severity score for the overall FIS questionnaire was 4.28 and almost half of the caregivers reported no impact of their children’s oral conditions on their family’s quality of life. These findings represent a low severity score, compared to the 7.33 observed in a 2002 Canadian study, when the instrument was developed\textsuperscript{88}. This difference in scores may be attributed to the different prevalence of untreated caries between these studies (32.9\% vs. 54.4\%). A more recent study applied the FIS to examine its evaluative properties. Parental perceptions were used to evaluate changes in OHRQOL after dental treatment under general anesthesia in a group of 130 children\textsuperscript{126}. Mean severity scores observed for the overall FIS and subscales were also higher than those from the present study (10.1), due to the high prevalence and severity of dental caries in that population\textsuperscript{126}. Discriminative properties of the instrument were confirmed in both studies and it was concluded that it offers good evaluative measures for use in dental research, although the importance of having further studies involving groups with diverse severity levels of disease was stressed\textsuperscript{88}.

The high prevalence of floor effects indicates that the instrument was unable to capture a small variability in OHRQOL, a situation that may lead to two distinct interpretations. On one hand, it may indicate the poor responsiveness of the instrument in detecting changes in the quality of life over time, which is an undesirable outcome in interventional studies. On the other hand, the inability of the instrument to capture a small variability in OHRQOL among healthy patients is a desirable discriminatory power that permits the identification of disadvantaged individuals whose oral diseases appear as a burden to their quality of life\textsuperscript{149}. High floor effect values have been described in studies where no
specific condition was investigated\textsuperscript{131}, whereas zero or small proportions are observed in studies comprising children with specific conditions, such as cleft lip or palate and restorative or orthodontic treatment needs\textsuperscript{84}. From the public health perspective, the presumed inability of the OHRQOL measurement to detect minor oral health-related impacts on daily activities highlights the instrument’s potential to identify subpopulations in which the burden of oral diseases may justify public investments in oral health promotion and care. It is worth noting that significant associations between the questionnaires’ scores and the dental caries status of the participants were observed in the current study despite the high prevalence of floor effects.

The use of patient-centered subjective indicators has been advocated as a complement to clinical exams since using only normative methods to assess the population’s dental status often provide a non-realistic estimate of resource use\textsuperscript{16-18}. Moreover, they may highlight health disparities among vulnerable populations whose dental status would justify public investments\textsuperscript{10, 150}. Notwithstanding good construct validity, internal consistency reliability, and test-retest reliability of the P-CPQ and FIS, the association between patient-centered instruments and clinical indicators is still controversial\textsuperscript{64}.

This study has a number of limitations. Although our consecutive sampling may have minimized volunteerism\textsuperscript{116}, the results cannot be generalized and no causal associations can be drawn. Additionally, the low prevalence of some oral conditions may have underestimated the significance and strength of the observed associations. To the best of our knowledge, little or no research has been performed so far with similar designs in which the performance of the P-CPQ has been evaluated.
CONCLUSION

This study presented strong associations between caregivers’ perceptions about their children’s OHRQOL and this study’s primary objective, namely untreated dental caries (dt+DT≥1). Emotional and social impacts on wellbeing were, respectively, seven and four times more frequent in children with untreated caries in both primary and permanent teeth than in children with no decay. General weak associations were observed between the FIS questionnaire and untreated caries, although caregivers of children with caries experience were almost six times as likely to report that their children’s oral health disturbs family activities when compared to caregivers of caries-free children. Further studies are necessary to investigate the performance of the P-CPQ and FIS questionnaires as subjective oral health tools for use in oral health care planning initiatives. Once the relationship between subjective reports and oral health outcomes is clearly outlined, the use of subjective measurements for collection of oral health data may raise the visibility of oral health issues in the public policy sphere.

Acknowledgements:

This study was sponsored by grants from the Dental Research Institute, Faculty of Dentistry, University of Toronto. The authors deny any conflicts of interest related to this study. The authors thank everyone who contributed to the completion of this survey: Dr. Dick Ito, Ms. Snezana Djuric and her staff at the paediatric dental clinic, the research assistants from TARGGet Kids! specially Laurie Thompson; and volunteer students, Angel Wang, Hong Yang (Dennis) Chen, Negar Harraji and Muhammed Qasim Parekh.
Table 1: Demographic, behavioural and clinical characteristics of the sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>% of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Mean Age (SD) – Years</td>
<td>7.1±2.64*</td>
</tr>
<tr>
<td>Gender (Male)</td>
<td>53.0</td>
</tr>
<tr>
<td><strong>Behavioural Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Brushing ≥2x/day</td>
<td>76.5</td>
</tr>
<tr>
<td>Flossing ≥5x/week</td>
<td>47.0</td>
</tr>
<tr>
<td>Insured</td>
<td>49.7</td>
</tr>
<tr>
<td>Insurance type:</td>
<td></td>
</tr>
<tr>
<td>Publicly Funded (%)</td>
<td>22.8</td>
</tr>
<tr>
<td>Privately Funded (%)</td>
<td>26.8</td>
</tr>
<tr>
<td>Making regular preventive dental visits</td>
<td>35.7</td>
</tr>
<tr>
<td>Last dental visit &lt; 1 year ago</td>
<td>85.2</td>
</tr>
<tr>
<td>Avoid dental care due to cost</td>
<td>25.5</td>
</tr>
<tr>
<td>Avoid recommended dental care due to cost</td>
<td>18.8</td>
</tr>
<tr>
<td><strong>Clinical Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Presence of trauma</td>
<td>4.7</td>
</tr>
<tr>
<td>Malocclusion</td>
<td>25.5</td>
</tr>
<tr>
<td>Oral Hygiene Index – Good</td>
<td>100.0</td>
</tr>
<tr>
<td>Gingival Index – Mild</td>
<td>99.3</td>
</tr>
<tr>
<td>Debris Index – Mild</td>
<td>80.5</td>
</tr>
<tr>
<td>Calculus Index – Mild</td>
<td>100.0</td>
</tr>
<tr>
<td>Decayed, missing, filled teeth (Mean ± SD):</td>
<td></td>
</tr>
<tr>
<td>Primary teeth (5.03 ± 4.13)</td>
<td>74.5</td>
</tr>
<tr>
<td>Permanent teeth (0.63 ± 1.57)</td>
<td>22.8</td>
</tr>
<tr>
<td>Total (5.66 ± 4.34)</td>
<td>79.0</td>
</tr>
<tr>
<td>Decayed teeth (Mean ± SD):</td>
<td></td>
</tr>
<tr>
<td>Primary teeth (1.13 ± 2.40)</td>
<td>28.9</td>
</tr>
<tr>
<td>Permanent teeth (0.14 ± 0.56)</td>
<td>8.1</td>
</tr>
<tr>
<td>Total (1.28 ± 2.50)</td>
<td>32.9</td>
</tr>
<tr>
<td>Missing teeth (Mean ± SD)</td>
<td></td>
</tr>
<tr>
<td>Primary teeth (0.79 ± 1.73)</td>
<td>36.9</td>
</tr>
<tr>
<td>Permanent teeth (0.05 ± 0.43)</td>
<td>2.0</td>
</tr>
<tr>
<td>Total (0.83 ± 1.83)</td>
<td>36.9</td>
</tr>
<tr>
<td>Filled teeth (Mean ± SD)</td>
<td></td>
</tr>
<tr>
<td>Primary teeth (3.11 ± 3.20)</td>
<td>62.4</td>
</tr>
<tr>
<td>Permanent teeth (0.44 ± 1.28)</td>
<td>17.4</td>
</tr>
<tr>
<td>Total (3.56 ± 3.50)</td>
<td>67.8</td>
</tr>
</tbody>
</table>

*Mean and standard deviation. Data about the ethnicity of the sample were not collected.
Table 2: Descriptive statistics of the prevalence, extent and severity scores of the impact of the oral condition on each item of the global questions, P-CPQ and FIS, according to parents’ reports.

<table>
<thead>
<tr>
<th>Global Questions</th>
<th>Prevalence (%)</th>
<th>Mean Extent Score ± SD (Range)</th>
<th>Median Extent Score (IQR)</th>
<th>Mean Severity Score ± SD (Range)</th>
<th>Median Severity Score (IQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Oral Health</td>
<td>28.2%</td>
<td>0.3 ± 0.5 (0, 1)</td>
<td>0 (0,1)</td>
<td>0.3 ± 1.5 (0, 1)</td>
<td>0 (1,3)</td>
</tr>
<tr>
<td>General Wellbeing</td>
<td>15.4%</td>
<td>0.2 ± 0.4 (0, 1)</td>
<td>0 (0,0)</td>
<td>1.2 ± 1.2 (0, 4)</td>
<td>1 (0,2)</td>
</tr>
<tr>
<td>OverallQuality of life</td>
<td>36.2%</td>
<td>1 ± 1.7 (0, 8)</td>
<td>0 (0,1)</td>
<td>11.8 ± 11.7 (0, 53)</td>
<td>8 (3,17)</td>
</tr>
<tr>
<td>Oral Symptoms</td>
<td>20.1%</td>
<td>0.3 ± 0.7 (0, 3)</td>
<td>0 (0,0)</td>
<td>4.2 ± 3.7 (0, 15)</td>
<td>2 (1,6)</td>
</tr>
<tr>
<td>Functional Limitation</td>
<td>26.2%</td>
<td>0.4 ± 0.9 (0, 4)</td>
<td>0 (0,1)</td>
<td>4.6 ± 5.2 (0, 24)</td>
<td>3 (0,8)</td>
</tr>
<tr>
<td>Emotional Wellbeing</td>
<td>8.1%</td>
<td>0.1 ± 0.5 (0, 3)</td>
<td>0 (0,0)</td>
<td>2 ± 3.4 (0, 16)</td>
<td>0 (0,2)</td>
</tr>
<tr>
<td>Social Wellbeing</td>
<td>8.1%</td>
<td>0.1 ± 0.5 (0, 3)</td>
<td>0 (0,0)</td>
<td>1.6 ± 3.4 (0, 23)</td>
<td>0 (0,1)</td>
</tr>
<tr>
<td>Overall Quality of life of the family</td>
<td>29.5%</td>
<td>0.7 ± 1.5 (0, 7)</td>
<td>0 (0,1)</td>
<td>4.3 ± 6.4 (0, 31)</td>
<td>1 (0,6)</td>
</tr>
<tr>
<td>Parental Emotions</td>
<td>12.8%</td>
<td>0.2 ± 0.5 (0, 3)</td>
<td>0 (0,0)</td>
<td>1.5 ± 2.4 (0, 11)</td>
<td>0 (0,2)</td>
</tr>
<tr>
<td>Parental /Family Activity</td>
<td>17.4%</td>
<td>0.3 ± 0.7 (0, 4)</td>
<td>0 (0,0)</td>
<td>1.7 ± 2.7 (0, 13)</td>
<td>0 (0,2)</td>
</tr>
<tr>
<td>Family conflict</td>
<td>6.7%</td>
<td>0.1 ± 0.5 (0, 3)</td>
<td>0 (0,0)</td>
<td>0.6 ± 1.6 (0, 10)</td>
<td>0 (0,0)</td>
</tr>
<tr>
<td>Financial Burden</td>
<td>8.7%</td>
<td>0.1 ± 0.3 (0, 2)</td>
<td>0 (0,0)</td>
<td>0.3 ± 0.8 (0, 4)</td>
<td>0 (0,0)</td>
</tr>
</tbody>
</table>

Note: IQR: Inter-quartile range
Table 3: Percentage of floor effects in the P-CPQ and FIS questionnaires

<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample</th>
<th>Overall P-CPQ</th>
<th>OS</th>
<th>FL</th>
<th>EW</th>
<th>SW</th>
<th>Overall FIS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>This Study</strong></td>
<td>149 caregiver-children dyads</td>
<td>8.7</td>
<td>14.8</td>
<td>29.5</td>
<td>58.4</td>
<td>53.0</td>
<td>47.0</td>
</tr>
<tr>
<td><strong>Do LG, Spencer AJ, 2008</strong></td>
<td>1401 children aged 8 to 13 from a regional school dental service population</td>
<td>3.5</td>
<td>6.0</td>
<td>39.7</td>
<td>51.9</td>
<td>63.9</td>
<td></td>
</tr>
<tr>
<td><strong>Malden PE, Thomson WM, Jokovic A, Locker D, 2008</strong></td>
<td>130 children receiving dental treatment under GA</td>
<td>0.0</td>
<td>17.0</td>
<td>15.0</td>
<td>45.0</td>
<td>40.0</td>
<td>25.0</td>
</tr>
<tr>
<td><strong>Jokovic A, Locker D, Tompson B, Guyatt G, 2004</strong></td>
<td>68 targeted children with dental caries or clefts of the lip and palate</td>
<td>0.0</td>
<td>8.8</td>
<td>16.2</td>
<td>17.6</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td><strong>Foster Page LA, Boyd D, Thomson WM, 2013</strong></td>
<td>200 5-8-year-old children in community dental clinics in 2011</td>
<td>13.7</td>
<td>16.9</td>
<td>43.2</td>
<td>57.9</td>
<td>67</td>
<td></td>
</tr>
</tbody>
</table>

This table presents the proportion of questionnaires with floor effects (score=0), which indicates no impact of oral conditions on quality of life. Data were extracted from the P-CPQ and FIS and are presented in comparison with available dental literature. Information about the references sample is provided:

OS: Oral Symptoms
FL: Functional Limitation
EW: Emotional Wellbeing
SW: Social Wellbeing
Table 4: Global ratings, P-CPQ and FIS overall and subscales severity and extent scores, and their association with children’s DMFT, deft+DMFT, dt+DT and ft+FT (Unadjusted ORs and 95% CI).

<table>
<thead>
<tr>
<th></th>
<th>DMFT</th>
<th>dmf+DMFT</th>
<th>dt + DT</th>
<th>ft + FT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall P-CPQ</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>1.1</td>
<td>(1.1, 1.1)</td>
<td>1</td>
<td>(1, 1.1)</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td></td>
<td>2</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Oral Symptoms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>1.2</td>
<td>(1, 1.3)</td>
<td>1.1</td>
<td>(1, 1.2)</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td>(0.8, 9.8)</td>
<td>2.5</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Functional Limitation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>1.1</td>
<td>(1.1, 1.3)</td>
<td>1.1</td>
<td>(1, 1.2)</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td>(0.8, 5.9)</td>
<td>1.4</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Emotional Wellbeing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>1.3</td>
<td>(1.2, 1.5)</td>
<td>1.1</td>
<td>(1, 1.2)</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td></td>
<td>7.3</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Social Wellbeing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>1.27</td>
<td>(1.1, 1.5)</td>
<td>1.1</td>
<td>(1, 1.1)</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td></td>
<td>4.7</td>
<td>NA</td>
</tr>
<tr>
<td><strong>General Oral Health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>3.8</td>
<td>(0.8, 17)</td>
<td>3.5</td>
<td>NA</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td>(2.1, 121)</td>
<td>16</td>
<td>NA</td>
</tr>
<tr>
<td><strong>General Wellbeing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>3.2</td>
<td>(1.2, 8.4)</td>
<td>2.8</td>
<td>NA</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td>(0.2, 1.5)</td>
<td>0.6</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Overall FIS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>1.10</td>
<td>(1, 1.2)</td>
<td>1.3</td>
<td>(1, 1.5)</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td></td>
<td>1.1</td>
<td>(1, 1.1)</td>
</tr>
<tr>
<td><strong>Parental Emotion</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>1.3</td>
<td>(1.1, 1.5)</td>
<td>1.4</td>
<td>(1, 1.8)</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td></td>
<td>1.2</td>
<td>(1, 1.4)</td>
</tr>
<tr>
<td><strong>Parental /Family Activity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>1.2</td>
<td>(1.1, 1.4)</td>
<td>3.2</td>
<td>(1.4, 7.3)</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td></td>
<td>1.2</td>
<td>(1.1, 1.4)</td>
</tr>
<tr>
<td><strong>Family Conflict</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>1.2</td>
<td>(1, 1.5)</td>
<td>1.3</td>
<td>(0.9, 1.9)</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td></td>
<td>1.05</td>
<td>(0.9, 1.2)</td>
</tr>
<tr>
<td><strong>Financial Burden</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>1.7</td>
<td>(1.1, 2.6)</td>
<td>NA</td>
<td>1.4</td>
</tr>
<tr>
<td>E</td>
<td>NA</td>
<td></td>
<td>2.2</td>
<td>(1, 4.7)</td>
</tr>
</tbody>
</table>
Table 5: Global ratings, P-CPQ and FIS overall and subscales severity and extent scores, and their association with children’s DMFT, deft+DMFT, dt+DT and ft+FT (Adjusted ORs and 95% CI).

<table>
<thead>
<tr>
<th></th>
<th>DMFT</th>
<th>dmft + DMFT</th>
<th>dt + DT</th>
<th>ft + FT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall P-CPQ</strong></td>
<td>S</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.1, 1.2)</td>
<td>(1, 1.1)</td>
<td>(1, 1.1)</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>NA</td>
<td>2.4</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.9, 6.5)</td>
<td>(0.9, 4.1)</td>
</tr>
<tr>
<td><strong>Oral Symptoms</strong></td>
<td>S</td>
<td>1.2</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.1, 1.3)</td>
<td>(1.1, 1.4)</td>
<td>(1, 1.2)</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>NA</td>
<td>3.2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.8, 13)</td>
<td>(0.8, 4.9)</td>
</tr>
<tr>
<td><strong>Functional Limitation</strong></td>
<td>S</td>
<td>1.2</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.1, 1.4)</td>
<td>(1.1, 1.4)</td>
<td>(1, 1.2)</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>NA</td>
<td>2.9</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.9, 9.4)</td>
<td>(0.7, 3.8)</td>
</tr>
<tr>
<td><strong>Emotional Wellbeing</strong></td>
<td>S</td>
<td>1.4</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.2, 1.6)</td>
<td>(1, 1.3)</td>
<td>(1, 1.2)</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>NA</td>
<td>NA</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1.7, 33.8)</td>
</tr>
<tr>
<td><strong>Social Wellbeing</strong></td>
<td>S</td>
<td>1.3</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.1, 1.5)</td>
<td>(1, 1.2)</td>
<td>(1, 1.1)</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>NA</td>
<td>NA</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1, 15.6)</td>
</tr>
<tr>
<td><strong>General Oral Health</strong></td>
<td>S</td>
<td>4.5</td>
<td>5.4</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.9, 22.6)</td>
<td>(1.7, 16.9)</td>
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</tr>
<tr>
<td></td>
<td>E</td>
<td>NA</td>
<td>24</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.7, 212)</td>
<td>NA</td>
</tr>
<tr>
<td><strong>General Wellbeing</strong></td>
<td>S</td>
<td>3.8</td>
<td>2.4</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.2, 11.8)</td>
<td>(0.9, 6)</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>NA</td>
<td>0.5</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.2, 1.5)</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Overall FIS</strong></td>
<td>S</td>
<td>1.1</td>
<td>1.3</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1, 1.2)</td>
<td>(1.1, 1.6)</td>
<td>(1, 1.2)</td>
</tr>
<tr>
<td><strong>Parental Emotion</strong></td>
<td>S</td>
<td>1.4</td>
<td>1.3</td>
<td>1.3</td>
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<tr>
<td></td>
<td></td>
<td>(1.1, 1.7)</td>
<td>(1, 1.8)</td>
<td>(1.1, 1.5)</td>
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<tr>
<td><strong>Parental Family Activity</strong></td>
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<td>5.7</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.1, 1.5)</td>
<td>(1.9, 17.3)</td>
<td>(1.1, 1.4)</td>
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<td>1.3</td>
<td>1.3</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
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<td>(0.9, 1.8)</td>
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<tr>
<td><strong>Financial Burden</strong></td>
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<tr>
<td></td>
<td></td>
<td>(1, 2.9)</td>
<td></td>
<td>(0.8, 2.3)</td>
</tr>
</tbody>
</table>
Figure 1: Forest plot representing a total picture of the various CIs and point estimates representing the overall effect of the observed associations between the P-CPQ scores and untreated caries in primary and permanent teeth in the sample population.
Figure 2: Associations between the global questions scores and dmft+DMFT

Figure 2: Forest plot representing a total picture of the various CIs and point estimates representing the overall effect of the observed associations between the global questions scores and caries experience in primary and permanent teeth in the sample population.
Figure 3: Associations between the FIS scores and dmft+DMFT

Figure 3: Forest plot representing a total picture of the various CIs and point estimates representing the overall effect of the observed associations between the FIS scores and caries experience in primary and permanent teeth in the sample population.
Manuscript 3: Performance of the Oral Health Impact Profile-14 as a potential tool for patient-centered oral health assessment in systematic surveys.

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Running title: OHIP-14 as a tool for oral health assessment

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Abstract

Background: Patient-centered subjective indicators have been advocated as a means for identifying subgroups of the population whose dental needs have an impact on their quality of life.

Objective: To investigate the association between objective and subjective oral health parameters, and to assess the performance of the Oral Health Impact profile (OHIP-14) as a potential tool in identifying oral health care priorities.

Methods: Between April and June/2014, 149 caregivers of children who were regular patients at the Faculty of Dentistry, University of Toronto, or at The Applied Research Group for Kids (TARGet Kids!) were enrolled in this cross-sectional study. Associations between subjective information from the OHIP-14 and missing teeth as the primary outcome were investigated using bivariate and multivariate analyses (P ≤ 0.05).

Results: Participants with missing teeth were almost 5 times as likely to report more physical disability (OR=4.9; 95% CI=1.3, 18.1), when compared with participants with no missing teeth, as well as almost 2 times as likely to report at least frequent impacts of oral conditions on their general quality of life (OR=1.8; 95% CI=1.1, 2.8) and more likely to report functional limitation, pain, and physical and social disability when performing daily activities (OR=1.7; 95% CI=1.1, 2.5; OR=1.5; 95% CI=1, 2.1; OR=1.5; 95% CI=1, 1.9; OR=1.4; 95% CI=1.1, 1.7, respectively).

Conclusion: The significance of the association between the OHIP-14 scores and missing teeth may emphasize the negative impact of tooth loss on people’s quality of life. Future research is needed in order to investigate the discriminative property of the OHIP-14.

Keywords: oral health, quality of life, adults, subjective assessment, oral health status
INTRODUCTION

Reducing oral health inequities and the impact of oral conditions on certain segments of the population has been a challenge\textsuperscript{12}. Management of chronic conditions, dental caries included, is still a burden to the health care system\textsuperscript{151}, due to their multifactorial nature\textsuperscript{41} and increasing costs\textsuperscript{148}. Thus, early identification of groups at high-risk for oral conditions may lead to a more controlled and supervised assistance to prevent disease progression at the population level\textsuperscript{152}. Changing the existing clinical oral health approach by incorporating aspects of oral health-related quality of life (OHRQOL) may assist in preventing and treating dental diseases\textsuperscript{67}.

Pioneer studies investigating the social impact of oral health conditions on the productivity of the population suggested the use of sociodental indicators in surveys as a complement to clinical parameters traditionally used in dental research\textsuperscript{76}. OHRQOL questionnaires were then developed with focus on individuals’ perceptions of the impact of oral conditions on daily performances\textsuperscript{68, 77, 153}, that are considered as legitimate as that of clinicians\textsuperscript{154}.

The Oral Health Impact profile (OHIP) is one of the various instruments deemed to evaluate the impact of oral conditions on the quality of life. It has 49 questions and the ‘social impact’ of oral disorders is evaluated according to different domains, such as dysfunction, discomfort and disability, using a Likert-type scale with responses varying from \textit{very often}, \textit{fairly often}, \textit{sometimes}, \textit{hardly ever}, or \textit{never}\textsuperscript{75}. Thus, self-perceived oral health is measured in a broad perspective, which gives the instrument a desirable discriminant power, or the ability to identify differences in the health status between
groups which may distinguish those whose oral diseases appear as a burden to their quality of life. Although it is argued that the OHIP is one of the most technically sophisticated OHRQOL tools, it is too lengthy to be used in epidemiological studies, which led to the development of its short form, the 14-question OHIP.

Despite the worldwide use of the OHIP-14 in association with clinical measures to evaluate the impact of oral conditions on the quality of life, OHRQOL data in Canada were documented by a telephone interview survey with no collected clinical data. Taking into consideration that cultural differences within and between populations influence self-perceptions about the impact of oral conditions on quality of life, and the observed link between clinical findings in older adults and variations in OHRQOL questionnaire scores, the purpose of this study was to investigate the association between the OHIP-14 scores and findings from a clinical examination in a sample of Canadian adults.

**METHODS**

**Study design and population:** Between April and June/2014, caregivers of children who were regular patients at the Paediatric Clinic at the Faculty of Dentistry, University of Toronto, or at The Applied Research Group for Kids (TARGet Kids!) Group-affiliated paediatric offices (a practiced-based research network collaboration between community paediatricians and researchers at The St. Michael’s Hospital and the Hospital for Sick Children in Toronto) were enrolled in this cross-sectional study. The two different settings were chosen to address logistic problems and challenges during the application of the questionnaire in private offices. Participants should be in good health and able to be examined intra-orally. An exclusion criterion was caregivers’ inability to give informed
consent or to complete the questionnaires due to being unable to read, understand and communicate freely in English.

**Data collection:** Participants were first asked to complete the OHIP-14, from which subjective information of the impact of oral diseases on their quality of life were collected. Then, a single examiner (EC) performed the oral examinations to collect objective clinical data, following the World Health Organization (WHO) standards and a Canadian tool kit for conducting oral health surveys. Prior to the study, the examiner was trained and calibrated by a WHO gold standard examiner with the kappa statistics ranging from 0.77 to 1.0 (substantial to almost perfect agreement).

**Data analysis:** Data extracted from the OHIP-14 were used as independent variables, while findings from the dental clinical exam were used as dependent variables. The subjective information was analysed as measures of severity (simple sum of ordinal response codes to all items) and extent (the number of items reported as *fairly often* or *very often*). Questionnaires with missing values >2 OHIP-14 items were excluded from the study and those with ≤2 missing responses were replaced with the mean value of valid responses for that item. The objective information was based on the following clinical indices: Decayed, Missed, Filled Teeth (DMFT) Index and its components (Decayed [DT]; Missing [MT] and Filled [FT] teeth; Gingival Index (GI); Simplified Debris Index (DI-S); Simplified Calculus Index (CI-S); Simplified Oral Hygiene Index (OHI-S); Trauma Index; and Occlusal Status. The primary outcome was missing teeth (MT≥1). The prevalence of the other dental indices were used as exploratory secondary outcomes. Bivariate analyses using Wilcoxon rank test, Pearson’s Chi-square test, or Fisher’s exact test for contingency tables larger than 2x2 were
performed to assess the correlation between OHIP-14 severity/extent scores, as well as global questions, and the clinical findings. Logistic regression models were then used to adjust the associations for potential confounders, such as brushing and flossing frequency, smoking habits, avoiding dental care due to cost, avoiding recommended care due to cost, dental check-up frequency, date of the last dental visit, marital status, level of education and employment status. This information was collected from the demographic and behavioural questions that were included at the end of the questionnaire. Sample size calculation was performed for a larger study. Using missing teeth as the primary outcome, the power calculation allowed detection of an Odds Ratio of 1.53, which is equivalent to a Cohen's d around 0.25 in a sample of 150 patients. Statistical significance was set at 5% and analyses were carried out using SAS 9.2 (SAS institute Inc., Cary, NC).

**Ethical considerations:** All participants signed a written consent. This study was approved by the Research Ethics Boards of the Hospital for Sick Children (Protocol No 1000032247) and the University of Toronto (Protocol No. 30064).

**RESULTS**

**Participants’ descriptive characteristics:** A total of 149 participants (mean age: 40.3±6.8 years; 12 from the TARGet Kids! and 137 from the Faculty of Dentistry) agreed to participate in the study. Their demographic, behavioural and clinical characteristics are presented in Table 1. The majority of the participants were female (79.2%), living in the same household (79.9%), employed (55.7%), and had a post-secondary education (69.1%). Although the majority of them reported brushing their teeth at least twice a day (86%), less than half reported flossing more than 5 times each week (42.3%). A dental visit within the last year was reported by 59.7%, albeit only 38.3% reported regular dental
visits. Cost was reported as a barrier for visiting a dentist or completing a dental treatment in 36.9% and 34.2% of patients, respectively. Only 14.1% of participants were smokers. A majority of the participants had no history of trauma (92.6%) and acceptable occlusion (69.1%) according to standards from the Canadian Health Measures Survey (CHMS)\textsuperscript{29}. More than half of the parents presented a good oral hygiene index (54.4%) and mild gingivitis (89.3%), debris (73.2%) and calculus (66.4%). The prevalence of caries experience in the sample was 93.3% (mean 9\pm6.2), from those 46.3% had untreated caries (mean 1.2\pm2), 45.6% had missing teeth (mean 1.7\pm2.9) and 84.6% had filled teeth (mean 6.1 \pm 5; Table 1).

Overall impacts of oral conditions on the study participants’ OHRQOL were frequent (Table 2). Almost a quarter of participants reported impacts of oral issues on their quality of life (overall OHIP-14 prevalence of 23.5%). The mean extent score of 0.5 \pm 1.3 indicated that severe impacts were not frequently observed, while the mean severity score 5.6\pm8.1 highlighted that most of impact appeared to be of low severity on each performance. In general, the sum of the prevalence of all the disability domains was high (24.8%), which indicated that one quarter of participants reported some kind of impairment due to the outcomes of oral diseases.

A majority of the participants (71.1%) rated their oral health as good to excellent and were very satisfied or indifferent to the appearance of their teeth (80.5%). Psychological discomfort was the most prevalent subscale; results indicated that almost one-sixth of participants (14.8%) were self-conscious or tense because of problems with their teeth, mouth or dentures. The prevalence of impacts in the other subscales ranged from 1.3%
(physical pain) to 8.7% (physical disability) and very low extent and severity scores were observed in all OHIP-14 subscales.

The prevalence of floor effects, or the percentage of subjects having total scores of zero was 41.6% for the overall OHIP-14, while no impact of oral conditions on general oral health and on general wellbeing was observed in 5.4% and 15.4% of participants, respectively. No subject with maximum scores, namely ceiling effects, was identified (Table 2).

**Associations between OHRQOL measures and clinical variables:** Tables 3 and 4 and Figures 1 and 2 present the results of the most important observed associations. Significant associations were observed between the OHRQOL measures and the primary outcome (MT≥1), as well as with a secondary outcome (DT≥1) at the bivariate level. After adjustment for confounders, DT≥1 and MT≥1 remained strongly associated with at least one fairly/very often impact on general oral health (OR=1.8, 95% CI=1.7, 4.3 and OR=2.8, 95% CI=1.2, 6.6, respectively), while MT≥1 alone was associated with worse general oral health and wellbeing (OR=2.2, 95% CI=1.4, 3.5; OR=2, 95% CI=1.2, 3.1, respectively). In the OHIP-14 questionnaire, MT≥1 was associated with at least one fairly/very often impact on the general quality of life (OR=1.75; 95% CI=1.09-2.79) and physical disability (OR=4.9, 95% CI=1.3, 18.1). MT≥1 was also associated with worse general quality of life (OR=1.1; 95% CI=1, 1.2), limitations in the function of the mouth (OR=1.7, 95% CI=1.1, 2.5), pain (OR=1.5, 95% CI=1, 2.1), and worse levels physical (OR=1.5, 95% CI=1, 1.9), psychological (OR=1.4; 95% CI=1, 1.8), and social (OR=1.4, 95% CI=1.1, 1.7) disabilities. No significant associations were observed between the extent/severity scores of the OHIP-14 questionnaire and global questions, and clinical
findings such as caries experience, filled teeth, dental trauma, malocclusion, gingivitis, debris, calculus an oral hygiene status.

DISCUSSION

The most prevalent findings observed in this study were the significant although weak associations between the primary outcome and the OHIP-14 scores. These general weak associations are in accordance with findings from previous studies comprising older adults\textsuperscript{10, 64, 82, 148}, suggesting that some subscales do not identify common oral conditions\textsuperscript{160}, such as dental caries and periodontal diseases, since their chronic nature may not severely impact the individual quality of life\textsuperscript{148}. On the other hand, the impact of tooth loss due to caries was moderately associated with functional limitations in the mouth and also with a moderate chronic impact on the general quality of life. It is worth noting that 1 in 6 participants reported some psychological discomfort as consequence of missing teeth, which may reflect the concept that the instrument focuses on outcomes from the psychosocial domains. The strongest observed association suggested that patients with missing teeth were almost 5 times as likely to have at least one fairly/very often impact on the physical disability domain, when compared with patients with no missing teeth. In accordance, previous studies indicated that about half of the items are concentrated on relatively severe consequences of the diseases\textsuperscript{160, 162}, which are less prevalent in the general population\textsuperscript{142}. Appropriately, the prevalence of reported severe impacts tends to be very low\textsuperscript{160}, which may distinguish the OHIP-14 as a potential tool in assessing priorities of care in disadvantaged populations\textsuperscript{75}. Despite this strong association, the large width of the CIs suggests an uncertainty about the position of the point estimate and thus about the clinical significance of the difference\textsuperscript{146}, although it
cannot be argued that there was not enough precision to evaluate the utility of the instrument\textsuperscript{147}.

Almost a quarter of the participants (23.5\%) reported 1 or more \textit{fairly often} or \textit{very often} impact of oral conditions of their daily activities, however the mean number of impacts reported was very low (0.51), which may be explained by the 46\% who reported only a single impact, among those who reported any impact. These findings are in accordance with a Canadian population study, in which the prevalence score observed was 19.5\% with also a low mean number of impacts (0.49), due to a single impact reported in almost half of the affected individuals (49.1\%)\textsuperscript{160}. Moreover, almost no difference was observed between the severity scores observed in these two studies (5.58 or 10\% of the scale range and 4.9 or 9\% of the scale range). Since the OHIP-14 items were developed in order to hierarchically encompass both mild and severe oral health-related impacts, some decrease in its sensitivity to minor issues is to be expected and should not be a concern from the public health perspective\textsuperscript{143}.

The prevalence of floor effects, namely the percentage of subjects having total scores of zero, was high (41.6\%), when compared with studies in which the size of the sample population ranged from 173 to 225 participants, such as 3.6\%\textsuperscript{163}, 6.0\%\textsuperscript{164} and 30.2\%\textsuperscript{142}. However, it was about half of the values observed in large population-based studies in Canada (80\%)\textsuperscript{160}, England (84\%) and Australia (81.8\%)\textsuperscript{143}. High prevalence of floor effects is commonly observed in population-based studies in developed countries, where most participants are more likely to have acceptable levels of oral health\textsuperscript{143}. Since participants from this study were not regular dental patients but caregivers of children
who were attending the paediatric clinic, no preference was given to any specific oral condition or demographic characteristic, as it is observed in the general population.

This study has some limitations. Firstly, due to its cross-sectional design, it was not possible to quantify risks in order to draw any inference regarding causal associations. Secondly, although this study’s approach to enroll a convenience consecutive sample helped to minimize volunteerism\textsuperscript{116}, it reduces the generalizability of the results. Thirdly, given the low prevalence of some of the clinical findings, the statistical testing may have underestimated the significance and strength of the observed associations.

Having acknowledged these limitations, this study has been strengthened by the use of a single WHO-trained and calibrated examiner, and contributes to dental public health, since it evaluated a specific questionnaire (OHIP-14) for a specific purpose (identify patients most in need of dental treatment). Accordingly, one of the objectives of the national oral health guiding plan, namely The Canadian Oral Health Framework 2013-18 (COHF) is the identification of “…some areas of opportunity to engage with other health and public sectors to improve the oral health of Canadians – especially the subpopulation of Canadians who suffer from a disproportionate burden of oral disease\textsuperscript{30}. In a health care scenario with financial constraints, the application of OHRQOL measures in healthcare settings in order to identify the burden of oral conditions in disadvantaged populations may be an effective way to draw policymakers’ attention to issues related to access to dental care and oral health disparities at a low cost\textsuperscript{70}. It is an opportunity to capitalize on the potential strength of the OHIP-14 in providing information that may be used as baseline data in epidemiology surveys, as well as for resource allocation and access to dental care, the outcomes of which may change the oral health trajectory of a
significant number of people, whose oral health status affects their quality of life. More studies are needed to investigate the usefulness of OHRQOL tools in collecting systematic oral health data for the ultimate goals of evaluating disease trend and the effectiveness of public programs, by means of a standard comparison with other health care systems\textsuperscript{165}.

**CONCLUSION**

In addition to other studies that have consistently reported significant associations between the OHIP-14 scores and missing teeth in older adults\textsuperscript{10, 64, 157}, this study’s findings suggest that similar associations are observed in younger adults. The observed high prevalence of impacts in the disability domains suggests a concentration of items on relatively severe consequences of the oral conditions, which reinforces the discriminant behaviour of the tool. The significance of the association between the OHIP-14 scores and missing teeth may emphasize the negative impact of tooth loss on people’s quality of life, and bring attention to the importance of natural teeth to general wellbeing. Future clinical research with larger samples is further needed in order to investigate the discriminative property of the OHIP-14.

**Acknowledgements:**

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Table 1: Demographic, behavioural and clinical characteristics of the sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>% of respondents</th>
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<tbody>
<tr>
<td><strong>Demographic Characteristics</strong></td>
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<tr>
<td>Mean Age (SD) – Years</td>
<td>40.3±6.8*</td>
</tr>
<tr>
<td>Gender (Female)</td>
<td>79.2</td>
</tr>
<tr>
<td>Conjugal Status (Living together)</td>
<td>79.9</td>
</tr>
<tr>
<td>Employment Status (Not employed)</td>
<td>55.7</td>
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<tr>
<td>Level of Education (&lt;Degree or diploma)</td>
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</tr>
<tr>
<td>• Complete secondary</td>
<td>30.9</td>
</tr>
<tr>
<td>• &lt; Complete secondary</td>
<td>82.6</td>
</tr>
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<td></td>
<td>17.4</td>
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<td><strong>Behavioural Characteristics</strong></td>
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<td>Brushing ≥2x/day</td>
<td>85.9</td>
</tr>
<tr>
<td>Flossing ≥5x/week</td>
<td>42.3</td>
</tr>
<tr>
<td>Making regular preventive dental visits</td>
<td>38.3</td>
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<tr>
<td>Last dental visit &lt; 1 year ago</td>
<td>59.7</td>
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<tr>
<td>Avoid dental care due to cost</td>
<td>36.9</td>
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<tr>
<td>Avoid recommended dental care due to cost</td>
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<td>Smoker</td>
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<td>Time taken away from work</td>
<td>16.1</td>
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<td><strong>Clinical Characteristics</strong></td>
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<td>Presence of trauma</td>
<td>7.4</td>
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<tr>
<td>Malocclusion</td>
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<td>Oral Hygiene Index – Good</td>
<td>54.4</td>
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<td>Gingival Index – Mild</td>
<td>89.3</td>
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<tr>
<td>Debris Index – Mild</td>
<td>73.2</td>
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<tr>
<td>Calculus Index – Mild</td>
<td>66.4</td>
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<tr>
<td>Decayed, missing, filled teeth - Mean ± SD = 9.02 ± 6.22</td>
<td>93.3</td>
</tr>
<tr>
<td>Decayed teeth - Mean ± SD = 1.20 ± 1.95</td>
<td>46.3</td>
</tr>
<tr>
<td>Missing teeth - Mean ± SD = 1.70 ± 2.94</td>
<td>45.6</td>
</tr>
<tr>
<td>Filled teeth - Mean ± SD = 6.12 ± 4.99</td>
<td>84.6</td>
</tr>
</tbody>
</table>

*Mean and standard deviation. Data about the ethnicity of the sample were not collected.
Table 2: Descriptive statistics of the prevalence, extent and severity of impacts of oral condition on the quality of life of participants according to global questions and OHIP-14 scores.

<table>
<thead>
<tr>
<th></th>
<th>Prevalence (%)</th>
<th>Mean Extent Score ± SD (Range)</th>
<th>Median Extent Score (IQ Range)</th>
<th>Mean Severity Score ± SD (Range)</th>
<th>Median Severity Score (IQ Range)</th>
<th>Floor Effects (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Oral Health</td>
<td>28.9%</td>
<td>0.3 ± 0.5 (0, 1)</td>
<td>0 (0,1)</td>
<td>2.1 ± 1 (0, 4)</td>
<td>2 (1,3)</td>
<td>5.4</td>
</tr>
<tr>
<td>General Wellbeing</td>
<td>19.5%</td>
<td>0.2 ± 0.4 (0, 1)</td>
<td>0 (0,0)</td>
<td>1.5 ± 1 (0, 4)</td>
<td>1 (1,2)</td>
<td>15.4</td>
</tr>
<tr>
<td>Overall OHIP</td>
<td>23.5%</td>
<td>0.5 ± 1.3 (0, 11)</td>
<td>0 (0,0)</td>
<td>5.6 ± 8.1 (0, 49)</td>
<td>2 (0,8.5)</td>
<td>41.6</td>
</tr>
<tr>
<td>Functional Limitation</td>
<td>3.4%</td>
<td>0 ± 0.2 (0, 1)</td>
<td>0 (0,0)</td>
<td>0.5 ± 1.2 (0, 6)</td>
<td>0 (0,0)</td>
<td>82.6</td>
</tr>
<tr>
<td>Pain</td>
<td>1.3%</td>
<td>0 ± 0.1 (0, 1)</td>
<td>0 (0,0)</td>
<td>0.6 ± 1 (0, 5)</td>
<td>0 (0,1)</td>
<td>68.5</td>
</tr>
<tr>
<td>Psychological Discomfort</td>
<td>14.8%</td>
<td>0.2 ± 0.4 (0, 2)</td>
<td>0 (0,0)</td>
<td>1.5 ± 2.1 (0, 8)</td>
<td>0 (0,3)</td>
<td>58.4</td>
</tr>
<tr>
<td>Physical Disability</td>
<td>8.7%</td>
<td>0.1 ± 0.4 (0, 2)</td>
<td>0 (0,0)</td>
<td>0.9 ± 1.6 (0, 8)</td>
<td>0 (0,2)</td>
<td>68.5</td>
</tr>
<tr>
<td>Psychological Disability</td>
<td>4.0%</td>
<td>0.1 ± 0.3 (0, 2)</td>
<td>0 (0,0)</td>
<td>0.7 ± 1.5 (0, 8)</td>
<td>0 (0,0)</td>
<td>77.2</td>
</tr>
<tr>
<td>Social Disability</td>
<td>8.1%</td>
<td>0.1 ± 0.3 (0, 2)</td>
<td>0 (0,0)</td>
<td>1 ± 1.8 (0, 8)</td>
<td>0 (0,2)</td>
<td>67.8</td>
</tr>
<tr>
<td>Handicap</td>
<td>4.0%</td>
<td>0.1 ± 0.2 (0, 2)</td>
<td>0 (0,0)</td>
<td>0.4 ± 1 (0, 7)</td>
<td>0 (0,0)</td>
<td>82.6</td>
</tr>
</tbody>
</table>

Note: IQR: Inter-quartile range
Table 3: Global questions and overall OHIP-14 and subscales severity and extent scores, and their association with missing teeth

<table>
<thead>
<tr>
<th>Participants with missing teeth (MT ≥ 1) vs. those with no missing teeth (MT=0)</th>
<th>Severity (simple sum of ordinal response codes to all items)</th>
<th>Extent (Report of at least one fairly/very often impact)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UOR (95% CI)</td>
<td>AOR (95% CI)</td>
</tr>
<tr>
<td>General oral health</td>
<td>2 (1.4, 2.8)</td>
<td>2.2 (1.4, 3.5)</td>
</tr>
<tr>
<td>General wellbeing</td>
<td>1.8 (1.3, 2.6)</td>
<td>2 (1.2, 3.1)</td>
</tr>
<tr>
<td>General quality of life</td>
<td>1.1 (1, 1.2)</td>
<td>1.1 (1, 1.2)</td>
</tr>
<tr>
<td>Functional Limitation</td>
<td>1.7 (0.2, 2.5)</td>
<td>1.7 (1.1, 2.5)</td>
</tr>
<tr>
<td>Pain</td>
<td>1.4 (1, 1.2)</td>
<td>1.5 (1, 2.1)</td>
</tr>
<tr>
<td>Psychological Discomfort</td>
<td>1.2 (1, 1.4)</td>
<td>1.2 (1, 1.4)</td>
</tr>
<tr>
<td>Physical Disability</td>
<td>1.5 (1.2, 2)</td>
<td>1.5 (1.1, 1.9)</td>
</tr>
<tr>
<td>Psychological Disability</td>
<td>1.4 (1.1, 1.8)</td>
<td>1.4 (1, 1.8)</td>
</tr>
<tr>
<td>Social Disability</td>
<td>1.4 (1.1, 1.7)</td>
<td>1.4 (1, 1.7)</td>
</tr>
<tr>
<td>Handicap</td>
<td>1.7 (1.1, 2.6)</td>
<td>1.6 (1, 2.6)</td>
</tr>
</tbody>
</table>

Note: UOR: Unadjusted Odds Ratio; AOR: Adjusted Odds Ratio controlling for brushing and flossing frequency, smoking habits, avoiding dental care due to cost, avoiding recommended care due to cost, dental check-up frequency, date of the last dental visit, marital status, level of education and employment status.
Table 4: Global questions and overall OHIP-14 and subscales severity and extent scores, and their association with untreated caries.

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Severity (Simple sum of ordinal response codes to all items)</th>
<th>Extent (Report of at least one fairly/very often impact)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
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<td>General quality of life</td>
<td>1 (1, 1.1)</td>
<td>1 (1, 1)</td>
</tr>
<tr>
<td>Functional Limitation</td>
<td>1.4 (1, 1.8)</td>
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<td>1 (0.8, 1.6)</td>
</tr>
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<td>Psychological Discomfort</td>
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<td>1 (0.9, 1.2)</td>
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<td>Physical Disability</td>
<td>1.2 (1, 1.5)</td>
<td>1.1 (0.9, 1.4)</td>
</tr>
<tr>
<td>Psychological Disability</td>
<td>1.1 (0.9, 1.4)</td>
<td>1.1 (0.8, 1.4)</td>
</tr>
<tr>
<td>Social Disability</td>
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Note: UOR: Unadjusted Odds Ratio; AOR: Adjusted Odds Ratio controlling for brushing and flossing frequency, smoking habits, avoiding dental care due to cost, avoiding recommended care due to cost, dental check-up frequency, date of the last dental visit, marital status, level of education and employment status.
Figure 1: Associations between the OHIP-14 scores and missing teeth

Figure 1: Forest plot representing a total picture of the various CIs and point estimates representing the overall effect of the observed associations between the OHIP-14 scores and missing teeth in the sample population.
Figure 2: Associations between the global questions scores and missing teeth

Figure 2: Forest plot representing a total picture of the various CIs and point estimates representing the overall effect of the observed associations between the global questions scores and missing teeth in the sample population.
CHAPTER 3

3. Discussion

This cross-sectional observational study presents objective and subjective information concerning the oral health status of children who were routine patients at the Faculty of Dentistry, University of Toronto, and from the TARGet Kids! research network, as well as their caregivers. The study’s findings reinforce current dental literature data regarding the association between the oral health status of children and caregivers and draws attention to the role of OHQOL tools to monitor trends in oral health. Three specific objectives were met:

1) The first objective was to investigate the association between the oral health of caregivers and children. It was found that children whose caregivers had missing teeth were more likely to have more active lesions in both primary and permanent teeth than were children whose caregivers had no missing teeth due to caries;

2) The second objective was to investigate if parental perceptions of the impact of oral diseases on children or their families corresponded to their oral health status. Emotional and social wellbeing were strongly associated with at least one fairly/very often impact on untreated caries in both primary and permanent teeth, although the large width of the CIs may suggest some uncertainty about the precision of the point estimate.

3) The third objective was to investigate the association between caregivers’ oral health and their own perceptions of OHRQOL, using self-reported answers from the OHIP-14-14 questionnaire. The most important finding was the strong
association between tooth loss and the extent score of the physical disability domain, suggesting that patients with missing teeth are almost 5 times as likely to experience chronic disability, when compared with patients with all teeth present in the mouth.

The interpretation of the strength of the associations was based on the “Guide to strength of association” proposed by Richard Monson\textsuperscript{166}, and is described bellow:

**Odds Ratio  Strength of the Association**

1.0 – 1.2          None

1.2 – 1.5          Weak

1.5 – 3.0          Moderate

3.0 – 10.0         Strong

> 10               Infinite

**3.1. Sample general findings**

The consecutive nature of the sample favoured the inclusion of all subjects who voluntarily agreed to participate in the study during the period of data collection. A total of 171 children and 163 caregivers were included in the study. Eight children had a sibling included in the study. Therefore, the younger child was excluded from the sample to avoid the use of complex models for intra-cluster statistical analysis and 163 children-caregiver dyads remained. After the oral examination, 2 dyads were excluded from the sample due to insufficient teeth for the calculation of the GI, DI-S, CI-S and OHI-S.
Finally, after the assessment of the OHRQOL questionnaires, 12 more dyads were excluded and the final sample comprised a total of 149 dyads.

The prevalence of employed caregivers (55.7%) was very similar to the one observed in the CHMS\textsuperscript{29} (58.3%), as were caregivers with at least a college education (69.1% vs. 76%, respectively). A further analysis of the education level of caregivers demonstrated that the group with less than a college education comprised 46 caregivers from which 38 (82.6%) had a complete secondary education (Table 1; Manuscript 1). Although no functional health literacy measure was performed, such level of formal education, along with the age of caregivers, may have limited the adverse influence of health literacy on the self-report of oral health outcomes\textsuperscript{167}. Univariate analysis also showed that caregivers’ ages ranged from 25 to 56 in 98.7% of this study’s population (mean of 40.3), which make it possible to compare against the demographic and behavioural characteristics of the adult population from the CHMS, using the 20/39-40/59 age range. The CHMS data was also used as a reference to compare results within children groups, although it is important to note that the National survey did not include children younger than six years.

The observed prevalence of caries-experience (79.2%) and of untreated caries (32.9%) in both primary and permanent teeth in the children group decrease, although not much, if only the 6-11 year-olds are considered (78.2% and 30.8%, respectively). These findings are higher than the 56.8% and 4.7% observed in the same age group from the CHMS\textsuperscript{29}. On the other hand, the observed prevalence of caries experience and untreated caries in the primary dentition decrease substantially from 74.5% to 54% and from 28.9% to 19% when the three to five year-olds were excluded from the sample, which are closer to the
47.8% and 14.1% from the CHMS survey. The prevalence of filled teeth in all primary, permanent and mixed dentitions presented lower values when compared to the CHMS (62.4% vs. 82.4%; 17.4% vs. 82.0% and 67.8% vs. 82.3%, respectively). These findings may be attributed to the lower frequency of dental visits (35.7%) compared to the 92.2% of the CHMS, along with children’s insurance status, since 50.3% of children in the current study were uninsured compared to only 21.7% from the general Canadian population\textsuperscript{29}.

The prevalence of caries experience in the caregivers group (93.3%) is within the range of caries experience for the 20/39-40/59 year-old group in the CHMS (91.2-98.8\%)\textsuperscript{29}, although DMFT components in this study presented higher prevalence scores when compared to the National survey: DT 46.3\% (18.5\%-22.5\%), MT 45.6\% (5.7\%-19.6) and FT 84.6\% (76.7\% - 82.4\%).

In terms of OHRQOL, 28.2\% of caregivers reported that their children had fair or poor general oral health because of problems with their mouths compared to 8.2\% of reports from the CHMS. In the caregivers group, fair or poor oral health was reported in 28.9\% of questionnaires, compared to 17.4\% from the Canadian survey. These differences may be due to the higher prevalence of untreated decay observed in both children and caregivers groups when compared to the CHMS findings\textsuperscript{29}.

At the time when the P-CPQ and OHIP-14 were developed and validated, a \textit{don't know} statement was included as a response option\textsuperscript{82, 84}. Therefore, questionnaires with \textit{don't know} responses were analysed according to references from literature. The authors of the P-CPQ argued that a \textit{don't know} option is essential when proxy perceptions of health or
OHRQOL are evaluated and recommended that it should be analysed as a score 0 (no impact), since such approach does not seem to impact the questionnaire’s performance. On the other hand, excluding questionnaires with the aforementioned responses may lead to loss of valuable information. Moreover, once giving subjective information is a memory-dependent task, not being able to recall the answer to the item may indicate no or low impact of oral diseases on the respondent quality of life. The don’t know responses in the OHIP-14 were entered as missing values and replaced with the mean value of valid responses for that item if no more than 2 were founded. The questionnaire was excluded if 3 or more items contained missing values.

The general purpose of this study was to perform a descriptive and exploratory evaluation of the association between common dental conditions in children and caregivers, and their impact on the quality of life of these patients. Its ultimate goal was to evaluate the feasibility of OHRQOL tools in providing subjective information about the oral health status within this group. Untreated dental caries was defined as the primary outcome in manuscripts 1 and 2 due to the high prevalence and impact of the disease in children. For manuscript 3, the primary outcome, namely, missing teeth is identified in the literature as the most severe consequence of dental caries in adults. Conjointly, poorer maternal oral health outcomes, such as gingival inflammation and clinical findings such as dental plaque, along with poor oral hygiene practices and level of education predicted poorer oral health outcomes in children. Therefore, other clinical indices were collected from caregivers and children and included as secondary outcomes for an exploratory analysis. It is worth noting that the OHIP-14 and the P-CPQ were developed.
to capture the impacts of general oral diseases on the individual’s quality of life\textsuperscript{75}, which allowed the statistical analysis of oral health indices other than the DMFT scores.

3.1. Assessing the association between the oral health status in children and caregivers

The association between caregivers’ and children’s oral health status was investigated based on the premises about the influence of adverse early life events on dental caries onset, and the interactions between caregivers and children that positively or negatively affect children’s oral health outcomes. Aside from the strong observed associations with secondary outcomes, caregivers’ missing teeth were moderately associated with the study’s primary outcome (dt+DT in children), which is in accordance with a longitudinal study in Norway that observed an association between missing teeth in caregivers and the subsequent development of carious lesions in their children\textsuperscript{117}.

In this regard, findings from this study corroborate the current scientific position that dental public strategies to improve the oral health of children should also target at improving caregivers' oral health\textsuperscript{97}, since it is argued that improving oral health in caregivers may result in significant reductions in dental caries experience among children throughout generations\textsuperscript{97}.

3.2. Assessing the association between proxy perceptions of OHRQOL and oral health status in children.

This study’s overall P-CPQ mean severity score (11.76, SD=11.73) is lower than the mean severity score observed in another study involving children with extensive dental disease (25.9, SD=16.1)\textsuperscript{126}. On the other hand, a lower impact frequency was also
observed in an Australian study (11.6±11.2), in which a complex strategy to obtain a diverse and representative sample of the general population was employed\textsuperscript{145}. Similarly, the sample population of this study was also not representative of any special social group or oral condition.

The calculation of extent scores for each domain was included in this study in order to compensate the inability of the severity score to identify different profiles. For instance, a score 8 would be either the sum of 8 items marked as 1 or of 2 items marked as 4. Despite the same total score, the latter has two daily activities \textit{everyday/almost everyday} affected by oral conditions, while in the former the frequency is only \textit{once or twice}. The inclusion of the extent scores indicates the number of high frequency impacts in addition to the severity of the impact\textsuperscript{90}.

Another important point that needs to be considered is that the range of each dependent variable in the study. For instance total DMFT and each of the D, M, F component scores was also reduced by dichotomization, due to the skewed distribution of the oral conditions. This procedure might have attenuated the significance level of some associations, leading to further underestimation of effect sizes\textsuperscript{140}.

In addition to the strong observed associations between untreated caries and the wellbeing domains in the P-CPQ, strong associations were also observed between global questions and various dental findings in the children group. Although it has been argued that global questions are the best indicators of the quality of life\textsuperscript{170}, the relationship between clinical and non-clinical variables in relation to OHRQOL was systemically tested and no association was observed between global oral health perceptions and
subjective wellbeing\textsuperscript{171, 172}. Moreover, it was observed that global questions do not provide information about which oral health perspective was affected by the disease. For instance, some people focus on the physical state to answer the question, while others on the emotional wellbeing domain. The study concluded that global oral health perceptions should not be interchangeably used as an OHRQOL information\textsuperscript{173}.

This study’s weak associations between some clinical parameters in children and parental perceptions of their oral health was not unexpected, since OHRQOL tools were not designed specifically as predictive indices\textsuperscript{10}. Moreover, it seems clear that patient-centered subjective measures are not able to identify objectively defined treatment needs, while dentist-centered clinical exams will not normatively identify what is subjectively perceived\textsuperscript{174}. It is important to note though, that the ideal assessment of oral health issues includes the identification of the biological and social factors that will influence the effectiveness of the treatment\textsuperscript{175}.

From the dental public perspective, the results from this study raise relevant questions. The observed high prevalence of floor effects reinforces the assumption about the inability of the instrument to detect minor oral health-related impacts on daily activities, which may highlight health disparities among vulnerable populations\textsuperscript{10, 150}. Based on this argument, a closer look at the results for dmft+DMFT and dt+DT when analysed against the P-CPQ scores shows important differences between the severity and the extent score values. While the associations for the severity scores follow a constant pattern of significance, it cannot be said that an association exists, since the effect size is weak, and the CI range is extremely narrow and close to 1, which is very close to a no association. In short, it is very likely that this is the real value and strength of the associations. On the
other hand, most of the extent scores, although non-significant, present wide confidence intervals and moderate to high effect sizes. Therefore, it can be argued that the association was influenced by a random error that may disappear in further studies with larger sample sizes. It is worth noting that the extent scores represent the number of the most severe reported impacts, which may affect just a small portion of the total population.

The aforementioned discussion about changes in point estimates and CI leads to the hypothesis about the influence of socio-demographic factors as confounders. As expected, some significant correlations were not able to retain their significance after the statistical adjustments for demographic and behavioural factors were performed. In contrast, the odds of caregiver with missing teeth children having caries experience increased from 6 to 7 times in mixed dentitions and from 5.4 to 6.2 times in primary dentitions. These findings reinforce the concept that not only were biological factors responsible for the observed associations between children and caregivers, but also the behavioural and social characteristics at the family level.

3.3. Assessing the association between self-perceptions of OHRQOL and oral health status in caregivers

Findings from the analysis of the relationship between the OHIP-14 scores and the oral health status of caregivers showed relatively weak associations. The most important observed findings were the association between missing teeth in caregivers and the overall OHIP-14 and subscales severity scores. These findings are in accordance with previous studies that reported significant but weak associations between the overall
OHIP-14 and subscales scores and missing teeth in older adults. Special consideration should be given to the significant associations between missing teeth and the extent and severity scores of the general oral health and wellbeing. Likewise, the physical disability subscale also appeared as the stronger association in Locker and Slade, 1994. Overall, findings from a systematic review and meta-analysis of observational studies provided fairly strong evidence that tooth loss negatively affects quality of life, independently of the OHRQOL measurement applied.

3.4. OHRQOL measurements - potential uses

The impact of socio determinants of health on the prevalence and incidence of dental caries is undeniable and strategies toward health promotion and disease prevention should focus on certain subgroups in need of special attention. An early identification of this high-risk group would lead to a more controlled and supervised assistance to prevent further disease progression at the population level.

The concept of OHRQOL has emerged to address the objective and the subjective aspects of oral health, by incorporating the impact of social, psychological and cultural influences on daily activities. OHRQOL measurements are currently included in oral health surveys and clinical studies to identify perceived needs, by means of subjective measures, in a multidimensional construct. It is a bi-directional approach that identifies the impact of the disease on the individual’s quality of life and the interaction of factors that contribute to disease progression. It is nowadays recognized as a health priority due to its valuable contribution to the assessment of perceived needs in population surveys. Once normative needs are identified, findings from the perceived needs assessment might be used either
as a strategy to prioritize resources or to improve a patient’s oral health. If the question is *who to be treated?*, then questionnaires with good discriminant properties should be considered. However, if *what to be treated?* is the strategy, the focus should be on the identification of patient-centered factors that might improve oral health. For instance, the Oral Impact on Daily Performance (OIDP) has a very distinctive role in population surveys, while the OHIP-14 assesses care priorities, evaluates dental treatment and provides relevant data for advocating for oral health\textsuperscript{122}.

OHRQOL questionnaires have been used to evaluate qualitative changes and the positive impact of dental treatment on the general health of the patient. For instance, changes in the OHRQOL were observed in a study involving preschool children with ECC, in which proxy and self-reports about OHRQOL were used as baseline data. Results indicated that the initial low OHRQOL observed in the case group was significantly improved after treatment according to differences in the questionnaires scores\textsuperscript{124}.

The selection of OHRQOL tools should be based on their performance and properties, as well as on the goals of the assessment. The P-CPQ, FIS and OHIP-14 instruments were investigated on the grounds of their good construct validity, good internal consistency reliability, and excellent test-retest reliability as an option to identify oral health needs that go beyond the lenses of the traditional dental exam\textsuperscript{176}. For assessment of children’s OHRQOL, the P-CPQ was chosen based on the assumption that caregivers are the most important actors in their children’s process of care\textsuperscript{70}. It should be emphasized that the limited knowledge some caregivers may have concerning their children’s OHRQOL\textsuperscript{71} does not lessen the importance of their reports for paediatric research\textsuperscript{125}, since their perceptions will determine health care and utilization standards\textsuperscript{70}. Hence, parental
perceptions are a good proxy of children’s OHRQOL irrespective of the extent to which they reach a level of significant agreement. Additionally, these validated questionnaires may alert caregivers about any gaps in their children’s oral health.

The use of OHRQOL data has been advocated as a means to complement the objective clinical exams since the use of only normative methods for assessment of the population’s dental needs often provide a non-realistic estimate of resources. Moreover, subjective information based on patients perspectives would highlight health disparities among vulnerable populations that would not be identified by objective assessments of need. Taking into consideration the present Canadian environment of economic austerity often defined by the mantra of “no new dollars” for dental public health, the use of these patient-centered information - along with the clinical examination - would help identify those patients most likely to benefit from dental care.

Implementation of a periodic needs assessment using OHRQOL questionnaires might provide valuable data to support healthcare providers involved with planning oral health policy and care. The use of systematic information about disease prevalence and trends would be an effective mechanism to communicate with policy makers about the importance of oral health and equal access to care. If subjective information is considered during the health care decision-making process, more attention will be given to basic values in social policy that determine the empowerment of the population against health inequities. Since the ultimate goal of oral health policies is to improve the oral health of the population, the use of patient-centered surveys would enable the quantification of subjective information for evaluation purposes, more importantly, a shift from the evaluation of healthcare outcomes to the evaluation of health outcomes.
Despite the vast dental literature about OHRQOL, some points are still controversial. Some confusion still exists about the difference between subjective health status and HRQOL. The former offers a description of a person’s current status, while the latter offers a description of a person’s current status and a subjective evaluation of that status. Moreover, the concept of HRQOL seems to go beyond the role of health care. Health care aims to improve the individual’s health status by means of interventions that remove potential barriers to a good quality of life; yet quality of life is an unpredictable consequence. It is argued that this confusion is a consequence of the model of oral health proposed by Locker (1988), which influenced research designs, public policies and clinical practice afterwards. Although it is claimed that Locker’s model is in accordance to the new concept of health, it illustrates ill-health by means of a unidirectional and linear design with a focus on the consequences of oral disability and no positive impact of the mouth on daily activities. This unidirectional approach is contrary to the concept of health as a dynamic process that influences and is influenced by individual perceptions that change over time. Some potential misinterpretations are also attributed to the current OHRQOL tools. For instance, an affirmative response to an item means that the problem had occurred with no reference to the patients’ concerns that indeed varies from person to person according to cultural experiences.

Notwithstanding the problems and criticism about the design and use of OHRQOL measurements, the use of subjective indicators are becoming increasingly used in healthcare and policy, as well as in adult dental health surveys. The importance of survey in the dental field is of paramount importance in order to provide reliable
information to draw the attention of policy-makers to the oral health issues of the population182.

3.5. Future directions

There is an urgent need of systematic collection of oral health information in order to assess oral diseases’ trend. Despite their inherent cohort importance, national surveys comprising normative methods for assessment of dental needs in the population require resource and financial investments that contraindicate their periodical implementation182. The use of subjective indicators emerges as a promising alternative for health data collection based on currents concepts of health and social determinants of health. The current study investigated the oral health and OHRQOL associations within the family environment, as well as the use of OHRQOL questionnaires as potential tools for oral health data collection in dental public health, according to proxy perceptions. Weak associations were observed between clinical and OHRQOL information from which no tangible conclusions can be drawn. Future clinical research with larger samples is needed in order to investigate the discriminative strength of the OHRQOL scores to identifying subgroups of the population at most risk of dental caries. In this regard, further studies are needed to evaluate the usefulness of the extent scores in addition to the prevalence and severity scores, as a measure of the impact of oral diseases on OHRQOL. It has been argued that the extent score would enrich the analysis of impacts due to its ability to identify different profiles with the same severity score. On the other hand, the dichotomization of the extent variable might attenuate the significance level of some associations. It is worth noting that some profile inconsistencies are still observed despite
the inclusion of different scoring systems aimed at facilitating the interpretation of OHRQOL findings.

3.5.1. The role of Primary Healthcare Providers

In the Journal of Pediatrics, Vol.36, No.6, June 1950, Rovelstad states:

“Yet, dental disease of children seems to go on unchecked, seemingly involving more children and younger children today than a century ago. […] more and more emphasis is being laid by dental educators upon the need for early dental care of the most complete kind. […] The pediatrician, as the chief consultant for the parents of his patients, is in an excellent position to start the young child down the right road. With this in mind, the pediatrician should be fully acquainted with dental caries as it affects children, and with the most recent information regarding the prevention of this disease” (Rovelstad 1950, p. 687-696).

The mouth can no longer be considered a separate entity from the body. Since the time of birth, the mouth plays an important role in providing the baby all its basic needs. Primary healthcare providers open the baby’s mouth to do all the suctioning even before the baby’s shoulders are out. The baby cries, breathes and is breast-fed. Early signs of a series of childhood viral and bacterial diseases manifest in the mouth, as well as fungal infections and vitamin deficiencies. All the aforementioned procedures are 100% covered by the Canadian public health care system, but yet whose strategies do not include dental care.

Taking into consideration the existing barriers to dental care along with the argument that dental caries “cannot truly be prevented, but rather controlled by a multitude of interventions”, it is argued that dental health strategies should be designed to influence social norms and behaviours by using an established primary health care infrastructure, especially in an environment of publicly financed medical care and privately financed dental care as in Canada.
PHPs are deemed an option to disseminate dental knowledge through oral health education and even oral interventions as a way to reduce dental caries rates in the population\(^9^3\). They are seen as of paramount importance in reducing children's susceptibility to oral diseases since such professionals may work on parent education, community awareness and policy changes\(^1^1\). When access to a dentist is difficult, primary healthcare providers should consider administering risk-based oral health measures\(^9^3\), given that:

- 87% of infants and one-year-olds have office-based physician visits annually while with only 2% have dental visits\(^9^6^\);
- Physician office visits are 190-fold more prevalent than visits to general dentists\(^9^6^\);
- The concept of routine preventive medical care is well accepted as a priority, while dental care was relegated to when there is an obvious problem - primary teeth will "just fall out anyway"\(^5^5^\);
- Caregivers’ bad experiences with a dentist have an impact on their children's dental care\(^5^5^\);
- The medical office is a more familiar place than a dental office\(^5^5^\);
- Patients feel comfortable with the idea of a paediatrician’s performing oral health exams\(^5^5^\).
Some recommendations about preventive oral health interventions in paediatric offices are the establishment of a multi-professional approach to optimize the implementation of oral health practices in medical offices and the establishment of a dental home, as follows:

1. Implementation of a preventive oral health project – Lift the Lip (Appendix 10)

2. Implementation of the oral risk assessment during well baby visits

3. Dietary counseling and oral hygiene instruction to parents

4. Implementation of pilot projects using questionnaires for collection of subjective oral health data
CHAPTER 4

4. Conclusion

This cross-sectional study investigated the interplay between oral health and OHRQOL within the family environment. Accordingly, a comprehensive literature review was performed in order to address the influence of biological, behavioural and social factors on the dental caries process, and comprised the following rationale:

- The concept of vulnerability emphasized that children are positively or negatively modeled by their caregivers within the socioeconomic environment they live;
- The life course approach described the temporal influence of these factors on dental caries progression, as well as the vicious circle that perpetuates the disease throughout generations;
- The complex nature of dental caries reinforces the argument that dental caries “cannot truly be prevented, but rather controlled by a multitude of interventions”; including psychosocial factors within the familial environment;
- Taking into consideration the publicly financed medical healthcare system in Canada, PHP may be deemed in strategies to disseminating dental awareness and prevention.

Firstly, it was investigated the association of the oral health status between children and caregivers. A moderate association was observed between untreated caries in 3 to 12 year-old children and missing teeth in their caregivers. Other dental findings in primary, permanent and mixed dentitions were also associated with tooth loss in caregivers. These findings were in accordance with other dental studies, and corroborate the positive or negative influence of caregivers on children’s oral health outcomes.
Based on this premise and taking into account the concept of vulnerability and the early-life approach, caregivers report about OHRQOL was used to investigate the association between subjective and objective outcomes in both groups.

Caregivers’ perceptions about their children’s OHRQOL were strongly associated with untreated dental caries, especially in the emotional and social wellbeing domains of the P-CPQ and weakly associated with the FIS scores. In the caregiver group, missing teeth were strongly associated with physical disability.

Within the limitations of this study, some inferences can be drawn: public health strategies targeted at improving caregivers’ oral health may result in reductions in dental caries experience across generations and subjective data may be used as an auxiliary measure of oral health in the general population.

Further studies are necessary to investigate the performance of OHRQOL questionnaires as subjective oral health measures for use in oral health care planning initiatives and systematic surveys. For instance, the use of predictive modeling may help build evidence on patient-centered oral health outcomes that may guide the identification of patients whose oral conditions have an impact on the individual daily activities.
APPENDICES

Appendix 1: Scientific Merit of the Study

July 2, 2013

New Ethics Proposals
Office of Research Ethics
McMurrich Building, 2nd floor
12 Queen’s Park Crescent West
Toronto, ON
M5S 1S8

To Whom It May Concern:

This is to inform you that the following study being undertaken by a graduate student has been approved for scientific merit:

Student Investigator: Elaine de Oliveira Cunha Cardoso, currently in the MSe specialty program in Dental Public Health at the Faculty of Dentistry at the University of Toronto

Supervisor: Dr. Amir Azarpazhooh

Title of Proposal: Target Kids! Office based intervention to reduce bottle use in toddlers:
A 6 year follow-up study

External Examiner on the Committee Approving Scientific Merit: Dr. Jonathon Maguire, from the Department of Paediatrics, Faculty of Medicine

(Note: An external examiner from another discipline is chosen by the Associate Dean of Graduate Studies and must be at arm’s length from the work of the principal investigator).

Date of approval of scientific merit: June 27, 2013

In light of this approval by the supervisory committee and the external examiner, I understand that the project can now be submitted for Ethics approval.

Yours Truly,

Ernest Lam
Associate Dean, Graduate & Postgraduate Studies
Appendix 2: Ethics Approval – The Hospital for Sick Children

Research Ethics Board (REB)

The Research Ethics Board for The Hospital for Sick Children is organized and operates according to the principles and practices outlined in the Tri-Council Policy Statement, the ICH Harmonized Tripartite Guidelines: Good Clinical Practice, and Division 5 and the Medical Devices Regulations of the Food and Drug Act as well as the Natural Health Products Regulations of Health Canada. This signed document is in lieu of the Health Canada Research Ethics Board Attestation Form.

Approval & Terms of Agreement

Investigators: Dr. Jonathan Maguire, C. Birken, P. Parkin, M. Mamdani

Study Title: TARGET Kids! office-based intervention to reduce bottle use in toddlers: A 6 year follow-up study

REB File number: 100002247 Level of Continuing Review: II D
Protocol Version Date: March 20, 2013
Consent & Assent Form Version Date(s): Parent/Guardian Research Consent Form (15 Apr 13), Assent Form (29 May 12)
Investigator’s Brochure Version Date: n/a
Other Approved Document Dates: Invitation Letter (Jan 2013), Dental Exam Data Collection Form (13 Feb 12), Participant Information Nutrition and Health Questionnaire (over 6 years old) (15 Jun 12), Oral Health: Impact Profile Child and Parent Oral Health (26 Jun 12)

I agree to carry out the proposed research involving human subjects in accordance with the above-noted guidelines and regulations (as applicable) and using only the REB-approved study protocol and consent/assent forms. I shall notify the division/department head and the REB prior to implementing any amendments in the protocol and consent/assent forms and of any deviations or any changes in study activity. I shall also notify the REB of any unexpected adverse events as per REB guidelines. As applicable, I certify that the research contract and corresponding protocol are consistent and will inform the contract manager of any protocol amendments as required.

I agree that, in accordance with the Personal Health Information Protection Act of Ontario, I am responsible for adhering to all conditions and restrictions imposed by the REB governing the use, security, disclosure, return and disposal of the research subjects’ personal health information. I am also responsible for reporting immediately any privacy breaches to the REB Chair and to Janice Campbell, the Sick Kids privacy officer. I will ensure that the personal health information is used, only as necessary, to fulfill the specific research objectives and related research questions described in this application and approved by the REB.

Signature of Principal Investigator: 

DATE May 30/13

I approve of this research protocol, agree to share responsibility for its proper conduct, and will ensure that the REB is notified of concerns, as appropriate.

Signature of Division/Department Head: 

DATE J Y 13

The REB of the Hospital for Sick Children has reviewed and approved the above-named research study.

Mr. Richard Sugarman, REB Chair
555 University Avenue, Toronto, Ontario, M5G 1X8
Tel: 416-813-6152 Fax: 416-813-5085 Email: richard.sugarman@sickkids.ca

DATE OF APPROVAL: JUL 10 2013 EXPIRY DATE: J U L Y 2 0 1 4

REB Form Version Date: 2008-02-01
Appendix 3: Administrative Review Approval letter

PROTOCOL REFERENCE # 29270
August 20, 2013

Dr. Amir Azarpazhooh
FACULTY OF DENTISTRY

Elaine Cardoso
FACULTY OF DENTISTRY

Dear Dr. Azarpazhooh and Elaine Cardoso,

Re: Administrative Approval of your research protocol entitled, "TARGet Kids! Office based intervention to reduce bottle use in toddlers: A 6 year follow-up study evaluating the impact on oral health status"

We are writing to advise you that the Office of Research Ethics (ORE) has granted administrative approval to the above-named research protocol. The level of approval is based on the following role(s) of the University of Toronto (University), as you have identified with your submission and administered under the terms and conditions of the affiliation agreement between the University and the associated TAHSN hospital:

- Graduate Student research - hospital-based only
- Storage or analysis of De-identified Personal Information (data)

This approval does not substitute for ethics approval, which has been obtained from your hospital Research Ethics Board (REB). Please note that you do not need to submit Annual Renewals, Study Completion Reports or Amendments to the ORE unless the involvement of the University changes so that ethics review is required. Please contact the ORE to determine whether a particular change to the University's involvement requires ethics review.

Best wishes for the successful completion of your research.

Yours sincerely,

Daniel Gyewu
REB Manager
Appendix 4: Delegated Review Approval letter

PROTOCOL REFERENCE # 30064

March 24, 2014

Dr. Amir Azarpazhooh
FACULTY OF DENTISTRY

Elaine Cardoso
FACULTY OF DENTISTRY

Dear Dr. Azarpazhooh and Elaine Cardoso,

Re: Your research protocol entitled, "TARGet Kids! office based intervention to reduce bottle use in toddlers: A 6-year follow-up study evaluating the impact on oral health status"

ETHICS APPROVAL

Original Approval Date: March 24, 2014
Expiry Date: March 23, 2015
Continuing Review Level: 1

We are writing to advise you that the Health Sciences Research Ethics Board (REB) has granted approval to the above-named research protocol under the REB’s delegated review process. Your protocol has been approved for a period of one year and ongoing research under this protocol must be renewed prior to the expiry date.

Any changes to the approved protocol or consent materials must be reviewed and approved through the amendment process prior to its implementation. Any adverse or unanticipated events in the research should be reported to the Office of Research Ethics as soon as possible.

Please ensure that you submit an Annual Renewal Form or a Study Completion Report 15 to 30 days prior to the expiry date of your current ethics approval. Note that annual renewals for studies cannot be accepted more than 30 days prior to the date of expiry.

If your research is funded by a third party, please contact the assigned Research Funding Officer in Research Services to ensure that your funds are released.

Best wishes for the successful completion of your research.

Yours sincerely,

Elizabeth Peter, Ph.D.
REB Chair

Dario Kuzmanovic
REB Manager

OFFICE OF RESEARCH ETHICS
McMurrich Building, 12 Queen's Park Crescent West, 2nd Floor, Toronto, ON M5S 1S8 Canada
Tel: +1 416 946-3273 • Fax: +1 416 946-5783 • ethics.review@utoronto.ca • http://www.research.utoronto.ca/for-researchers-administrators/ethics/
Appendix 5: Consent Form

PARENT/GUARDIAN RESEARCH CONSENT FORM
TARGet Kids! office based intervention to reduce bottle use in toddlers:
A 6-year follow-up study

Investigator(s):
Principle Investigator:
Dr. Amir Azarpazhooh  (416) 979-4900 ext. 4429
Co-investigators:
Dr. Jonathon Maguire(416) 813-2129
Dr. Catherine Birken (416) 813-6933
Dr. Muhammad Mamdani(416) 864-3037
Kevin Thorpe  (416) 864-5776
Dr. Patricia Parkin(416) 813-6933

Purpose of the Research:
You and your child participated in a randomized controlled trial when your child was 9 months to 2 years of age. This trial looked at whether a counselling intervention regarding infant nutrition is effective in preventing low iron stores during infancy. Now that your child is older, we would like to see if the counselling intervention has long term effects such as dental health, iron stores, behavioural issues, and BMI (body mass index).

Description of the Research:
If you agree to participate, we will ask you to complete four short questionnaires (approximately 35 minutes total).

- Dental Questionnaires – designed to assess oral health and its effects. Questionnaire includes topics such as how you feel about your child and your oral health, and how your or your child’s oral health affects you or him/her.
- Nutrition and Health Questionnaire (NHQ) – an age specific TARGet Kids instrument designed to capture important predictors and health outcomes for young children not covered in the other validated instruments.
- Children’s Behavior Questionnaire (CBQ) – designed to assess temperament, activity and parenting across 3 domains: surgency, negative affect and effortful control
We will record your child’s height/length, weight, waist circumference and blood pressure. We will record your height, weight and waist circumference. A trained health professional experienced with pediatric blood collection will take a small blood sample from your child. These blood tests will be processed by experts from the Mount Sinai Services team. A trained dental hygienist or dentist will look in your child’s mouth to determine if your child has any cavities and will take two X-rays from his/her back teeth. The dental hygienist or dentist will also look in your mouth to determine if you have any cavities and will also take two X-rays from your back teeth. Each examination is expected to take 15 minutes. We will use the data that you provided about your child during the initial study to account for any differences between the study groups.

A total of 251 children will be asked to participate in this study. We expect that your visit will take no more than 45 minutes. If you would like to have a home visit instead of visiting your physician’s office, this option can be discussed with you.

**Potential Harms, Discomforts or Inconvenience:**
We will collect a small blood sample (4–7 ml of blood) from your child’s arm using a needle. Topical anesthetic cream (EMLA or Ametop) will be offered to minimize discomfort from venipuncture. There may be slight discomfort, bruising or redness that will usually disappear in a few days. Blood collection is usually a quick process (about 5 minutes) and at other times it can require a little more time. To protect you and your child from unnecessary radiation, good radiological practices such as the use of lead apron to protect the body, thyroid collars (to protect the neck), high-speed films and an artifact to lower the size of the X-ray machine will be used. In terms of possible harms to the patient, the effect of 20 dental X-rays (which is 10 times more radiation than what is proposed in this project) is equivalent to one week of daily background radiation exposure through the use of domestic appliances such as the television and microwave.

**Potential Benefits:**
Your child may benefit from participating in the TARGet Kids! study by having his or her blood measured as the results will be provided to your child’s doctor with your permission. This could inform your doctor if your child might need a nutritional supplement or changes in diet or lifestyle. In addition to knowing one has helped sick children across Canada and the world, participants themselves (and/or family member or friend) could potentially be a patient at SickKids or other paediatric health centre, and benefit directly from the results obtained from this study.

Additionally, the dental exam will provide you with information about whether you or your child requires dental treatment for cavities or other problems.

**Confidentiality:**
We will respect your privacy. No information about who you or your child is will be given to anyone or be published without your permission, unless required by law. For example, the law could make us give information about you if a child has been abused, if your child has an illness that could spread to others, if your child or someone else talks about harming themselves or others, or if the court orders us to give them the study papers.
SickKids Clinical Research Monitors, employees of the funders, or the regulator of the study may see your questionnaire responses or your child’s blood test results to check on the study. By signing this consent form, you agree to let these people look at this information.

The data produced from this study will be stored in a secure, locked location. Only members of the research team (and maybe those described above) will have access to the data. This could include external research team members. Following completion of the research study, the data will be kept as long as required then destroyed as required by SickKids policy. Published study results will not reveal you or your child’s identity.

We will give you a copy of this consent form. We will also keep a copy in a locked drawer in a locked room at SickKids.

**Reimbursement:**
We will reimburse you for all your reasonable out of pocket expenses for being in this study (eg. parking) if the visit is scheduled outside of your child’s regularly scheduled appointments.

**Participation:**
It is your choice to participate and to allow your child to take part in this study. You can stop at any time. The care you receive at your primary care institution will not be affected in any way by whether you take part in this study.

During this study we may create new tests, new medicines, or other things that may be worth some money. Although we may make money from these findings, we cannot give you or your child any of this money now or in the future because you and your child took part in this study.

Participation in research is voluntary. If you choose not to participate, you and your family will continue to have access to quality care at SickKids and at your child’s doctor’s office if needed. If you choose on behalf of your child to participate in this study you can take your child out of the study at any time. Again, you and your family will continue to have access to quality care at SickKids and at your child’s doctor’s office if needed.

New information that we get while we are doing this study may affect your decision to take part in this study. If this happens, we will tell you about this new information. And we will ask you again if you still want to be in the study. If your child becomes ill or is harmed because of study participation, we will treat your child for free.

Your signing this consent form does not interfere with your legal rights in any way. The staff of the study, the hospital, and the doctor’s office are still responsible, legally and professionally, for what they do.

Results will be made available to you through the TARGet Kids! newsletter, which is at your physician’s office. You may also contact the Research Coordinator if you wish to obtain more detailed study results.

**Conflicts of Interest**
Dr. Maguire and the other research team members have no conflict of interest to declare. This means that they will not benefit personally or financially from this study.
**Sponsorship:**
Funding for this TARGet Kids! study is provided by The Hospital for Sick Children Foundation’s grant to our research program, the Pediatric Outcomes Research Team (PORT) and the Canadian Institute for Health Research (CIHR).

**Future Research:**
In the future, our research team may approach you to participate in other studies with the aim of improving children’s health. The research will be explained to you and your consent will be asked for at that time.

Would you like to be approached for future research?  □ Yes  □ No

**Consent:**
By signing this form, I agree that:

1) You have explained these studies to me. You have answered all my questions.
2) You have explained the possible harms and benefits (if any) of these studies.
3) I understand that I have the right to refuse to let my child take part in the study. I also have the right to take my child out of the study at any time. My decision about my child taking part in the study will not affect my child’s health care.
4) I understand that I have the right to refuse to take part in the study. I also have the right to withdraw myself from the study at any time. My decision about taking part in the study will not affect my health care.
5) I am free now, and in the future, to ask questions about the study.
6) I have been told that my child’s and my information, questionnaires, blood test results and medical records will be kept private except as described to me.
7) I understand that no information about my child or me will be given to anyone unless required by law.
8) I understand the publication of the results from this study will not identify my child or myself in any way.

I agree, or consent, that my child ____________________________ may take part in this study.
I, ____________________________________ agree, or consent, to take part in this study.

________  __________                __________  __________
Printed Name of Parent/Legal Guardian      Parent/Legal Guardian’s signature      date

________  __________                __________  __________
Printed Name of person who explained consent    Signature of Person who explained consent       date

________  __________                __________  __________
Printed Witness’ name (if the parent/legal guardian does not read English)        Witness’ signature                date

If you have any questions about the TARGet Kids study, please call Dr Jonathon Maguire at (416) 813-2129. If you have questions about your child’s rights as a subject in a study or injuries during a study, please call the Research Ethics Manager at 416-813-5718.
Appendix 6: Study’s Questionnaires

INSTRUCTIONS TO PARENTS

1. This questionnaire is divided in two parts:
   a. The effects of oral conditions on children's wellbeing and everyday life, and the effects on their families (Parental perception of child’s oral health questionnaire)
   b. The effects of oral conditions on your wellbeing and everyday life, and the effects on your families (Parent’s oral health questionnaire)

We are interested in any condition that involves teeth, lips, mouth or jaws. Please answer each question.

2. To answer the question please put an ☑ in the box by the response.

3. In the first questionnaire, please give the response that best describes your child's experience. If the question does not apply to you or your child, please answer with "Never". In the second questionnaire, please give the response that best describes your own experience. If the question does not apply to you, please answer with "Never".

   Example: How often has your child had a hard time paying attention in school?

   If your child has had a hard time paying attention in school because of problems with his/her teeth, lips, mouth or jaws, choose the appropriate response. If it has never happened or it has happened for other reasons, choose "Never".

   ☐ ☐ ☐ ☐ ☐ ☐ ☐
   Never Once or twice Sometimes Often Everyday or almost everyday Don't know

4. Please do not discuss the questions with your child, as we are interested only in the parents' perspective in this questionnaires
PART A: Parental Perception of Child’s Oral Health Questionnaire

SECTION 1: Child’s oral health and wellbeing

1. How would you rate the health of your child's teeth, lips, jaws and mouth?

   □ Excellent □ Very good □ Good □ Fair □ Poor

2. How much is your child's overall wellbeing affected by the condition of his/her teeth, lips, jaws or mouth?

   □ Not at all □ Very Little □ Some □ A lot □ Very much

SECTION 2: The following questions ask about symptoms and discomfort that children may experience due to the condition of their teeth, lips, mouths and jaws.

<table>
<thead>
<tr>
<th>During the last 3 months, how often has your child had:</th>
<th>Never</th>
<th>Once or Twice</th>
<th>Sometimes</th>
<th>Often</th>
<th>Everyday or almost everyday</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Pain in the teeth, lips, jaws or mouth?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>4. Bleeding gums?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
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<tr>
<td>5. Sores in the mouth?</td>
<td>□</td>
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<td>□</td>
<td>□</td>
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<tr>
<td>6. Bad breath?</td>
<td>□</td>
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</tr>
<tr>
<td>7. Food stuck in the roof of the mouth?</td>
<td>□</td>
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<td>□</td>
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<tr>
<td>8. Food caught in or between the teeth?</td>
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<td>□</td>
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<tr>
<td>9. Difficulty biting or chewing foods such as fresh apple, corn on the cob or firm meat?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
During the last 3 months, because of his/her teeth, lips, mouth or jaws, how often has your child had:

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Once or Twice</th>
<th>At times</th>
<th>Often</th>
<th>Everyday or almost everyday</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Breathed through the mouth?</td>
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<td>11. Had trouble sleeping?</td>
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<tr>
<td>12. Had difficulty saying any words?</td>
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<tr>
<td>13. Taken longer than others to eat a meal?</td>
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<tr>
<td>14. Had difficulty drinking/eating hot/cold foods?</td>
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<tr>
<td>15. Had difficulty eating foods he/she would like to eat?</td>
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<tr>
<td>16. Had diet restricted to certain types of food (e.g. soft food)?</td>
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</tbody>
</table>

SECTION 3: The following questions ask about the effects that the condition of children’s teeth, lips, mouths and jaws may have on their feelings and everyday activities.

During the last 3 months, because of his/her teeth, lips, mouth or jaws, how often has your child been:

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Once or Twice</th>
<th>At times</th>
<th>Often</th>
<th>Everyday or almost everyday</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. Upset?</td>
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</tr>
<tr>
<td>18. Irritable or frustrated?</td>
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<td></td>
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<tr>
<td>19. Anxious or fearful?</td>
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</tbody>
</table>

During the last 3 months, because of his/her teeth, lips, mouth or jaws, how often has your child:

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Once or Twice</th>
<th>At times</th>
<th>Often</th>
<th>Everyday or almost everyday</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>20. Missed school (pain, appointments, surgery)?</td>
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<tr>
<td>21. Had hard time paying attention in school</td>
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<td>22. Not wanted to speak or read out loud in class?</td>
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<td>23. Not wanted to talk to other children?</td>
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<tr>
<td>24. Avoided smiling or laughing when around other children?</td>
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</tr>
</tbody>
</table>
During the last 3 months, because of his/her teeth, lips, mouth or jaws, how often has your child:

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Once or Twice</th>
<th>Sometimes</th>
<th>Often</th>
<th>Everyday or almost everyday</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>25. Worried that he/she is different than other people?</td>
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<tr>
<td>26. Worried that he/she is not as good-looking as other people?</td>
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<td>27. Acted shy or embarrassed?</td>
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<tr>
<td>28. Been teased or called names by other children?</td>
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<tr>
<td>29. Been left out by other children?</td>
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<tr>
<td>30. Not wanted or been unable to spend time with other children?</td>
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<tr>
<td>31. Not wanted or been unable to participate in activities such as sports, clubs, drama, music, school trips?</td>
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<tr>
<td>32. Worried that he/she has fewer friends?</td>
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<tr>
<td>33. Asked questions by other children about his/her teeth, lips, mouth or jaws?</td>
<td></td>
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<td></td>
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</tbody>
</table>
### SECTION 4: The following questions ask about effects that a child’s oral condition may have on parents and other family members

**During the last 3 months, because of his/her teeth, lips, mouth or jaws how often had you:**

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Once or Twice</th>
<th>Sometimes</th>
<th>Often</th>
<th>Everyday or almost everyday</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>34. Been upset?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>35. Had sleep disrupted?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>36. Felt guilty?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>37. Taken time off work (e.g., pain, appointments, surgery)?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
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<tr>
<td>38. Had less time for yourself or the family?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
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</tr>
<tr>
<td>39. Worried that your child will have fewer life opportunities (e.g., for dating, getting married, having children, getting a job he/she will like)?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
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<tr>
<td>40. Felt uncomfortable in public places (e.g., stores, restaurants) with your child?</td>
<td>□</td>
<td>□</td>
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<td>□</td>
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</tbody>
</table>

**During the last 3 months, because of his/her teeth, lips, mouth or jaws how often has your child:**

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Once or Twice</th>
<th>Sometimes</th>
<th>Often</th>
<th>Everyday or almost everyday</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>41. Been jealous of you or others in the family?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>42. Blamed you or another person in the family?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
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</tr>
<tr>
<td>43. Argued with you or others in the family?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
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</tr>
<tr>
<td>44. Required more attention from you or others in the family?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
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<td>45. Interfered with family activities at home or elsewhere?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
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<tr>
<td>46. Caused disagreement or conflict in your family?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
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<tr>
<td>47. Caused financial difficulties for your family?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
SECTION 5: Brushing / Flossing habits

48. How often does your child usually brush his/her teeth? (So many times per day, per week, per month)
   _____ Times
   □ □ □ □
   Per day Per week Per month Per year Never

49. How often does your child usually floss his/her teeth?
   _____ Times
   □ □ □ □ □ □ □
   Per day Per week Per month Per year Never Full set of dentures

SECTION 6: Cost Issues Related to Dental Care

Now a few questions about the cost of YOUR dental care. It is important that we get this information from each individual that we interview, even those in the same family.

50. In the past 12 months, have you avoided going to a dental professional for your child because of the cost of dental care?
   ( ) Yes ( ) No

51. In the past 12 months, have you avoided having all the dental treatment that was recommended for your child because of the cost?
   ( ) Yes ( ) No

52. Do you have insurance or a government program that covers all or part of your child dental expenses?
   ( ) Yes
   ( ) No (Skip next question) ( ) Don’t know/Refuse (Skip next question)

53. If yes, is it… (Mark all that apply.)
   ( ) … an employer-sponsored plan?
   ( ) … a provincial program for children or seniors?
   ( ) … a private plan?
   ( ) … a government program for social service (welfare) clients?
   ( ) … a government program for First Nations and Inuit?

54. Do you usually see a dental professional for your child:
   ( ) … more than once a year for check-ups or treatment?
   ( ) … about once a year for check-ups or treatment?
   ( ) … less than once a year for check-ups or treatment?
   ( ) … only for emergency care?
   ( ) … never? (Skip the next question)

55. When was the last time you saw a dental professional for your child:
   ( ) Less than 1 year ago ( ) 3 years to less than 4 years ago
   ( ) 1 year to less than 2 years ago ( ) 4 years to less than 5 years ago
   ( ) 2 years to less than 3 years ago ( ) 5 or more years ago
   ( ) Never
SECTION 1: Oral Health and Wellbeing

1. In general, would YOU say the health of YOUR mouth is:

☐ Excellent  ☐ Very good  ☐ Good  ☐ Fair  ☐ Poor

2. How satisfied are YOU with the appearance of YOUR teeth and/or dentures?

☐ Very satisfied  ☐ Satisfied  ☐ Neither satisfied nor dissatisfied  ☐ Dissatisfied  ☐ Very dissatisfied

SECTION 2: Persistent or On-going Pain Anywhere in the Mouth

3. In the past 12 months, how often have YOU had any other persistent or on-going pain anywhere in YOUR mouth?

☐ often  ☐ Sometimes  ☐ Rarely  ☐ Never

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<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>4. In the past month, have YOU had a toothache?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>5. In the past month, have YOU had pain in YOUR teeth when consuming hot or cold foods or drinks?</td>
<td>☐</td>
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<tr>
<td>6. In the past month, have YOU had severe tooth or mouth pain at night?</td>
<td>☐</td>
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<tr>
<td>7. In the past month, have YOU had pain in or around YOUR jaw joints?</td>
<td>☐</td>
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<tr>
<td>8. In the past month, have YOU had other pain in YOUR mouth?</td>
<td>☐</td>
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<tr>
<td>9. In the past month, have YOU had bleeding gums when brushing YOUR teeth?</td>
<td>☐</td>
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<tr>
<td>10. In the past month, have YOU had persistent dry mouth?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>11. In the past month, have YOU had persistent bad breath?</td>
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</table>
### SECTION 3: Oral Health Related Quality of Life

**How often have you had the problem during the last year?**

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<tr>
<th>Question</th>
<th>Never</th>
<th>Hardly Ever</th>
<th>Occasionally</th>
<th>Fairly Often</th>
<th>Very Often</th>
<th>Don’t Know</th>
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<tbody>
<tr>
<td>12. Have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?</td>
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<td>13. Have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?</td>
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<td>14. Have you had painful aching in your mouth?</td>
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<td>15. Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?</td>
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<td>16. Have you been self conscious because of your teeth, mouth or dentures?</td>
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<td>17. Have you felt tense because of problems with your teeth, mouth or dentures?</td>
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<td>18. Has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?</td>
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<td>19. Have you had to interrupt meals because of problems with your teeth, mouth or dentures?</td>
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<td>20. Have you found it difficult to relax because of problems with your teeth, mouth or dentures?</td>
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<td>21. Have you been a bit embarrassed because of problems with your teeth, mouth or dentures?</td>
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</table>
### SECTION 4: Brushing / Flossing habits

26. How often do **YOU** usually brush **YOUR** teeth and/or dentures? (For example: so many times per day, per week, per month)

   ______ Times

   □ Per day  □ Per week  □ Per month  □ Per year  □ Never

27. How often do **YOU** usually floss **YOUR** teeth?

   ______ Times

   □ Per day  □ Per week  □ Per month  □ Per year  □ Never  □ Full set of dentures

### SECTION 5: Frequency of Seeing a Dental Professional

28. Do **YOU** usually see a dental professional:

   □ More than once a year for check-ups or treatment?
   □ About once a year for check-ups or treatment?
   □ Less than once a year for check-ups or treatment?
   □ Only for emergency care?
   □ Never? (Skip the next question)
29. When was the last time YOU saw a dental professional?

☐ Less than 1 year ago

☐ 1 year to less than 2 years ago

☐ 2 years to less than 3 years ago

☐ 3 years to less than 4 years ago

☐ 4 years to less than 5 years ago

☐ 5 or more years ago

☐ Never

SECTION 6: Time Away From Work, School or Normal Activities Because of Dental Check-ups, Treatment or Problems

30. In the past 12 months, have YOU taken time away from work, school or YOUR normal activities because of the need to have dental treatment including dental check-ups or because of problems with YOUR mouth?

☐ Yes

☐ No (Skip next question)

☐ Don’t Know, Refused (Skip next question)

31. In the past 12 months, how many hours did YOU take away from normal activities?

________ Hours

SECTION 7: Cost Issues Related to Dental Care

32. In the past 12 months, have YOU avoided going to a dental professional because of the cost of dental care?

☐ Yes ☐ No

33. In the past 12 months, have YOU avoided having all the dental treatment that was recommended because of the cost?

☐ Yes ☐ No
SECTION 8: Personal data (Parents)

1. Gender: □ MALE    □ FEMALE

2. Age: __________________

3. Highest Level of Education
   □ Incomplete Elementary    □ Diploma
   □ Complete Elementary     □ Degree
   □ Incomplete Secondary    □ Pos-graduate studies
   □ Complete Secondary

4. Religion: ______________________________________

5. Marital Status:
   □ Single    □ Divorced    □ Separated    □ Married    □ Living Together    □ Widowed

6. Employment Status
   □ Student, in school, in training
   □ Retired
   □ Housewife, home duties
   □ Permanently disabled
   □ Unemployed
   :________

   □ Employed part-time, less than 15h/week
   □ Employed part-time, 15-32h/week
   □ Employed more than 32h/week
   □ Helping family member
   □ Other

Date completed: ______/______/_____

DAY MONTH YEAR

Full name

Signature

THANK YOU FOR YOUR PARTICIPATION
The study of the relationship between caregiver’s and 7-year-old child’s oral health status

Patient name: ___________________________________________________________ # ______
Date: ___________________ DOB: ______________________

### DMFT/dmft Index

**Dentition:** Primary: □ Mixed: □ Permanent: □

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### Trauma Index

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### Occlusal Status (Mark all that apply)

( ) 0 Acceptable occlusion
( ) 1 Anterior crossbite
( ) 2 Severe crowding
( ) 3 Severe spacing
( ) 4 Posterior crossbite
( ) 5 Anterior open bite (> 1 mm)
( ) 6 Excessive overbite (100% or more)
( ) 7 Excessive overjet (> 9 mm)
( ) 8 Midline shift (> 4 mm)
### Gingival Index

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### Simplified Calculus Index (CI-S)

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Appendix 8: Clinical Examination Manual

The study of the relationship between caregiver’s and 7-year-old child’s oral health status

**DMFT/dmft Index**

Dentition: Primary:____ Mixed:____ Permanent: _______

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Use the following codes in filling the odontogram as per the WHO

00 = Sound, no decay ever
01 = Sound with a sealant
02 = Decayed pit or fissure only
03 = Decayed smooth surface only
04 = Decayed both pit or fissure and smooth surface
05 = Filled no decay
06 = Filled with other decay
07 = Tooth missing due to caries
08 = Tooth lost due to trauma, or congenitally absent (e.g., trauma anterior)
09 = Sound abutment tooth or special crown
10 = Tooth to be lost due to caries

The following would be considered as urgent findings:

**Pain**: Conditions which are presently causing pain or have caused pain frequently in the week immediately preceding eligibility determination.

**Infection**: Visually apparent abscesses or swellings, and/or acute gingival conditions requiring immediate attention (e.g. necrotizing ulcerative gingivitis and any suppurative gingival conditions that would cause abnormal or extreme gingival conditions).

**Haemorrhage**: Haemorrhage associated with trauma or accidents.

**Trauma**: To the premaxilla, maxilla, and/or mandible which affects the teeth and supporting structures.
Pathology: Any specific pathological condition of the hard or soft tissues where further investigation is recommended; or developmental anomalies or pathology of a potentially serious nature.

Caries: Large open lesions in permanent teeth well into the dentine, or in crucial primary teeth that, if left untreated, the child might be deemed to be in a state of dental neglect and thus eligible for referral to a Children’s Aid Society

Gingival Index (GI)
To obtain the GI, the examiner first will need sufficient lighting, a mouth mirror, and probe. The teeth and gingiva (gums) also should be dried lightly with a blast of air and/or cotton rolls. The GI was developed to assess the severity and prevalence of gingivitis by examining only the qualitative changes (i.e., severity of the lesion) of the gingival soft tissue. The GI does not take into account periodontal pocket depth, degrees of bone loss, or any other quantitative change of the periodontium. **Do not probe the pocket/sulcus depth to determine the gingival index.**

<table>
<thead>
<tr>
<th>16 (55)</th>
<th>12 (52)</th>
<th>24 (64)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>44 (84)</th>
<th>32 (72)</th>
<th>36 (75)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Record the worst score for each tooth.

Gingivitis:

1. No inflammation – no bleeding or edema - normal gingiva
2. Mild inflammation – slight changes in color or slight edema, no bleeding on probing
3. Moderate inflammation – redness, edema, glazing or bleeding on probing
4. Severe inflammation – marked redness and edema, ulceration or tendency to spontaneous bleeding
5. Tooth missing

The buccal, lingual, mesial, and distal surface areas of six teeth are examined and scored according to the following criteria and scoring system (Loe and Silness, 1963). The six permanent teeth that are evaluated are the upper right first molar, the upper right lateral incisor, the upper left first premolar, the lower left first molar, the lower left lateral incisor, and the lower right first premolar. If a permanent index tooth is missing use the corresponding deciduous tooth.

Assess gingival status beginning in the maxilla, on the right side with the upper right quadrant (tooth 16), progress through the maxillary arch to the maxillary anterior segment (tooth 12), and then to the maxillary left posterior segment (tooth 24). Proceed to the lower left quadrant in the mandible (tooth 36), progress through the mandibular arch to the mandibular anterior segment (tooth 32), and then to the mandibular right posterior segment (tooth 44). **No substitutes are allowed.** Permanent teeth take precedence over primary teeth - record the status of the permanent tooth.

An index tooth should be probed, using the probe as a "sensing" instrument to detect subgingival calculus and any tissue response. The sensing force used should be no more than 20 grams. A practical
test for establishing this force is to place the probe tip under the thumb nail and press until blanching occurs. For sensing subgingival calculus, the lightest possible force that will allow movement of the probe along the tooth surface should be used. When measuring probing depths, the tip should follow the anatomical configuration of the surface of the tooth root. If the patient feels pain during probing, this is indicative of the use of too much force. The probe tip should be inserted gently into the gingival sulcus at the 3 points on each tooth: mesio-buccal, mid-buccal, disto-buccal.

**Simplified Debris Index (DI-S)**

Oral debris is defined as the soft foreign matter loosely attached to the teeth. It varies in colour from greyish white to green or orange.

In this case only place the tip of the probe perpendicular to the tooth surface, and drag it along the surface of the tooth to observe whether 'piling-up' of debris occurs.

Record the condition at the following:
- Teeth in the maxilla and lower incisors: labial surface
- Molar teeth in the mandible: lingual surface.

Observe the stain and incisal extent of debris and record the highest score for each sextant, as follows:

The primary tooth should be used as a substitute when the permanent tooth is unerupted. In the event that both the primary and permanent teeth are absent, record a “5” (i.e., missing tooth).

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No soft debris or stain</td>
<td>No soft debris or stain present</td>
</tr>
<tr>
<td>1</td>
<td>Less than 1/3 of surface covered</td>
<td>Less than 1/3 of the labial/lingual surface covered with soft debris or extrinsic stain</td>
</tr>
<tr>
<td>2</td>
<td>1/3 to 2/3 of surface covered</td>
<td>1/3 to 2/3 of the labial/lingual surface covered with soft debris or extrinsic stain</td>
</tr>
<tr>
<td>3</td>
<td>More than 2/3 of surface covered</td>
<td>More than 2/3 of the labial/lingual surface covered with soft debris or extrinsic stain</td>
</tr>
<tr>
<td>4</td>
<td>Teeth missing</td>
<td>Missing tooth and substitutes or unavailable for assessment</td>
</tr>
<tr>
<td>5</td>
<td>Teeth unavailable for debris and Calculus assessment</td>
<td>Teeth all crowned or all partially erupted (there may be additional situations as where this code would apply)</td>
</tr>
</tbody>
</table>

![Diagram for scoring Debris Index](image)
Oral calculus is defined as a deposit of inorganic salts composed primarily of calcium carbonate and phosphate mixed with food debris, bacteria and desquamated epithelial cells. DO NOT PROBE for subgingival calculus in respondents with positive oral health restriction, or in children under the age of 15 years. The periodontal probe is used to estimate the surface area covered by the supragingival calculus and to probe for subgingival calculus. Record the condition at the following surfaces:
Teeth in the maxilla and lower incisors: labial surface
Molar teeth in the mandible: lingual surface
Six measurements are required for each respondent. Record the highest (worst) score observed for each tooth.

**Simplified Calculus Index (CI-S)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No calculus</td>
<td>No calculus present</td>
</tr>
<tr>
<td>1</td>
<td>Less than 1/3 of surface covered</td>
<td>Supragingival calculus covering less than 1/3 of the labial or lingual surface.</td>
</tr>
<tr>
<td>2</td>
<td>1/3 to 2/3 of surface covered</td>
<td>Supragingival calculus covering 1/3 to 2/3 of the labial/lingual surface or lingual surface OR flecks of subgingival calculus OR both.</td>
</tr>
<tr>
<td>3</td>
<td>More than 2/3 of surface covered</td>
<td>Supragingival calculus covering more than 2/3 of the labial or lingual surface OR heavy band of subgingival calculus OR both.</td>
</tr>
</tbody>
</table>
Trauma Index
This is to record the condition of each of the four permanent upper and four permanent lower incisor teeth.
Record the condition of each tooth in the appropriate box.
0 = No evidence of traumatic injury
1 = Unrestored enamel fracture – does not involve dentin
2 = Unrestored enamel fracture – involves dentin
3 = Untreated damage – dark discolouration, swelling, fistula
4 = Restored fracture – full crown
5 = Restored fracture – other restoration
6 = Lingual restoration plus history of root canal treatment
7 = Other
Occlusal Status

Mark all that apply
0 = Acceptable occlusion
1= Anterior crossbite
2= Severe crowding
3= Severe spacing
4= Posterior crossbite
5= Anterior open bite (> 1 mm)
6= Excessive overbite (100% or more)
7= Excessive overjet (> 9 mm)
8= Midline shift (> 4 mm)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Acceptable occlusion</td>
<td>Having none of the conditions below</td>
</tr>
<tr>
<td>1</td>
<td>Anterior crossbite</td>
<td>One or more anterior maxillary teeth being lingual to mandibular teeth, or one or more mandibular teeth being labial to the maxillary tooth/teeth</td>
</tr>
<tr>
<td>2</td>
<td>Severe crowding</td>
<td>Crowding estimated to be more than 4 mm in either arch in the anterior segment</td>
</tr>
<tr>
<td>3</td>
<td>Severe spacing</td>
<td>Spacing estimated to be more than 4 mm in either arch in the anterior segment</td>
</tr>
<tr>
<td>4</td>
<td>Posterior crossbite</td>
<td>Lateral positioning of the molar teeth compared to acceptable occlusion. This may involve one or more teeth and usually the malpositioning is lingual to acceptable occlusion</td>
</tr>
<tr>
<td>5</td>
<td>Anterior open bite</td>
<td>Anterior opening greater than 1 mm</td>
</tr>
<tr>
<td>6</td>
<td>Excessive overbite</td>
<td>The maxillary anterior teeth overlapping the mandibular anterior teeth by either equal to or greater than a full tooth depth (100%+)</td>
</tr>
<tr>
<td>7</td>
<td>Excessive overjet</td>
<td>Greater than 9 mm</td>
</tr>
<tr>
<td>8</td>
<td>Midline shift</td>
<td>Estimated to be greater than 4 mm</td>
</tr>
</tbody>
</table>
Appendix 9: Mouth/Teeth Examination Report

Mouth/Teeth Examination Report

To whom it may concern:

While collecting the oral health data on __/__/______, the UoT Graduate Student from the Faculty of Dentistry had no concerns about the condition of ____________’s teeth. He/She is encouraged to visit a dental professional in the near future.

Thank you for participating in the survey,

Dentist Examiner

Dentist Examiner Remarks

Mouth/Teeth Examination Report

To whom it may concern:

While collecting the oral health data on __/__/______, the UoT Graduate Student from the Faculty of Dentistry had some concerns about the condition of ____________’s teeth. He/She is encouraged to visit a dental professional in the near future.

Thank you for participating in the survey,

Dentist Examiner

Dentist Examiner Remarks

Mouth/Teeth Examination Report

To whom it may concern:

While collecting the oral health data on __/__/______, the UoT Graduate Student from the Faculty of Dentistry had serious concerns about the condition of ____________’s teeth. He/She is encouraged to visit a dental professional in the near future.

Thank you for participating in the survey,

Dentist Examiner

Dentist Examiner Remarks
Appendix 10: Lif the Lip Pilot Study

Pilot Study - Protocol

Lif the Lip
Integrating Dental Screening into a Primary Care Environment

Student:
Elaine Cardoso, MSc Candidate DPH
Faculty of Dentistry, University of Toronto, Toronto, Ontario

Principal Investigator:
Amir Azarpazhooh,
Faculty of Dentistry, University of Toronto, Toronto, Ontario
Introduction

Dental caries is a bacterial infection characterized by a reversible multifactorial process of tooth demineralization and remineralization. It is the most common chronic childhood disease and it is recognized as a public health problem, as well as an international public health challenge, especially the particular virulent form of the disease, namely Early Childhood Caries (ECC).

Dental caries in infants and toddlers follows a peculiar pattern and is called Early Childhood Caries (ECC). It is an aggressive form of the disease that affects children 71 months of age or younger. ECC is initially recognized as a dull white demineralized enamel surface, which quickly cavitates along the gingival margin of upper anterior primary teeth of very young children. If left untreated, it progresses to the maxillary first molars, culminating with the destruction of the whole primary dentition. When a smooth surface is affected, and if the child is under the age of three, it represents an even more aggressive form of the disease: Severe Early Childhood Caries (S-ECC), which usually requires extensive rehabilitative treatment possibly under general anaesthesia (GA). From ages three through five years, caries history is taken into consideration when diagnosing S-ECC, using the decayed, missing, filled surface (DMFS) score. Within this age group, one smooth surface in the primary upper anterior teeth or a DMFS score of $\geq 4$ (age 3), $\geq 5$ (age 4), or $\geq 6$ (age 5) in any teeth constitutes S-ECC.

Consequences of ECC have the potential to affect the child’s general wellbeing, along with immediate and long-term quality of life issues to the family and significant social and economic consequences to the community.
**Epidemiology**

The prevalence of ECC varies from 28% to 85% in different populations\(^{34,35}\). Prevalence of all ECC has increased from 9.8% to 11.6% in Toronto between 1999 and 2006 and from 28.6% to 30.4% with a mean deft+DMFT of 1.3, if only the 5 year-old group is considered\(^{36}\). In Canada, ECC data range from less than 5% of the population\(^{37}\) to 80%\(^{38}\) if only the high-risk population is considered, such as children of immigrants from ethnic minorities and aboriginal children\(^{39}\).

Failure to prevent and identify dental caries leads to costly long-term adverse effects. If left untreated, the consequences can be dental pain, oral abscess, bone resorption and tooth loss\(^2\). Premature loss of deciduous teeth can result in malocclusion, inadequate eating habits, inappropriate nutritional intake, and delayed or insufficient height and weight development\(^{185}\). The consequences of pain and infection from dental caries in children include hospitalizations, emergency room visits, and increased treatment costs\(^{27}\). Surgical treatment of dental caries is the most common daycare procedure at most paediatric hospitals in Canada. From a broader perspective, the consequences of dental caries early in life have the potential\(^{186}\) to immediately affect the child’s general wellbeing, along with long-term quality of life issues for the family and significant social and economic consequences to the community\(^{184}\).

**Parental influences on dental caries**

Susceptibility to dental caries and the resulting oral health status is influenced by early life factors associated with caregivers’ oral health-related b, because children rely on their caregivers to take care of their oral health needs\(^4,5\). On the other hand, caregivers’ oral health-related decisions are to some extent influenced by children’s attitudes and by also their own state of vulnerability in the socioeconomic environment in which they live\(^4\).
Microbiological risk factors and Sugars

Cariogenic bacteria (Streptococcus mutans) salivary counts in caregivers are important predictors of dental caries in children\textsuperscript{102,103}. The microbiological approach - as the etiologic factor of dental caries - has been reinforced by laboratory diagnostic tests. For instance, genetic studies of serotyping and bacteriocin typing have demonstrated the transfer of specific S. mutans strains from the mother to her children\textsuperscript{40}, which have been associated with caries occurrence and development in the primary dentition, mixed dentition and permanent dentition\textsuperscript{106,107}. When in association with clinical parameters, infection by S. mutans was associated longitudinally with sharing of utensils at 9 months and 21 months, and the latter with high rates of caries in children\textsuperscript{49}.

The development of dietary habits and food preferences appears to be established between 6\textsuperscript{46} and 12 months of age\textsuperscript{50}. Timing along with frequency and types of food introduced are linked to a susceptibility to bacterial colonization, and the impact of a carbohydrate-rich diet on children’s oral health is unequivocal\textsuperscript{46}. Parents’ own negative diet practices, such as high sugar consumption, are linked to active caries with high levels of S. mutans and are strongly associated with children’s caries prevalence\textsuperscript{105}.

An association was observed between feeding behaviours such as sleeping with the bottle and/or continual sucking from the bottle during the day and dental caries severity\textsuperscript{53}. Bottle weaning is recommended between 12 and 18 months of age, after which children are encouraged to drink liquids from an open cup to quench their thirst\textsuperscript{110}. It is important to note that the use of bottles and no-spill-training cups containing sugary liquids must also be avoided\textsuperscript{110} due to the associated increased risk of dental caries\textsuperscript{187}. Finally, although it is suggested that dental caries is a result of the interaction of multiple factors, inappropriate bottle use is widely accepted as a risk indicator for caries development.
in young children\textsuperscript{52} and changing attitudes in regard to bottle-feeding practices may have positive impacts on dental caries prevention.

**Oral hygiene habits**

Caregivers’ lack of awareness about the importance of good oral hygiene is related to decreased brushing frequency in children\textsuperscript{5}. Poor oral hygiene has been correlated with dental caries incidence on occlusal surfaces and buccal surfaces in molars\textsuperscript{56} while regular tooth brushing habits exert a protective role in reducing caries risk\textsuperscript{5}. Along with other factors, effective oral hygiene techniques are considered important components in dental caries prevention since they have a protective impact on the oral health of the child even in an adverse environment, such as in cases of high salivary S. mutans counts\textsuperscript{111}.

**Families’ socioeconomic, behavioural and cultural profile**

Parents' knowledge and attitudes in regard to oral health and dental care are identified as confounders that influence the likelihood of dental caries developing\textsuperscript{7}. Poor information about the importance of the primary dentition and dental fears are often observed in studies on ethnic groups, and work as barriers to preventive oral health care access and dental treatment\textsuperscript{55}.

Disadvantaged families are seen as vulnerable to oral diseases since they choose non-healthy behaviours for their children\textsuperscript{51}. Caregivers’ educational level has been associated with caries experience risks in children. For instance, low-income children whose primary caregivers had less than high school education are more likely to have no preventive dental visits than children whose caregivers had completed high school, or were college-educated\textsuperscript{59}.
Rationale

ECC often goes untreated and predicts a higher probability of subsequent caries in both primary and permanent dentitions. Unlike other infectious conditions, it is not self-limiting, requiring professional treatment to restore tooth function\textsuperscript{184}.

When access to a dentist is difficult, primary medical-related providers have a strategic role in reducing children's susceptibility to oral diseases since such professionals can work on parent education, community awareness and policy changes\textsuperscript{11}. In this regard, they should consider administering risk-based oral health measures\textsuperscript{93}, so must be knowledgeable about the basic concepts and prevention of dental caries, as well as available interventions available at the medical level\textsuperscript{94 93}.

Data from the United States show that 87\% of infants and 1-year-olds have had office-based physician visits annually while with only 2\% have had dental visits\textsuperscript{96}. Physician office visits are 190-fold more prevalent than visits to general dentists\textsuperscript{96}. Differences are found in parents' attitudes regarding general health care and dental health care for young children\textsuperscript{55}. The concept of routine preventive medical care is well accepted as a priority, while dental care is relegated to when there was an obvious problem, as primary teeth will "just fall out anyway"\textsuperscript{55}. Caregivers in the aforementioned study felt comfortable with the idea of paediatricians performing oral exams and they relied on them for a dental referral in case of any oral problem\textsuperscript{55}. Physicians have fifteen scheduled preventive interventions from birth to four years of age, of which 12 are for the first 24 months of life. This is a period of profound changes in the oral cavity when the establishment of oral preventive recommendations is of paramount importance. Therefore, physicians play an important role in managing the non-classic infectious process of dental caries along with dental professionals\textsuperscript{94}. 
Pilot-study Objective

The aim of this project is to measure the accuracy of oral examination performed by allied health care providers in identifying ECC in children from a private medical care office.

Population

TARGet Kids! (Toronto Applied Research Group for Kids) research

Study Protocol

Training phase: The Lift the Lip protocol will be used for dental caries screening in a collaboration project between the Target kids group from the Sick Kids Hospital and the Faculty of Dentistry, University of Toronto. It consists of a visual check of child's anterior (front) teeth, once they are the most implicated in early childhood dental caries. Screening for dental caries involves simply lifting the child's top lip to check the outer surfaces of the top front teeth, looking for white chalky lines on the teeth, near the gum line. The project consists of TK research assistants training for early identification of cases of Severe Early Childhood Caries (S-ECC) and Early Childhood Caries (ECC) in pre-school children (06 months to 5 year-olds). The training tool kit will be based on the Action Plan Workbook and Toolkit about how to prevent early childhood tooth decay from the Healthy Smile Happy Child Pilot Project of the Manitoba Collaborative Project for the Prevention of Early Childhood Tooth Decay.
Training objectives include:

- To improve TK assistants’ knowledge and attitudes toward oral health;
- To train TK assistants to screen for dental caries in the front teeth for early detection of oral health issues.

Calibration phase: each TK research assistant will evaluate 10 children and results will be compared to a “gold standard” evaluator – dentist (calibration for interrater agreement). The value of the kappa statistic test shall be equal 0.77 (substantial agreement) or over\textsuperscript{161}.

**Study Significance**

Dissemination of dental knowledge among medical-related health care providers has been shown to be an important strategy for oral health management in various population groups.

Providing preventive services during well-child visits is a defining component of pediatric primary care practice\textsuperscript{189}. Physicians are amongst the only health professionals who see nearly all preschool children, and thus they are in a unique position to provide universal oral care\textsuperscript{190}. It has been proposed that failure to deliver preventive services could be more detrimental to children than any other age group given the potential for early investments to establish optimal trajectories for health and wellbeing\textsuperscript{191}.

Accuracy of oral examination after 2 hours of oral health education was tested for primary care pediatricians. Results showed sensitivity of 0.76 (19/25) and specificity of 0.95 for identifying a child with 1 or more cavities and sensitivity of 0.63 (17/27) and specificity of 0.98 for identifying children in need of a dental referral when compared with a pediatric dentist evaluation\textsuperscript{192}. This study was considered as a good quality study according to a recent systematic review updating the US Preventive Services Task Force (USPSTF) recommendations\textsuperscript{193}. Once differences are found in parents' attitudes...
regarding general health care and dental health care for young children and routine preventive medical care is well accepted as a priority\textsuperscript{55}, paediatricians are deemed as an option to disseminate dental knowledge through oral health education in a way to reduce dental caries rates in the population\textsuperscript{93}.

**Long-term aims**

This is a unique opportunity of using the public health care system to disseminate dental knowledge amongst non-dental providers the consequences of which will have a profound impact over the oral health of those who fail to have access to dental care.

**Knowledge Translation**

This study resulted from collaboration between child health researchers at The Hospital for Sick Children, community primary health care providers and the Faculty of Dentistry, University of Toronto. It provides a novel opportunity for truly integrated knowledge translation. Other members of TARGet Kids! Group from The Hospital for Sick Children include policy makers in primary care.

End of grant knowledge will be shared with the academic community through publications in relevant journals and presentations at national and international conferences, and locally through hospital rounds and presentations. Messages will be relevant to professionals working in the fields of pediatrics, family medicine, dentistry and public health. Information will be disseminated to professionals by the research team with colleagues at the Ontario Agency for Health Protection and Promotion, the Centre for Effective Practice, the Maternal Infant Child and Youth Research Network (MICYRN), the Ontario Medical Association, the Canadian Pediatrics Society and the American Academy of Pediatrics.
References

13. Stapleton J, Murphy B, Xing Y. The Working Poor in the Toronto region Who they are, where they live, and how trends are changing; 2012.
43. Loesche WJ. Clinical and microbiological aspects of chemotherapeutic agents used according to the specific plaque hypothesis. Journal of dental research 1979;58(12):2404-12.


91. Quiñonez C, Locker D, Sherret L, et al. An environmental scan of publicly financed dental care in Canada. Toronto: Community Dental Health Services Research Unit, Dental Research Institute, Faculty of Dentistry, University of Toronto; 2006.


141


