

**DENTAL HEALTH NEEDS AND RELATED FACTORS IN INNER-CITY
VANCOUVER ELEMENTARY SCHOOL AGED CHILDREN**

by

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Abstract

Objectives: The aims of the study were: to describe the dental health and treatment needs of inner-city Vancouver elementary-school-aged children and to examine differences in dental health between socioeconomic and ethnic groups.

Methods: Principals of all 10 elementary schools in inner-city Vancouver were approached. Principals of 7/10 inner-city Vancouver elementary agreed to have their schools participate in this project. Consent letters were sent to parents/guardians. The clinical data included assessment of dental health and treatment needs. Self-reported data comprised information about ethnicity, gender, place of birth, years lived in Canada, dental insurance, family education and income.

Results: A total of 561 children of age 5-12 year were examined (kindergarten and grades 1-7). Of the children from ethnic minorities, 20% were Filipino, 18% south Asia and 14% Vietnamese. Overall, 57% of children had experienced caries. The mean number per child of decayed, missing or filled teeth was 2.67. In total, 32% of children needed dental treatment. Overall, there were no statistically significant differences among different demographic groups regarding dental treatment needs or dental health status, except that children born outside Canada had more decayed teeth as compared to their Canadian born counterparts.

Conclusion: With the information from this study it is possible to conclude that there is a difference in dental health status between children born in Canada and foreign born children. On average, foreign born children present with poorer dental health status than their native counterparts. Further research should also aim to determine the cause of the disparity, so that a more targeted approach can be taken to improve dental health status.

Preface

Ethics approval for the present research was obtained from the Research Ethics Board of the University of British Columbia (H11-00621).

Permission to contact teachers, parents and students in the Vancouver district and complete this research was obtained from Vancouver School Board.

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Chapter 1 Introduction

1.1 Literature Review

1.1.1 Dental caries

Dental caries is considered the most common global oral health burden, particularly among children (1-2). Specifically, 60-90% of schoolchildren worldwide are affected by dental caries (1-2), and dental caries is one of the four most expensive diseases to treat (3). According to the Canadian Health Measures Survey, (CHMS), dental care costs rank second only to cardiovascular disorders in total direct costs (4).

Dental caries is a preventable disease of the mineralized tissue of teeth with a multifactorial etiology related to the interplay of biological, behavioral, socioeconomic and cultural factors (5-6-7). High relative risk of dental disease has been related to socio-cultural determinants such as poor living conditions and low education. The risk of caries is also higher in low-income communities without water fluoridation, and this particularly applies to dental caries observed in children (8-9). Data collected on children enrolled in public schools in Dorval, Quebec, between 2003 and 2006 indicated that the percentage of kindergarten children at high risk of developing dental caries doubled in the two-year period after water fluoridation was halted (10). Although the British Columbia Dental Association supports the use of water fluoridation as a safe and effective preventive health measure to reduce tooth decay, tap water supplied by the Metro Vancouver Water District is not fluoridated (11). Consequently, children residing in Vancouver may be at a higher risk for caries than children of a similar background from fluoridated communities.

1.1.2 Need for surveillance

Dental health may have a major impact on overall health and well-being, and poor dental health is considered to be a public health burden (12). An unmet need for professional dental care (UNFPDC) can adversely affect an individual's general health status and functioning in the short and long-term (13). The term UNFPDC is commonly used in health services research to describe the extent to which existing health problems go unaddressed (14). Continuing surveillance of levels and patterns of dental disease risk factors is of fundamental importance to improve dental health systems and the effectiveness of community oral health programs (15). In particular, more research is needed that includes time-series data for dental health surveillance and that explores inequity in oral health and disease and the impact of social risk factors (16). The World Health Organization (WHO) has supported the surveillance of dental disease as a non-communicable disease at both national and regional levels for a number of reasons. Firstly, surveillance offers a systematic approach to data collection and helps communities monitor and evaluate emerging patterns and trends of disease. Secondly, governments can formulate policies and plans to prevent disease and to measure the progress, impact and efficacy of programs already in operation. Thirdly, surveillance systems may help strengthen health care for people and provide evidence for care, programs and policy (15, 17).

1.1.3 Dental health disparities

Although there has been a substantial improvement in oral health over the last few decades, health disparities are still found among sub-groups of any population (18).

Canada ranks among the top nations in the world in terms of standards of health; but this high standard is not shared equally by all members of Canadian society (19). Inadequate access to professional dental care is the most common unmet health care need among children from both the United States (20-21) and British Columbia, Canada (22). Evidence has consistently shown that poor dental health and poor oral health lifestyle such as smoking and a sugar-containing diet

are common in vulnerable subpopulations such as families with low income, low education, and certain cultural backgrounds (23-25). Residents from inner-city areas have been commonly identified as vulnerable populations. Inner-cities are defined as “*areas characterized by above average concentrations of unemployment, full-time workers living on low pay, single parents and the sick and the disabled who are living in poor quality and deteriorating housing conditions*” (26, 27). High numbers of low income families reside in inner-city Vancouver, thus this area may also have high numbers of children at risk for tooth decay.

1.1.4 The profile of Vancouver inner-city children

The Vancouver school district is a large, urban and multicultural school district. Since 2006, 11 schools and 3 annexes in the Vancouver School Board have been designated “Inner-City Schools”. These schools were identified based on the socioeconomic status of the children and families attending the schools factoring in income level, number of children in care, educational level, mobility statistics, need for income assistance, number of single parent households and crime statistics (31). Socio-economic status (SES) has been used to describe a variety of social and economic conditions within a geographic area of residence. For example, income, employment and education are most commonly used to determine both the individual SES of individuals as well as that of neighborhoods or communities (28).

The Human Early Learning Partnership (HELP) research network is a consortium of five major universities in BC (University of British Columbia, University of North British Columbia, Simon Fraser University, University of Victoria, and Thompson River University) (28). The HELP network explored how different early environments contribute to inequalities in child development; consequently they selected and mapped the socioeconomic indicators that are most relevant for understanding the social characteristics of neighborhoods and how those characteristics might influence early child development (28). About 60 theme-based components were used to evaluate 478 neighborhoods and to model how SES relates to vulnerability on different EDI (Early Developmental Index) scales. Statistical analysis revealed a distinct set of

SES components that relate to vulnerability for each EDI scale. The eight strongest components from all scales were chosen to form the HELP SES Index. Each of the chosen components contributes equally to the HELP SES Index. (Table 1.1)

Table 1.1 Operationalization of SES Index and components (28)

SES Component	Sample Variables in Each Component
Wealth: Families with Children	% families with young children with declared investment income. % families with young children with declared charitable donations.
Employment	Employment rate: females aged 15 and older Unemployment rate: people with children under six years.
Residential Stability	Home ownership rate. % people who moved into area in the past year.
Poverty: Women Only Earners	% couple families with young children, female only income. % couple families without young children, female only income.
Lone Parents	% lone female families. % lone male families.
Housing Density	% of dwellings that are single detached houses. % of dwellings that are apartments over five stories.
Population Diversity	% with a foreign language spoken at home. % first generation Canadian.
Women in Manufacturing	% of females in manufacturing, processing & utilities occupations.

According to the SES mapping provided by the Human Early Learning Partnership, Vancouver School District 39 (Vancouver School Board, 2011) is one of the most disadvantaged areas in the province (29). When we examine SES components compared to other districts in BC, Vancouver inner-city schools are situated in areas with the lowest residential stability, highest housing density and highest population diversity based on foreign languages, country of birth, religion and visible minorities (30).

The majority of inner-city schools is in the poorer neighborhoods of Vancouver and presents the highest levels of early childhood developmental vulnerability (31). These neighborhoods have high levels of unemployment, low-income, high social assistance rates, low educational attainment and high rates of lone-parenthood (31).

Vancouver inner-city elementary school-aged children mostly come from “newcomer”¹ families (32). Approximately 45% of students attending schools in the district are from a household in which a language other than English is spoken. Of the more than 120 languages other than English represented in these inner-city schools, the most common are Tagalog, Vietnamese, Punjabi, Hindi, Korean and Mandarin. The primary caregivers of these children often work multiple jobs and have very few family members or other types of social support. It has been observed that the children are often left without adult supervision from the time school finishes until early evening, because their caregivers are working and unable to pay for out of school care (32).

1.1.5 Oral health surveys in US and Canada

The US National Health and Nutrition Examination Survey (2000) demonstrated that low SES individuals as compared to higher SES individuals are nine times more likely to have missing teeth and four times less likely to have visited a dentist within the past 12 months (33). Low SES individuals were also more likely to have untreated dental decay (34); children who lived in poverty were three times more likely to have dental decay compared to their better-off counterparts (35). Preschool children from low SES families have five times more decayed teeth than children from high SES families (36). The prevalence of untreated tooth decay remains higher for those living below the 200 percent federal poverty line compared to those living above the 200 percent of the federal poverty line (37).

¹ A newcomer defines as an individual who has within six years come to Canada as an immigrant or refugee (<http://www.ppt.on.ca/pdf/reports/NewcomerReport.pdf>) accessed on November, 2012

The Toronto Public Health 2001 report describes that 6-10% of preschoolers experiencing tooth decay (38), with 11% of 5-year-olds having two or more teeth with untreated caries, and 7% being in need of urgent care. In 2000, 10% of 5-year-olds in US had one or more teeth affected by decay; by 2006 this percentage was 12% (39). Caries prevalence among 5, 7, 13 year-old children from North West Territories, Canada was 30%, 41%, and 39%, respectively, of which approximately 7% of 5-year-olds and 2% of 13 year-olds required urgent dental care (40).

The 2007-2009 Canadian Health Measures Survey (CHMS) reports that 39% of 12 year-olds have ≥ 1 permanent teeth affected by caries (4). The highest caries prevalence was in Aboriginal² children (84%), followed by children living in families without insurance (61%), or where the highest level of education was less than a high school degree or diploma (60%), or where children were from families in the middle income category (55%). The lowest prevalence (41%) of caries was found in children born outside Canada. The CHMS reported the following disease severities: the mean number of decayed, missing and filled (dmft) in primary teeth of children aged 6-11 years was 1.99, of which 1.64 were filled and 0.28 were decayed. Of all, 24% of 6-11 year-old children had caries in their permanent teeth with a mean of 0.49 DMFT per child. Combining the information about primary and permanent teeth showed that 57% of children aged 6–11 years were affected by dental caries (dmft+DMFT > 0). Prevalence was similar among boys (59%) and girls (55%), and significantly higher among children from Aboriginal families (89%) and in children from families with lower education (72%).

Time trends of decreasing caries can be suggested by comparing two national cross-sectional Canadian surveys, the Nutrition Canada Study (NCS) from 1970/72 (42) and the CHMS from 2007/2009 (4). The NCS found around 74% prevalence, whereas the CHMS found around 60% of children aged 6-11 years who had at least one unfilled, cavitated lesion. An even greater decrease has been observed in adolescents, where the proportion of adolescents having at least one cavity has fallen from 97% to 59% (4). However, it is important to consider that prevalence

² Aboriginal People are all indigenous people of Canada, including Status Indians, Non-Status Indian, Métis and Inuit people (41)

rates vary across Canada. For example, the caries rate in 6-year-olds in Manitoba was 54% while in Quebec 42% of children had tooth decay upon entering kindergarten (43-44). However, it should be noted that some of the differences in prevalence rates in different countries could be attributed to the diagnostic criteria (45-48).

Several recently published studies suggested that dental caries may be on the rise among children less than six years of age (49-51). However, this does not seem to be a consistent trend across Canada. In British Columbia (BC), the rate of visible decay in kindergarteners increased from 32% in 1993 to 41% in 2002 (52), while according to the 2006/7 and 2009/10 Kindergarten Dental Surveys, in Vancouver school areas around 50% of children had dental decay in 2006/2007 and this rate was around 42% in 2009/10 (53). Data about Quebec kindergarten children indicates that the number of children with dental caries increased from 8% in 2003 to 17% in 2006 (54). These variations among Canadian kindergarteners from two different provinces need to be explored further. Most importantly, true inter-province variations might be present. These variations might be attributed to differences in the way professional dental care is provided. In Quebec a number of free dental services are available for all children less than 10 years of age, while this is not a case in British Columbia where free dental treatments are available only for a fraction of children.

1.1.6 Determinants of dental disease

1.1.6.1 Immigrant status

Canada is a multiethnic society; therefore it is important to consider potential differences in caries experience and risk in different immigrant groups. High caries levels among immigrant children when compared to children born in the host country have been reported (55-71). According to the 2000 U.S. Surgeon General's Report, the social impact of oral diseases in

children is substantial and dental caries is a severe problem among low-income minority children with immigrant status (55). Similarly, many European as well as Australian and US studies found that children of immigrant status were at a higher risk for caries as compared to children of non-immigrant backgrounds (56-71).

Little information is available about the oral health status of immigrants and newcomers to Canada (72). Two studies have demonstrated a higher prevalence of disease and limited use of professional dental care among Canadian immigrant children and adolescents (73-74). The oral health status and treatment needs of immigrant and Canadian-born adolescents in North York, Ontario has shown that immigrant adolescents had poorer oral hygiene and higher dental treatment needs compared to the Canadian-born adolescents and were five times more likely to have dental caries (73). Of those children arriving in Canada within the previous two years, 23% required restorative dental care compared with only 4% of those born in Canada. Importantly, immigrant adolescent made fewer visits to a dentist despite their higher dental needs. Moreover, when length of residence in Canada was taken into account, there was a significant association between the time since immigration and oral health. In Ontario, recent immigrants had poor oral health and used dental services less frequently than immigrants who had been in Canada for six years or more (73). Abramson and Heimann looked at recently immigrated children and compared them to resident children of the Essex, Windsor region, Nova Scotia (74). Dental diseases were found to be significantly more prevalent in immigrant children (69.8% as compared to 7.9%). In all five age groups examined (5, 7, 9, 11 and 13 year olds) immigrant children had a higher dmft/DMFT. (74)

According to the 2011 Census data, over 80% of BC increase in population between 2006 and 2011 was due to immigration. International immigration accounted for most of the increase (66%), while interprovincial migration represented 15% and around 19% was due to natural population growth. The majority (70%) of immigrants in BC came from Asian countries (China, India, Philippines and South Korea) and their common destination was the Vancouver Census Metropolitan Area (CMA). On average, over the last five years, the Vancouver CMA was chosen

by 85% of all immigrants (30). A total of 44,176 immigrants and refugees arrived in BC in 2010. The two largest categories of immigrants were skilled workers and relatives rejoining other members of their families (75).

Of all provinces in Canada, British Columbia was second only to Alberta in terms of the income inequality amongst its residents (30). Moreover, in 2009, BC had the largest income gap among the provinces when the lowest 20% of earners are compared to the highest 20% (76). As measured by the 2009 Low Income Cut-Offs after income taxes, the child poverty rate in British Columbia rose from 10% to 12% (77). It was the eighth year in a row that BC had the worst child poverty rate among Canadian provinces. The BC child poverty rate of 12.0% in 2009 also remained higher than the national child poverty rate of 9.5 percent, and it has remained higher than the national poverty rate for a decade (77).

Recent immigrants to Canada are one of the groups known to be at high risk of poverty; this risk has significantly increased in recent years and poverty rates for immigrant children and younger adults have been on the rise (78). It has been suggested that it is now taking longer than in previous years for immigrant families to catch up with the incomes of Canadian-born families (77). One of the explanations might be that many immigrant workers need to seek “survival employment”; that is they are overqualified for jobs they have to take which are not in accordance to their education, skills and past work experience (79). Canada recruits skilled and educated immigrants, but it has employment policies that confine many immigrants to low-paid and insecure jobs (79).

The Human Early Learning Partnership reported increasing developmental vulnerability for the province’s children upon school entry and currently 31% of children are considered at risk (79). This is not unexpected with the persistently high poverty levels in BC children under six years of age (80). This disadvantage may predispose these children to more health problems as compared to their economically better-off counterparts (31).

Metro Vancouver is the home of over 700,000 immigrants who came to British Columbia during the last two decades. According to the most recent Census data, there are 78,560 immigrant children under 18 years of age in BC, which is about 9% of the province's total child population. Metro Vancouver was the intended destination of 88% of new immigrant children under 15 years of age (81). However, little information is available about the health needs of these children.

1.1.6.2 Barriers to dental health care

Disparities in the oral health status of Canadians may also be related to the structure of professional dental care (82-87). Poor oral health among immigrant children and adults and their limited access to dental care have been reported in a few Canadian studies (88-90). Evidence suggests that individuals avoid going to the dentist due to limited availability of services and accessibility and language barriers (91). Moreover, access to professional dental services can be limited by unequal distribution of dental care providers, lack of available government or partly funded programs as well as unawareness among low income families about the resources available for accessing professional dental care for themselves or their children (92).

It is important to consider that children from inner-city areas may be particularly vulnerable to dental disease as poor children are more likely than their better-off peers to be exposed to different health risks. These inequities may be further increased by limited access to dental care (93-94). A number of predisposing, enabling and need-based factors such as language barriers, low socio-economic neighborhoods, lack of dental awareness and education, cultural differences, and immigrant status have been identified as barriers to professional health care (5-6, 95).

Geographic disparities in oral health, access to care and treatment needs have also been observed (35); rural Canadians tend to have poorer health and access to service, and generally receive

fewer services than urban Canadians (96). Provincial variation is in terms of self-reported oral health, service use and dentists per capita have been reported (98).

1.1.6.3 Lack of financial resources

Those who are insured are more likely to visit a dentist, compared to those who pay for dental care out-of-pocket (99). An older Canadian study reported that the strongest predictor for higher levels of untreated caries in immigrant Canadian children was a lack of dental insurance (104). The 1996 National Population Health Survey reported that having “insured” dental care for some population sub-groups is an important precursor to an individual seeking professional care (87). However, if having dental insurance is still an important predictor of seeking professional care today is unknown.

The distribution of insurance varies among children of immigrants (105). According to the 2007-2009 Canadian Health Measures Survey, public insurance is most commonly held by Aboriginals (38%), while having no insurance is more than twice as common in lower income families (50%) as compared to higher income families (20%) (4). Canadian Surveys reported that despite the higher treatment needs in low income families, children from these families without dental insurance visit a dentist more irregularly compared to children families have higher SES and have dental insurance (106-107). Further, children from low-income families experiencing dental disease have limited opportunities for professional preventive care, potentially resulting in increased dental treatment needs (34, 36). Due to irregular dental visits and consequently, the lack of preventive care leading to advanced dental disease, the overall costs of dental treatment may be substantial for lower income families. The burden of dental disease results in 2.26 million school-days and 4.15 million working-days lost annually due to dental visits or sick days due to dental diseases (4).

The reasons for not being able to access dental care are important; policy makers report treatment costs as a primary cause for limited access to health care (99). However, in most studies, facing financial barriers is not the dominant reason study participants give for why they do not visit a dentist. For example, among those Canadians who did not visit a dentist within the last three years, a more common reason than the treatment cost was the belief that regular dental visits are unnecessary (91,108). A social gradient has also been observed, indicating that those individuals with the lowest income and education considered cost more frequently than their higher socioeconomic counterparts (108). Similarly, evidence suggests that low income groups tend to receive emergency services more often (e.g. extractions). Those who access dental care regularly, usually those of higher income and education, generally seek preventive services, as compared to irregular users who visit a dentist for restorative reasons or due to dental emergency (91).

1.1.6.4 Socio-economic status (SES) factors

Most studies from different countries have shown social disparities in children's oral health to be related to the children's socioeconomic backgrounds (109-110). Social differences should be considered at two levels: individual socio-economic variations as well as area-based socioeconomic differences, both potentially contributing to variations in dental disease experience.

Income, employment and education are the factors most commonly used to determine the individual SES. The 2007-2009 Canadian Health Measures Survey has demonstrated the association between low-income individuals and high levels of oral disease (4). It has also been reported that Canadians from lower income families compared to those from higher income families had poorer oral health outcomes as demonstrated by the following variables: caries experience among adolescents, untreated caries, lower rates of dental visits within the last year,

fewer annual check-ups, lower levels of sealant application and higher proportions of subjects avoiding dental visits or declining recommended treatments because of treatment costs (4).

Area based socioeconomic differences also need to be considered. Area-based socio-economic status (SES) is used to describe a variety of social and economic conditions within a specific geographic area of residence (28). It has been suggested that in Canada, a child's development is influenced by area-based socio-economic differences creating a "developmental gradient" that moves along the socio-economic spectrum (28). Inequalities in child development emerge in a systematic way and are shaped by a number of social factors such as family income, parental education, parenting style, neighborhood safety and cohesion, neighborhood characteristics, and access to quality child care (113). According to the SES mapping provided by HELP, the Vancouver School District 39 has been defined as one of the most disadvantaged areas of the province (29). The HELP final report "Evaluation of BC Early Childhood Dental Programs" using area-based SES index demonstrated that dental decay rates remained relatively stable across individual SES levels between the years 2006/7 and 2009/10. Concomitantly, dental decay rates varied substantially depending on the area-based SES differences (111).

1.1.7 Rationale of the present study

Dental caries is the most prevalent chronic disease in child populations. However, only a few researchers have studied the prevalence of dental disease and its related determinants in populations of Canadian children. The recent Canadian Health Measures Survey collected important information and gives an overview of Canadians' oral health, however the study does not provide detailed information about specific vulnerable populations, such as inner-city children. Most immigrants choose to live in the Vancouver area, but the recent Canadian Health Measures Survey did not specifically focus on children of immigrant background.

In addition, different provinces have different level of infrastructure for dental care; consequently, dental treatment needs for children might differ among Canadian provinces. Moreover, BC, as compared to other provinces, comprises the highest number of immigrant children and children living in poverty (77).

There is ample evidence from other studies that inner-city areas represent vulnerable populations, consequently children from these areas may be at a higher risk for caries. Around 90% of immigrant children reside in Metro Vancouver but no studies of metro-Vancouver school-aged children have been done. Furthermore, it is unknown how the data on vulnerable children from inner-city Vancouver areas compares with the data on vulnerable children living in other areas of Canada. Also most recent national Canadian surveys on children and adolescents have not collected data on different ethnic groups.

Having an accurate picture of a population's health is of key importance to plan necessary health care services (112-113). The first step is to collect representative data about the particular population's health and treatment needs (114).

1.1.8 Goal and specific aims of the present study

The overall goal of the present study was to examine the dental health and dental treatment needs of children attending inner-city Vancouver elementary schools.

The specific aims of the study were to:

1. describe dental health of inner-city Vancouver elementary school-aged children;
2. examine their dental treatment needs;

3. explore associations between the children's dental health, dental treatment needs and demographic factors;
4. compare the dental health status of Vancouver inner city children with recent national Canadian data

Chapter 2 Material and Methods

The study was approved by the UBC Ethics Board (H11-00621) and by the Vancouver School Board (Appendix 1). The data for this cross-sectional study was collected between September 2010 and December 2011. The information was gathered by means of a structured questionnaire and clinical examination. All students from seven inner-city elementary schools were invited to participate and their parents/guardians were asked to sign a consent form. After multiple invitations, the total response rate was 61.7%.

A dental examination was done by a dentist (FS) who had been trained and calibrated for this purpose and included assessments of dental health and need for dental treatment. The protocol for these clinical assessments was based on the WHO criteria for Oral Health Surveys (WHO, 2007). An examination/assessment form was developed and piloted (Appendix 2). Standard WHO codes for clinical status assessments were used. This dentist (FS) was assisted by another standardized dentist (JA).

2.1 Vancouver school district 39

The Vancouver School District 39 is one of the most diverse public school systems in Canada. This multicultural school district consists of 75 Elementary schools, including 16 elementary annexes and 11 inner-city schools. 126 languages are spoken in homes within this catchment area; 60% of school children speak a language other than English (32).

2.1.1 Inner-city Vancouver school areas

“Inner-city” refers to the usually older, central part of a city, often characterized by crowded neighborhoods in which low-income, minority groups predominate. These areas are associated with poverty, unemployment and substandard housing (27).

The present study focused on children from seven inner-city Vancouver elementary schools that fall in the catchment of Vancouver school district 39, which is one of the most disadvantaged areas of the province (29). The following elementary schools participated in our study: Florence Nightingale, Britannia, John Henderson, Queen Alexandra, Tillicum, Mount Pleasant and Grandview elementary schools. The profiles of the seven elementary schools are described in Table 2.1.

Table 2.1 Profile of inner-city elementary schools participated in this study

Inner-city Elementary School	Total number of students	English as second language (ESL) most common languages spoken Aboriginal
Florence Nightingale (115)*	200	48% (ESL) Tagalog, Chinese 8% Aboriginal
Queen Alexandra (116)*	161	38% (ESL) 22% Aboriginal
John Henderson (117)*	179	90% (ESL) Indian and Pakistan
Tillicum (118)*	105	60% (ESL) Filipino 25% Aboriginal
Britannia (119) *	148	27% (ESL) Cantonese, Vietnamese 56% Aboriginal
Mount Pleasant (120)*	140	75% (ESL)
Grandview (100)*	135	46% (ESL) Filipino, Vietnamese 44% Aboriginal

*reference number

2.2 Recruitment of children

Three different letters of initial contact were prepared: 1) for community partners (social, youth workers, school principals and their staff) and 2) for parents (Appendix 3-4). The letters of initial contact for parents together with a brief summary of the project were translated into five languages, according to the demographic profile of inner-city Vancouver. Examples of a parent consent and student assent form are presented in Appendix 5-6.

The census sampling framework included all elementary school-aged children from kindergarten to grade seven who attended Vancouver inner-city schools at the time of the study and who were eligible to participate in the study. In order to have a representative overview of the dental health and treatment needs in vulnerable inner-city Vancouver elementary school aged children, two schools out of 11 were excluded as these schools were already receiving dental services or screenings.

Subsequently, nine principals of inner-city Vancouver elementary schools were contacted by email or in person and informed about the study. They were also provided with letters explaining the study as well as copies of ethical permissions (UBC Ethics Board and Vancouver School Board). If a school principal/vice-principal did not respond to an initial request, additional attempts were made to contact him/her. Of 9 principals approached, the principal of General Brook Elementary and the principal of MacDonald elementary schools did not respond despite a number of invitations. Thus, a total of seven schools agreed to invite students to participate in the present study.

After a school consented to participate in the study, a list of all students enrolled, from kindergarten to grade seven, was obtained from each school. Subsequently, each school was supplied with individual packages for parents, including, a letter of initial contact, brief summary

of the project and a parental/guardian consent form. The recruitment of children was facilitated by school principals and family youth social workers. At least three attempts including follow-up calls were made to reach the parents/guardians of the children enrolled in participating schools.

To prepare for data collection, negotiations with school representatives were made to find out when the children would be available for examinations and to arrange for a suitable area that could be used for clinical examinations and completion of questionnaires. In addition, principals were asked to provide information about any current health promotion or health education activities carried out in their schools.

2.3 A Pilot study

A pilot study was performed in a sample of 20 children attending the after-school program at one of the participating elementary schools. The pilot study was used to test the study protocol as well as to prepare for the necessary revisions. During the pilot study, it became clear that a few questionnaire items needed to be re-written. There were no other problems with implementing the study protocol as initially planned.

2.4 The Study Protocol

All collected information was stored in a password-protected computer file. Signed parental consent forms, assent forms, and de-identified data entry forms were stored in locking file cabinets, and were accessible only to the project team. Each form included the student ID number, name of school, date of examination, grade and division and an odontogram that included information about the health status of the five surfaces of each tooth.

The study protocol was implemented in the following sequence:

Step1. The children and parents completed a structured questionnaire.

Step2. The examiner assessed each child's dental health and need for dental treatments.

Step3. A letter was prepared for each child's parents/guardians about the procedures performed and a referral for dental treatment was provided as necessary.

In order to minimize the amount of missing information, clinical records and questionnaire data were checked for accuracy and completeness before each child was released back to his/her class.

2.4.1 Structured Questionnaire

The structured questionnaire inquired about date of birth, gender, last dental visit, frequency of tooth brushing, birth inside or outside of Canada, and number of years in Canada (Appendix 9). Baseline information concerning the family's income, mother's and father's education, and dental insurance status was acquired from the Vancouver School Board.

Table 2.2 Operationalization of the study variables

Variable	Operationalization
Age	Date of birth, subsequently calculated in full years.
Gender	Boy (1), girl (2).
Ethnicity	Aboriginal (1), Chinese (2), European (5), Filipino (6), Vietnamese (7), South Asia (8), Other (9).
Income before taxes	Low Income group: (from no income to less than 20.000) Medium Income group: (20.000-40.000) High Income group (> 40.000).
Education	No formal education (1), Primary school education (2), Unfinished high school (3), High School (4), College or unfinished university (5), University or higher (6).
Dental insurance	Yes (1), No (0).
Place of birth	Born outside of Canada (0), Inside of Canada (1).
Years lived in Canada	Number of full years lived in Canada.
Frequency of brushing	Never (0), not daily (1), once a day (2), twice a day (3), after every meal (4).
Last dental visit	Months since the last dental visit.

2.4.2 Assessment of dental health status and need for dental treatment

Clinical examinations were done with non-latex dental exam gloves using a head light and a dental mirror. Current national recommendations and standards for both infection control and waste disposal were followed; used instruments were placed immediately in a disinfectant solution, then washed and drained before transporting them for sterilization.

All examinations were done in the designated school areas arranged for maximum efficiency and ease of operation using available school rooms and existing furniture. In some schools, clinical examinations were done while children lay on a table or a bench and the examiner stood or sat behind the subject's head. In some schools, upon a school's request, students were examined seated in a chair with a high backrest with the examiner

standing behind or in front of the chair. A table or platform to hold dental instruments and containers was available within easy reach of the examiner.

For quality assurance, the recorder (dentist) was seated close to the examiner (dentist) so that instructions and codes could be easily heard and the examiner could double check the clinical findings and the recorder could verify the clinical observations. In addition to completing paper clinical forms, voice recording was made, and at the end of each day the clinical findings as written on the forms were validated with the voice recordings.

The clinical examination was conducted following a standard procedure of the assessment of dentition status and treatment needs (97), i.e. examination in a systematic manner starting with the upper right molar and finishing with the lower right molar. A tooth was considered present in the mouth when any part of it was visible. If a permanent and primary tooth occupied the same tooth space, only the status of the permanent tooth was recorded. Codes for the dentition status of primary and permanent teeth are presented in Table 2.

Table 2.3 Codes for clinical examinations based on WHO criteria (97)

Condition/Status		Variable operationalization
Code for dentition status		
0	Sound	No evidence of treated or untreated clinical caries or absence of other positive criteria. If there was any doubt about presence of caries, it was recorded as a sound tooth.
1	Decayed	When a lesion in a pit or fissure, or on a smooth tooth surface, has an unmistakable cavity, undermined enamel, or a visual sign of a softened floor or wall*.
2	Filled with decay	When it had one or more permanent restorations and one or more areas that are decayed. No distinction was made between primary and secondary caries.
31	Filled no decay (amalgam)	When one or more permanent amalgam restorations were present and there was no caries anywhere on the crown.
32	Filled no decay (composite)	When one or more permanent amalgam restorations were present and there was no caries anywhere on the crown.
4	Missing due to caries	This code was used for primary teeth that had been extracted because of caries. This code was used when a subject was at an age when normal exfoliation would not be a sufficient explanation for a tooth absence**.
6	Unerupted	This classification is used only for permanent dentition.
7	Crown	A primary tooth covered by a full crown.
9	Exfoliated	When a primary tooth was missing.
10	Fissure sealant	Presence of fissure sealant on occlusal surface.

*A tooth with a temporary filling or one which is sealed but also decayed was included in this category. In cases where the crown had been destroyed by caries and only the root was left, the caries is judged to have originated on the crown and therefore scored as crown caries only at all tooth surfaces. When any doubt existed, caries was recorded as not present.

** Because in our study age group it was difficult to distinguish between an unerupted tooth or an already missing tooth, we used this code only for primary teeth.

The need for dental treatment was assessed at the tooth level. After the status of a tooth was recorded, the type of treatment needed was considered and recorded. If no treatment was

required, the code “0” was placed in the treatment box of the assessment form. The codes for the treatment needs in primary and permanent dentitions are presented in Table 2.3.

Table 2.4 Codes for assessment of dental treatment needs based on the WHO criteria (97)

Codes	Treatment need	Operationalization
0	No treatment	This code was recorded if a crown was sound, if it was decided that a tooth did not need any professional treatment
1	One surface filling	This code was recorded in two separate categories, one for the permanent and one for the primary dentition. The numbers of teeth requiring this treatment were also recorded.
2	Two surface filling	This code was recorded in two separate categories, permanent and primary dentition. The number of teeth requiring this treatment was recorded.
3	Three surface filling*	This code was recorded in two separate categories, permanent and primary dentition. The number of teeth requiring this treatment was recorded.
4	Pulp care	A tooth probably needed pulp care prior to restoration with a filling or crown because of deep and extensive caries, or because of tooth mutilation or trauma.
5	Extraction	Needed extraction due to extensive caries; caries had so destroyed the tooth that it cannot be restored; loose teeth, painful or functionless.
6	Professional cleaning	When calculus or plaque requires professional removal.

*One of the codes 1, 2 or 3 was used to indicate the treatment required to treat primary or secondary caries, or replace unsatisfactory filling. A filling was considered unsatisfactory if one or more of the following conditions existed: a deficient margin, an overhanging margin, a fracture of an existing restoration that either caused the filling to loosen or permitted leakage into the dentin and thus discoloration.

Two indices were chosen for assessing dental health, namely the DMFT and dmft indices and their constituent components. The decayed, missing and filled teeth (DMFT) index was used for assessing the permanent dentition and the dmft index was employed to record the status of the primary dentition (188). Both, the DMFT and dmft indices were calculated as follows:

1. Counting the total number of teeth that had existing dental decay (D/d component), or were missing (M/m component) or teeth that had filling/s (F/f component).
2. Summing the numbers of decayed, missing and filled teeth.
3. For the mixed dentition, summing the dmft+ DMFT and adjusting for the number of teeth present.
4. Caries status was measured as two outcomes; the prevalence of caries (% of children with at least one tooth with caries experience) and caries severity (the mean of DMFT, or dmft, or DMFT+dmft combined).

2.4.3 Need for immediate dental care and referral for a dental treatment

If there was a need for a dental treatment, this was recorded in a clinical assessment form and a referral letter including addresses of low cost dental clinics was provided to the child. All students who were examined received an information letter to take home outlining their individual current dental health status and treatment needs. (Appendix 8-9)

2.5 Assessment of the Intra-examiner reliability

Of all, 20 children were selected at random to assess the intra-examiner reliability employing the Cohen's Kappa test. The kappa of 0.92 was considered satisfactory.

2.6 Data analyses

All analyses were performed employing SPSS 21.00 software. Univariate analyses were used to describe frequency distributions of children regarding different study variables. In addition, univariate analyses were employed to test the data for normality to prepare for inferential bivariate and multivariate analyses. Bivariate analyses were employed to test gender, ethnic, and socioeconomic status related differences (independent sample t test, ANOVA or their nonparametric equivalents). The multivariate analyses (linear multiple regression) were done to evaluate the joint effect of the most important predictors found in bivariate analyses as they relate to dental health and dental treatment needs' outcomes.

Chapter 3 Results

The final response rate was 61.7%, and response rates for each participating school in more detail are presented in Table 3.1.

Table 3.1 Response rates for participating schools

Elementary Schools	Recruited/a total No	Response rates %
Florence Nightingale	120/200	60.0%
Queen Alexandra	92/161	57.1%
John Henderson	122/179	68.1%
Tillicum (Hasting)*	52/55	94.5%
Britannia	65/148	43.9%
Mount Pleasant	90/140	64.2%
Grandview**	20/45	44.4%

* Only half of the teachers agreed their students participate in this study. This response rate is based on number of students had been received consent forms.

**Only children participating in after school program participated.

3.1 Dental health and dental treatment needs

3.1.1 Univariate analyses

Results of the univariate analyses are presented in Tables 3.1-3.6. These analyses included three components. Part one relates to the sample distribution according to study variables (Table 3.1); part two presents dental health status in different age groups (Tables 3.2-3.4); part three reports dental treatment needs in inner city school-aged children.

3.1.1.1 Sample distribution regarding study variables

This cohort of Vancouver inner-city elementary school-aged children included 561 children from kindergarten to grade seven (Table 3.2). There were 312 boys and 242 girls. Table 3.1 shows the distribution of children regarding a number of demographic variables.

More than half of the children (55%) had dental insurance and 19% of children were born outside Canada. Slightly more than half of the children (58%) had visited a dentist within last year and few children (1%) were newcomers who had arrived less than one year ago. Filipino was the most common visible minority (20%).

Table 3.2 Sample distribution according to study variables

Study Variables	Number	%
Total children	561	100
Age groups		
Kindergarten	90	16.4
Grade 1-2	170	31.0
Grade 3-4	130	23.7
Grades 5-7	159	29.0
Gender		
Boys	312	56.3
Girls	242	43.7
Income groups		
<20.000	202	38.2
20.000-40.000	161	30.4
>40.000	166	31.4
Education		
Lowest	184	35.2
Middle	186	35.6
Highest	153	29.3
Having Insurance		
No	289	54.6
Yes	240	45.4
Born in Canada*		
No	104	18.5
Yes	357	63.5
Ethnicity		
Aboriginal	43	7.7
Chinese	59	10.5
European	85	15.1
Filipino	112	19.9
Vietnamese	67	11.9
Hindi	98	17.4
Other	95	16.9
Last dental visit last year		
Within last year	256	57.8
More than a year ago	230	5.2
Do not remember or never	164	37.0

* 18% did not answer the question about birth place.

3.1.1.2 Sample distribution according to prevalence and severity of dental caries

Dental health status was measured employing two types of caries scoring; namely caries prevalence and caries severity. The caries prevalence was measured as a percentage of children who had caries experience, i.e. dmft > 0 (decayed, or missing or filled primary teeth) or DMFT>0 (decayed, or missing permanent teeth). The caries severity was measured as a mean number of combined caries experiences in both dentitions. Dental health related data is presented in Tables 3.3 -3.5.

Table 3.3 illustrates dental health status in primary dentition. More than half of the kindergarten to grade four children and almost 30% of the grade 5-7 children had experienced primary tooth caries. In the primary dentition, the mean severity scores (dmft) as an average value per cohort for caries severity was dmft=1.50, i.e. 1.5 teeth on average per child were affected by dental caries.

Table3.3 Dental health status in the primary dentition of inner city school-aged children

Age Groups (N)	Percent with	dt*	mt*	ft*	dmft*
	dmft> 0 (%)	Mean± SD	Mean± SD	Mean± SD	Mean± SD
Kindergarten (90)	53.3	1.11±2.2	0.20±1.0	1.22±2.4	2.53±3.1
Grades 1-2 (170)	55.9	0.98±2.1	0.29±0.8	1.65±2.6	2.92±3.7
Grades 3-4 (130)	58.5	0.58±1.3	0.15±0.4	1.96±2.6	2.69±3.0
Grades 5-7 (159)	28.3	0.20±0.7	0.01±0.1	0.58±1.2	0.78±1.5
Total (549)	48.1	0.68±1.7	0.16±0.6	1.34±2.3	1.50±2.2

*“dt”- decayed teeth, “mt”- missing teeth, “ft” Filled teeth, “dmft”, decayed, missing and filled teeth

Table 3.4 illustrates dental health in the mixed dentition. Overall, 57% of the children had experienced caries in the dentition. The mean severity score (dmft+ DMFT) as an average value

per cohort for caries severity was (dmft+ DMFT) =2.67. The highest caries experience was seen in grades 3-4.

Table 3.4 Dental health status in the mixed dentition of inner-city school-aged children

Age groups (N)	Caries Prevalence	Caries Severity (number of teeth in mixed dentition with caries experience)			
	dmft+DMFT> 0 (%)	dt+DT * Mean ± SD	mt+MT * Mean ± SD	ft+FT * Mean ± SD	dmft + DMFT* Mean ± SD
Kindergarten (90)	53.3	1.11±2.2	0.21±1.0	1.22±2.4	2.53±3.1
Grades 1-2 (170)	57.1	1.04±2.3	0.29±0.8	1.66±2.7	3.02±3.8
Grades 3-4 (130)	61.5	0.38±1.7	0.15±0.4	2.29±2.8	3.22±3.3
Grades 5-7 (159)	52.2	0.69±1.3	0.01±0.1	1.22±2.0	1.91±2.4
Total (549)	56.6	0.88±1.9	0.16±0.6	1.61±2.5	2.67±3.3

* “dt+DT”- decayed +Decayed, “mt+MT”-missing +Missing, “ft+FT” - filled +Filled *, “dmft +DMFT” decayed, missing, filled + Decayed, Missing, Filled teeth

Table 3.5 illustrates dental health in permanent dentition. Almost one out of five (18%) of the children who participated in this study had caries experience in the permanent dentition.

Table3.5 Dental health status in the permanent dentition of in inner-city school children

Age Groups (N)	Caries Prevalence	Caries Severity (a number of teeth in permanent dentition with caries experience)			
	DMFT> 0 (%)	DT * Mean ± SD	MT * Mean ± SD	FT * Mean ± SD	DMFT * Mean ± SD
Grades 1-2 (170)	7.1	0.07±0.3	0.00±0.0	0.04±0.2	0.11±0.4
Grades 3-4 (130)	20.8	0.20±0.7	0.00±0.0	0.33±0.9	0.53±1.2
Grades 5-7 (159)	37.7	0.49±1.1	0.00±0.0	0.65±1.5	1.13±1.9
Total (549)	21.8	0.21±0.7	0.00±0.0	0.28±1.0	0.49±1.3

* “DT” Decayed Teeth, “MT” Missing Teeth, “FT” Filled Teeth, “DMFT” Decayed, Missing & Filled Teeth

3.1.1.3 Sample distribution regarding treatment needs

Dental treatment needs of different age groups are reported in Table 3.5. In total, 32% of children needed dental treatment and the distribution regarding treatment needs is presented in Table 3.6. Children from grades 3-4 had the highest treatment need (35%).

Table 3.6 Dental treatment needs in inner-city elementary school-aged children

Dental Treatment Needs (primary and permanent dentitions)								
Age groups (N)	1 surface filling N (%)	2 surface filling N (%)	3 surface filling N (%)	4 surface filling* N (%)	Pulpcare N (%)	Extraction ** N (%)	Professional Cleaning N (%)	Total N (%)
Kindergarten (90)	13 (14.4)	15 (16.7)	7 (7.8)	10 (8.8)	12 (13.3)	3 (3.3)	1 (1.1)	28 (31.1)
Grades 1-2 (169)	19 (11.2)	30 (17.8)	13 (7.7)	19 (11.2)	25 (14.8)	6 (3.6)	6 (3.6)	53 (31.3)
Grades 3-4 (129)	19 (14.7)	18 (14.0)	6 (4.7)	12 (9.3)	13 (10.1)	8 (6.2)	15 (11.6)	45 (34.8)
Grades 5-7 (159)	33 (20.8)	18 (11.3)	5 (3.1)	5 (3.1)	5 (3.1)	7 (4.4)	16 (10.1)	50 (31.4)
Total (547)	84 (15.4)	81 (14.8)	31 (5.7)	46 (8.3)	55 (10.1)	24 (4.4)	38 (6.9)	176 (32.1)

* needs a four surfaces filling or a crown

** Extraction needed for primary teeth

3.1.2. Inferential - Bivariate analyses

The results of bivariate analyses are presented in Tables 3.7-3.8. This section includes information about two outcomes: dental health and dental treatment needs. All outcomes were related to the study variables.

3.1.2.1 Dental health status with regard to study variables

Table 3.7 relates dental health status to gender, income, education, having or not dental insurance, born or not in Canada and ethnicity. Overall, there were no statistically significant differences among groups, except that children born outside Canada had more decayed teeth as compared to their Canadian-born counterparts ($P < 0.001$). The years lived in Canada correlated marginally and non-significantly (Pearson correlation coefficient = -0.088 , $P = 0.058$) with caries experience (combined DMFT + dmft score). There were no statistically significant socioeconomic differences regarding dental health status.

Table3.7 Dental health status with regard to study variables

Study variables (N)	Oral health status in the mixed dentition			
	dt +DT *	mt+MT*	Ft +FT*	dmft + DMFT
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Gender				
Boys (310)	0.84±1.7	0.14±0.5	1.57±2.5	2.55±3.2
Girls (241)	0.95±2.0	0.16±0.7	1.69±2.5	2.83±3.3
Independent sample t test	P=0.493	P=0.714	P=0.584	P=0.317
Income				
<20.000 (201)	0.92±1.9	0.20±0.8	1.76±2.6	2.88±3.3
20.000-40-000 (161)	0.81±1.8	0.13±0.6	1.64±2.6	2.58±3.2
>40.000 (162)	0.90±1.9	0.13±0.6	1.41±2.2	2.48±3.1
ANOVA with post Hoc Bonferroni adjustment	P=0.852	P=0.566	P=0.430	P=0.462
Education				
Lowest (184)	0.85±1.9	0.17±0.6	1.57±2.6	2.78±3.4
Middle (184)	0.95±2.0	0.18±0.8	1.77±2.5	2.8±3.2
Highest (181)	0.82±1.5	0.11±0.5	1.48±2.5	2.45±3.0
ANOVA with post Hoc Bonferroni adjustment	P=0.787	P=0.723	P=0.563	P=0.406
Insurance				
No (288)	0.86±1.8	0.16±0.7	1.67±2.5	2.69±3.1
Yes (236)	0.89±1.9	0.16±0.7	1.54±2.5	2.61±3.3
Independent sample t test	P=0.860	P=0.882	P=0.552	P=0.773
Born in Canada				
No (104)	1.67±2.7	0.16±0.5	1.50±2.4	3.34±3.3
Yes (357)	0.75±1.6	0.15±0.6	1.38±2.6	2.70±3.3
Independent sample t test	P<0.001	P=0.959	P=0.296	P=0.084
Ethnicity				
Aboriginal	0.86±2.3	0.28±0.7	2.14±3.0	3.28±4.0
Chinese	0.54±1.2	0.03±0.1	1.62±2.6	2.15±2.9
European	1.18±2.4	0.14±0.5	1.50±2.5	2.83±3.7
Filipino	1.00±1.8	0.23±0.7	1.27±2.2	2.55±3.3
Vietnamese	0.71±1.7	0.19±0.8	2.00±2.6	2.91±3.0
South Asia	0.77±1.7	0.09±0.47	1.42±2.3	2.29±2.7
Other	1.00±1.6	0.17±0.9	1.82±2.4	3.00±3.0
ANOVA with post Hoc Bonferroni adjustment	P=0.445	P=0.432	P=0.339	P=0.425

* “dt +DT ” decayed deciduous and Decayed permanent teeth, “mt+MT” missing deciduous and Missing permanent teeth, “ft+ FT” filled deciduous and Filled permanent teeth , “dmft +DMFT” decayed, missing, filled deciduous and Decayed, Missing, Filled permanent teeth.

3.1.2.2 Dental treatment needs with regard to study variables

Table 3.8 associates dental treatment needs to gender, income, education, having or not dental insurance, born in Canada or not and ethnicity. The following statistically significant differences were found: children born outside Canada as compared to their Canadian-born counterparts had more active caries as demonstrated by significant differences in need for pulp treatment and extractions due to caries ($P < 0.05$).

Table3.8 Dental treatment needs with regard to study variables

Study variables	Dental Treatment needs (deciduous and permanent dentitions combined)						
	One surface filling	Two surface filling	Three surface filling	Four surface filling or crown	Pulp care	Extraction	Professional cleaning
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Gender							
Boys	46 (14.9)	46 (14.9)	14 (4.4)	25(8.0)	31(10)	16 (5.2)	26 (8.4)
Girls	39 (16.1)	36 (14.9)	18 (7.4)	20 (8.2)	24(9.9)	8 (3.3)	12 (5)
Chi-Square	P=0.390	P=0.548	P=0.103	P=0.554	P=0.541	P=0.303	P=0.077
Income							
<20.000	32 (16)	34 (17)	9 (4.5)	17(8.5)	23 (11.5)	10 (5)	11 (5.5)
20.000-40.000	20 (12.4)	22 (13.7)	8 (5.0)	12(7.4)	14 (8.7)	6 (3.7)	12 (7.5)
>40.000	29 (17.8)	20 (12.3)	11 (6.7)	14(8.5)	15 (9.2)	7 (4.3)	13 (8)
Chi-Square	P=0.395	P=0.416	P=0.618	P=0.827	P=0.631	P=0.840	P= 0.612
Education							
Low	27(14.6)	21(11.4)	6(3.2)	13(7.0)	20(10.8)	11(5.9)	13(7.0)
Middle	26(14.2)	31(20.9)	14(7.6)	16(8.7)	18(9.8)	8(4.3)	12(6.5)
Highest	27(17.7)	23(15.1)	8(5.2)	13(8.5)	13(8.5)	5(3.2)	11(7.2)
Chi-Square	P=0.630	P=0.309	P=0.176	P=0.504	P=0.777	P=0.495	P=0.967
Insurance							
No	42(14.5)	45(15.6)	13(4.5)	22(7.6)	28(9.7)	14(4.8)	21(7.2)
Yes	37(15.6)	31(13.1)	15(6.35)	21(8.7)	23(9.7)	10(4.2)	15(6.3)
Chi-Square	P=0.410	P=0.456	P=0.436	P=0.636	P=1.000	P=0.835	P=0.404
Born in Canada							
No	20(19.2)	24(23.0)	9(8.6)	11(10.5)	16 (15.3)	11 (10.5)	8 (7.6)
Yes	59(16.6)	49(13.8)	19(5.3)	26(7.2)	30 (8.4)	10 (2.8)	28 (7.8)
Chi-Square	P=0.556	P=0.032	P=0.243	P=0.305	P=0.034	P=0.002	P=0.948
Ethnicity							
Aboriginal	5 (12.9)	3 (7.3)	3 (7.3)	3 (7.3)	3 (7.3)	2 (4.8)	2 (4.8)
Chinese	8 (13.7)	7 (12)	3 (5.1)	4 (6.7)	6 (10.3)	1 (1.7)	6 (10.3)
European	10 (11.7)	16 (18.8)	12 (14.1)	14 (16.4)	16 (18.8)	3 (3.5)	1 (1.1)
Filipino	15 (13.5)	20 (18)	6 (5.4)	11 (9.8)	11 (9.8)	8 (7.2)	2 (1.8)
Vietnamese	7 (10.4)	9 (13.4)	3 (4.4)	4 (5.9)	4 (5.9)	3 (4.4)	6 (8.9)
South Asia	17 (17.3)	11 (11.2)	1 (1.0)	5 (5.1)	8 (8.1)	0 (0)	14 (14.3)
Other	24 (25.2)	17 (17.8)	4 (4.2)	5 (5.2)	8 (8.4)	7 (7.3)	7 (7.3)
Chi-Square	P=0.117	P=0.432	P=0.015	P=0.129	P=0.150	P=0.129	P=0.004

3.2 Multivariate analyses

Four outcome variables were studied in multivariate analyses which are presented in Tables 3.9-3.12. In order to enable direct comparisons, all predictors are presented with standardized coefficients, where coefficients approaching zero mean no contribution and coefficients approaching unity denote substantial contribution to explaining an outcome.

Table 3.9 presents the most significant associations (predictors) between caries experience outcome (caries experience combining both dentitions) with study variables. The following predictors of caries experience were tested: gender, years living in Canada, age, time since last dental visit, having dental insurance, family’s education and income. The overall model was statistically significant ($P < 0.001$) and the statistically significant predictors of caries experience were gender and family income ($P \leq 0.001$). Overall girls had significantly higher caries experience than boys.

Table 3.9 Caries experience associations with selected study variables (Linear Multiple Regression)

Outcome: Caries experience (dmft + DMFT)*, selection method: backwards. Model summary: Adjusted R square= 0.424, P<0.001.		
Best Predictors	Standardized Coefficients Beta	P value
Gender	0.326	<0.001
Family Income	0.276	0.001
Predictors tested: gender, years in Canada, age, time since last dental visit, having dental insurance, family education and family income.		

*d/D-decayed teeth, f/F filled teeth, m/M missing teeth

Table 3.10 presents the linear multiple regressions for the outcome “decayed teeth”. The overall model was statistically significant ($P < 0.001$). The best and statistically significant predictors of

caries experience were being born in Canada or not and gender where boys had significantly higher decayed teeth than girls ($P < 0.001$).

Table 3.10 Caries experience (decayed teeth) associations with selected study variables (Linear Multiple Regression)

Outcome: Decayed Teeth (dt + DT)*, selection method: backwards		
Model summary: Adjusted R square= 0.220, P=<0.001.		
Best Predictors	Standardized Coefficients Beta	P value
Gender	-0.416	<0.001
Born in Canada	-0.330	<0.001
Last dental visit<1 year	0.105	0.092
Family income	0.258	0.015
Predictors tested: gender, years in Canada, age, time since last dental visit, having dental insurance, family education and family income.		

* d/D decayed teeth

Table 3.11 presents the linear multiple regressions for the outcome “filled teeth”. The overall model was statistically significant ($P < 0.001$) and the statistically significant predictors of caries experience were gender and family’s education.

Table 3.11 Treatment and caries experience (filled teeth) associations with selected study variables (Linear Multiple Regression)

Outcome: Filled Teeth (ft + FT)*, selection method: backwards		
Model summary: Adjusted R square= 0.300, P=<0.001.		
Best Predictors	Standardized Coefficients Beta	P value
Gender	0.295	0.003
Family’s education	0.272	0.007
Predictors tested: gender, years in Canada, age, time since last dental visit, having dental insurance, family education and family income.		

*f/F filled

Table 3.12 presents associations between the dental treatments need (total number of treatments needed per child) with the study variables. The same predictors as in the models above were tested. The overall model was statistically significant ($P < 0.001$) and two predictors related to dental treatment, namely gender and born in Canada, were statistically significant.

3.12 Dental treatment needs associations with selected study variables (Linear Multiple Regression)

Outcome: Number of treatments needed, selection method: backwards Model summary: Adjusted R square= 0.169, P<0.001.		
Best Predictors	Standardized Coefficients Beta	P Value
Gender	0.300	0.010
Born in Canada	-0.279	0.003
Predictors tested: gender, years in Canada, age, time since last dental visit, having dental insurance, family education and family income.		

Overall, the most significant predictor for all study outcomes was gender, where boys had significantly higher caries experience than girls, when this was controlled for other factors.

3.3. Comparison with the Canadian Health Measures Survey 2007/09

Tables 3.13 and 3.14 present comparisons between the present study and the Canadian Health Measures Survey (CHMS). The clinical protocol followed in this study and CHMS was based on World Health Organization (WHO) measures. Most of the determining characteristics in this comparison are self-evident but income requires some explanation. In CHMS, three income categories are used; The middle group consists of families who had incomes of \$30,000 to \$59,999 for 1 or 2 persons in the household, \$40,000 to \$79,999 for 3 or 4 persons, and \$60,000 to \$79,999 for 5 or more persons in the household. Families earning less than these amounts

make up the lower group; families earning more make up the higher income category (4). To allow for the comparison between this study and the CHMS, information on income and household size of inner-city families was obtained and for the analysis, that information was partitioned into categories same as the CHMS. Regarding education, our study sample size were grouped based on the CHMS; those living in families where someone has obtained a post-secondary degree or diploma and those in families where the highest level of education is some post-secondary education or less (4).

Table 3.13 demonstrates how caries prevalence compares locally (inner-city Vancouver) and nationally (Canada) and Table 3.14 compares findings about caries severity. There were a few differences between the local and national data: e.g. overall caries (dmft+DMFT>0) prevalence found in highest educated group in the present study was 29% as compared to the CHMS data that was 53%. In this study, overall caries prevalence in foreign born children (dmft+DMFT>0) was 70% as compared to the CHMS that was 50%. Similarly, caries prevalence in primary dentition (dmft>0) in foreign born children participated in present study was 56% as compared to CHMS that was 40%.

Table 3.14 shows the comparison between the present study and the CHMS regarding severity of dental caries. Overall, the severity of dental caries in primary and permanent dentitions (dmft+DMFT) was higher in the national Canadian study than in the present study. However differences between the two studies were less pronounced when comparisons included only primary dentition. Untreated decay (dt+DT) in all groups except for low education group was almost double in the present study.

Table 3.13 Comparison between the present study and the Canadian Health Measures Survey (CHMS) 2007-2009

Caries Prevalence	Gender (%)		Income groups (%)			Education groups (%)		Born in Canada (%)		Dental visit Last year (%)	
	Boys	Girls	Low	Medium	High	Low	High	Foreign *	Canada	<1year	>1year
dmft+DMFT>0											
CHMS	58.6	54.8	61.4	61.1	51.9	72.0	53.0	50.2	57.3	57.7	54.3
Present study	51.7	58.2	59.7	54.3	50.0	52.1	29.3	70.1	56.2	58.4	62.1
dmft >0											
CHMS	49.2	46.3	45.9	55.0	44.5	60.1	44.5	40.5	48.4	48.9	41.9
Present study	46.3	50.0	53.7	48.8	41.4	45.1	49.5	56.7	47.6	48.6	52.97
DMFT > 0											
CHMS	26.8	20.2	30.9	22.7	20.0	33.4	20.8	23.5	23.6	24.7	F**
Present study	17.6	19.8	17.4	14.9	23.7	16.8	19.8	21.1	21.0	20.1	18.9

*Foreign born

** F estimate not provided because of extreme sampling variability or small sample size.

Table3.14 Severity of dental caries: comparison between the present study and the Canadian Health Measures Survey (CHMS) 2007-2009

Caries Prevalence	Gender		Income			Education		Born in Canada		Last visit dental	
	Boys	Girls	Low	Medim	High	Low	Middle/High	No	Yes	< 1year	>1year
dmft + DMFT											
CHMS	2.62	2.34	2.53	2.95	2.16	3.45	2.21	2.04	2.52	2.25	2.55
Our study	2.64	0.95	0.92	0.81	0.90	0.85	0.51	1.67	0.75	2.67	3.32
dmft											
CHMS	2.03	1.94	1.86	2.44	1.77	2.67	1.79	1.43	2.03	2.03	1.91
Our Study	2.11	2.22	2.43	2.19	1.82	2.14	2.13	2.76	2.13	2.12	2.87
DMFT											
CHMS	0.59	0.40	0.68	0.51	0.39	0.79	0.41	F	0.48	0.52	F
Present study	0.43	0.60	0.44	0.39	0.65	0.44	0.54	0.56	0.56	0.54	0.47
Dt + dt											
CHMS	0.40	0.32	0.45	0.44	0.25	0.65	0.30	0.35	0.37	0.70	0.33
Present study	0.84	0.95	0.92	0.81	0.90	0.84	0.88	1.67	0.74	0.91	1.16
dt											
CHMS	0.30	0.26	0.30	0.33	0.23	0.48	0.23	0.21	0.29	48.9	41.9
Present study	0.65	0.71	0.72	0.63	0.66	0.67	0.66	1.35	0.52	0.72	0.82
DT											
CHMS	F	F	F	F	F	F	F	F	0.08	0.08	F
Our Study	0.20	0.26	0.20	0.18	0.26	0.18	0.24	0.33	0.24	0.20	0.35
MT+mt											
CHMS	F	F	F	F	0.05	F	F	F	F	F	F
Our Study	0.84	0.95	0.20	0.13	0.13	1.57	1.62	1.50	1.38	0.17	0.15
mt											
CHMS	F	F	F	F	0.05	F	F	F	F	F	F
Our study	0.84	0.95	0.20	0.13	0.13	1.57	1.62	1.50	1.38	0.17	0.15
MT											
CHMS	F	0.00	F	F	0.00	0.00	F	0.00	F	F	0.00
Our Study	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FT+ft											
CHMS	2.09	1.99	1.96	2.44	1.86	2.76	1.83	1.64	2.08	1.53	2.14
Our Study	1.57	1.69	1.76	1.64	1.41	1.57	1.62	1.50	1.38	1.58	2.02
ft											
CHMS	1.62	1.66	1.43	2.06	1.50	2.15	1.48	1.17	1.68	1.70	1.34
Our Study	1.34	1.36	1.51	1.43	1.04	1.30	1.32	1.26	1.46	1.24	1.89
FT											
CHMS	0.48	0.33	0.53	0.39	0.36	0.61	0.34	F	0.40	0.44	F
Our study	0.24	0.35	0.25	0.21	0.40	0.26	0.31	0.24	0.34	0.35	0.15

* CHMS Canadian Health Measures Survey, “F” Estimate not provided because of extreme sampling variability or small sample size

Chapter 4 Discussion

The present study employed census sampling, i.e. all children from participating schools were invited. The present study had three main objectives: 1) describe the dental health and dental treatment needs of inner-city Vancouver elementary school-aged children, 2) examine the associations between dental health, dental treatment needs and demographic factors and 3) compare the dental health status of Vancouver inner city children with the dental health status of children surveyed in the CHMS. Our main findings will be discussed, accordingly.

4.1 Dental health and dental treatment (both dentitions)

The present study found that over 50% of participating children had experienced caries. In the permanent dentition the mean number of teeth affected by caries per child was 0.49 and in the primary dentition it was 1.50. The corresponding findings from the Canadian Health Measures Survey 2007-09 (4) were: caries prevalence in the permanent dentition was 24% and in the primary 48% and the severity (DMFT, dmft) 2.5 and 1.99, accordingly.

Comparisons with other studies are feasible only in terms of kindergarten children. In the present study, the prevalence of caries in kindergarten children was over 50% with a mean dmft= 2.53, which was similar to a UK study in 2011 where caries prevalence and severity among 5-6 year-old inner and outer city children was around 50% and dmft=2.33, correspondingly (121).

In the present cohort of children approximately every third child needed a referral for dental treatment. High levels of untreated caries are usually found in certain regions within developed countries mainly with geographic, economic and cultural barriers to dental care (113,122- 123).

The findings of the present study are in accordance to other studies reporting higher levels of dental treatment needs in inner-city areas and related to some ethnic groups (101-102).

According to the 2006/07 kindergarten dental survey in Vancouver's inner-city schools, approximately 50% of kindergarten children had experienced caries (110). The percentage of kindergarten children without caries experience in 2009/10 was around 60% and in our study it was 50%. Based on the 2009/10 kindergarten survey, 15-20% of children had dental treatment experience in the primary dentition in comparison to 22% in 2006/07. According to our study, the corresponding percentage for this age group was 34%. Based on our findings as well as previous kindergarten surveys we suggest that dental caries is a considerable problem in young children (125).

In the present study of elementary school-aged children, every third child (32%) had untreated caries. This level of dental treatment needs observed in a cohort of these children may be at least partly explained by the infrastructure of British Columbia's dental health care system where there is relatively low dental public sector expenditure, professional dental care is primarily delivered by the private sector and dental treatment is costly. At present, only kindergarten children receive regular dental screenings and are referred for treatment if needed. Regular screenings for all elementary school age children may be useful in identifying children who may need dental treatment. However, screenings alone may be insufficient to address the dental treatment need in vulnerable children. For example, a screening program in a Washington inner-city school identified that 42% of the children screened were in need of dental treatment (127).

Considering socio-economic determinants of dental caries, we expected poorer dental health in the children from families with less education and income. Although bivariate comparisons showed no socio-economic differences, multivariate linear multiple regressions indicated the importance of social factors, e.g. more overall caries and treatment experience (dmft+DMFT) was found in children from families with higher income. This difference may at least partly be

explained that children from high income families may be more likely to receive dental treatments as compared to children from lower income families. This is in accordance to the Nelson et al. study which found that children in need of dental treatment had parents with less education and who were more likely to report visiting a dentist irregularly (127). Individual socio-economic status differences either in dental health or treatment needs were found only when analyses controlled for other known caries determinants. Similar findings were reported in a study by Di et al. (128). In addition to some individual socio-economic differences, area-based socioeconomic differences might also play an important role in caries experience in Vancouver inner-city children. It has been reported that dental decay rates overall in British Columbia remained relatively stable during the years 2006-2010 and varied depending on the area-based SES differences. Approximately 50% of children from low SES areas but only one third of children from moderate-level SES neighborhoods experienced dental decay (110). Gatou et al. reported that both socioeconomic area-based disparities and individual level socio-economic differences had an effect on caries experience, its severity and dental treatment needs in Greek children (50). Maliderou et al. studied oral health in relation to demographic factors in a sample of children from inner-city London areas and found an association between socio-economic status and dental health. Children from low socio-economic status families had higher caries prevalence in comparison to those belonging to higher socio-economic status families (129). In rural and inner-city residences, children whose parents had less than high school education and some racial/ ethnic minorities had high caries prevalence (130).

Future studies are needed to understand the potential interplay between individual and area-based socioeconomic factors and how they relate to dental health or treatment needs. Firstly, social deprivation may be more area-based and less related to individual socio-economic differences. Secondly, it may be that substantial socio-economic differences in relation to dental health may no longer exist in the inner city of Vancouver, particularly given that there were no differences in caries experience among SES groups of the present cohort. This explanation is in accordance to a UK study, which found that majority of the population in highly disadvantaged area of inner-city London were newly-arrived Bangladeshi whose caries prevalence was much lower, with a DMF of 1.56, than the white group at 3.39 . Moreover, two thirds of them had visited a dentist within a

last year (131). However, comparing our finding with studies performed in different countries should be done with caution, particularly considering differences in dental care delivery systems for children in different countries as well as different patterns of immigration among these countries.

In our study, the best predictors of caries experience were gender and not born in Canada. This may indicate that dental health of foreign-born children living in inner-city Vancouver is poorer than of those born in Canada, i.e. the former had significantly more decayed teeth and a greater need for comprehensive dental treatment. These findings are in accordance to other studies, where a relationship between immigration history and oral health status has been demonstrated (58, 66). Children who lived in Canada longer as compared to children who immigrated to Canada recently, i.e. less than six years ago might have better integrated into the Canadian environment. This finding is in agreement with a similar study in Ontario, Canada (73), which concluded that differences in oral health related to time since immigration may be an outcome of changing patterns of immigration. Recent immigrants may come from countries such as Philippines (102) or China (126) that are the least likely to have organized dental services or dental preventive programs. Patterns of immigration have changed over the past decade (132). For example, the association between dental health and time since immigration may reflect an upward social mobility. Social mobility is the transition over time of individuals or groups in term of social position and refers to classes, ethnic groups, or entire nations. Social mobility may measure health status, literacy, education and/or change in income and it also refers to movement of individuals or groups up or down from one socio-economic level to another, e.g. the social mobility of immigrant families who have been in the country for longer periods of time (73). Given that we found some socio-economic differences and relationships between caries experience and being born in Canada, we may at least partly support the hypothesis of social mobility. Possibly the better dental health status of immigrant inner-city Vancouver children who have been in Canada longer may be attributed to their access to public dental benefits programs, e.g. “Healthy Kids Program BC”; subsequently these children may receive free treatment up to 1400\$ every two years (152). Despite programs for low- income children available in BC, a substantial proportion of children are still in need of dental treatments. Level of caregiver’s

education and lack of awareness of the importance of the primary dentition may have played a role in low rate of care (127). In a small local survey in Ontario, 70% of recently immigrated children had acute dental disease compared to only 8% of Windsor-Essex County resident children (73). Another survey in North York indicated that a mother's short length of residency in Canada was a strong predictor for future decay in her children (104). The odds of newcomers' children for developing new dental lesions was 3.4 as compared to children whose mothers were born in Canada or lived in Canada for more than 20 years (104). The findings of a descriptive study by Barrow et al. of the oral health of Asian (Chinese) American schoolchildren in New York City were compared to a national study of U.S. children, demonstrating that the New York City Asian (Chinese) children had a significantly higher proportion of untreated dental caries as compared to other ethnic groups (149). Parental perceptions, experiences, attributions, and beliefs regarding their children's oral health in this study cohort need to be explored in further studies.

The present study showed one of the consistent predictors of caries experience was gender; girls had significantly higher caries experience than boys. Epidemiological and clinical studies have revealed a consistent trend in caries development, with females having higher prevalence than males (153). Several attempts have been done to provide an explanation for this trend by examining factors which contribute to caries and how these factors differ between males and females (154-156). It was reported more frequent consumption of sweets and soft drinks among girls than boys (157). In contrast, it was shown girls have reported using sugary snacks and soft drinks less frequently than boys (158). In Sweden and Finland a diet associated with high risk for caries was more common among boys than among girls (159-160). Girls have more favourable attitudes and behaviors towards oral health than boys (161). Seemingly, there might be gender-related behavioural differences that might explain gender-related differences in dental health. Therefore, further studies are needed to understand how gender-related differences in oral health develop.

The present study did not confirm differences in caries prevalence among children from different ethnic groups, and this finding is in contrast with findings from other countries. For example, dental caries in inner-city children in Ghent, Belgium was related to ethnicity as well as to socially deprived neighborhoods (133-134). Similarly, dental caries was higher amongst those of Asian origin in New Jersey (135) and in a sample of Vietnamese preschoolers in Vancouver (136). Understanding how socio-behavioral factors contribute to dental health may help to explain differences in dental caries prevalence and severity in different ethnic and gender groups (135). Sundby and Petersen indicated cultural differences in the dental attendance and self-care practices of the children and their parents (162). Tannure et al. reported that variation in genetics may be associated with caries experience mainly in subjects with poor oral health habits (163). However, even when considering the joint effect of some known determinants of caries, we did not find ethnic differences either in regards to worse dental health or higher need for dental treatment. An important point to consider about this study is the small sample size in each ethnic group that might have effect on the result as a predictor. If this finding is confirmed in future surveillance studies, the health needs of multi-ethnic inner city Vancouver school-aged children may be addressed considering the whole cohort without a specific focus on particular ethnic groups.

Around half of children did not have dental insurance, but we did not find an association between having dental insurance and less dental caries experience or lower levels of dental treatment needs. It is important to note that our finding that higher dental treatment needs were not related to lack of dental insurance can't be extrapolated to all children from low income areas as we examined only Vancouver inner-city elementary school-aged children. Thus, the association between lack of dental insurance and higher level of unmet treatment needs can't be excluded given that children from other Vancouver areas were not included.

Having dental insurance has been considered a key factor in whether or not individuals seek professional dental care. A lack of dental insurance for "working poor" Canadians has been consistently associated with worse oral health and dental care outcomes (137). Several Canadian

and American studies have demonstrated that the largest disparities between working poor and non-poor American families relate to differences in accessing dental care (138-139). Working poor families' report significantly more unmet dental care needs. In Canada, Williamson and Fast demonstrated that a lack of insurance had important implications for overall health, and that working poor families are generally healthier than families that receive social assistance (140-141).

Dental disease has serious consequences to both individuals and society. A child's overall health, nutrition, speech and school performance can suffer as a result of extensive caries. Dental caries can thus incur significant emotional and financial costs to parents as well resulting in financial cost to insurance providers and to society at large (55). In the context of preventing dental diseases, primary prevention aims to prevent dental caries, while secondary prevention is needed to repair the consequences of caries. Primary caries prevention is the most cost-effective strategy as it aims to prevent disease occurrence, while secondary prevention is more expensive as it involves the cost of dental treatments. Both primary and secondary preventions are necessary for the present cohort of inner city Vancouver children as a substantial proportion of these children experienced caries and with increasing age all children had accumulated higher levels of unmet treatment needs.

It has been reported that children from lower income areas have presented significantly higher caries risk and poorer oral hygiene compared to those living in more affluent areas (50). It has also been shown that individuals who experienced poverty at birth had high proportions of dental caries as adults regardless of their family income in adolescence or adulthood (142). Social mobility from birth to adulthood influences the proportion of decayed teeth in adulthood and the "always poor group" had the lowest proportion of sound teeth (142). The groups who experienced income mobility in either direction had outcomes similar to each other's but worse than those of the never poor group. Cumulative exposure to poverty in the life course was strongly and positively associated with caries experience in a dose-response relationship, showing the adverse effect on dental health of cumulative episodes of poverty (143). These

findings on social origins and oral health are similar to those reported by Poulton et al. (144) and Thomson et al. (145) in the Dunedin birth cohort study. Individuals experiencing poverty in early life had less access to and use of a variety of oral hygiene products and were more likely to make detrimental lifestyle choices, which predisposed them to dental caries (146). Adolescents who were born and grew up in poverty, “the always poor group”, had poorer dental health, worse tooth brushing habits and less frequent dental care visits than their better-off peers (147-148).

Towards suggesting a strategy for decreasing both, the burden of dental disease experience as well as its consequence of unmet treatment needs, two distinct approaches to prevention, namely high-risk and population-based strategies, may be considered. According to Geoffrey Rose, a world renowned epidemiologist, the high-risk approach focuses on individuals identified to be at high risk for a specific disease, while the population-based approach targets preventive activities to the whole population (150). It has been suggested that a population strategy of prevention is relevant for improving population health as well as for addressing social disparities (151). Given the prevalence and severity of dental disease in inner-city Vancouver elementary school age children, the whole cohort of children should be considered as an at-risk population. Subsequently, preventive programs should be tailored to the whole cohort if the aim is to reduce the burden of dental disease in this underserved population.

4.2 Limitations of this study

The limitations of the present study also need to be considered. The present cross-sectional study design does not allow any causal inferences. Wide age range of the study group may be considered as a limitation as well. Another limitation of the present study is that only simple clinical examination under field conditions was employed and did not include radiographic assessments. This means that some caries experience might be left undetected and even higher numbers of children than observed might be in need of dental treatment. Further, some parents

refused to enroll their children in the present study because their families have their own dentist. Therefore, some children did not participate in the study as we were not able to acquire either an informed consent or response from their parents. Thus, it is possible that some children in highest need for dental care did not participate in the present study. The recruitment of children was a challenge, but it substantially improved when recruitment was facilitated by school staff members and when help was sought help from social and youth workers. The relatively small numbers of children from Florence Nightingale School can be explained by difficulties in recruitment of these children as simultaneously to our study, a community service was provided by dental students. Therefore, then school staff prioritized the activities directly benefitting children (community service) over surveillance research (the present study) that focused on examining dental health and need for dental treatment in inner-city Vancouver children. Given the difficulties and challenges experienced in the present study, future studies in this population should consider effective strategies for participant recruitment.

Chapter 5 Conclusions

Over 50% of inner-city Vancouver children in all age groups except for kindergarten had experienced dental caries. Children who lived longer in Canada presented with lower caries experience and dental treatment needs as compared to children who had recently immigrated to Canada. Lack of dental insurance was not associated with either higher caries severity or a higher level of unmet dental treatment needs. The dental health of inner-city Vancouver children was comparable to that of children of similar ages examined in the Canadian Health Measures Survey 2008/9. Around one third of the elementary school-aged children in the present study needed referrals for dental treatments.

Based on the results of this study it is possible to conclude that there is a difference in dental health status between Vancouver inner city children born in Canada and foreign born ones. On average, foreign-born children presented with poorer dental health status than their native counterparts. Further research should be conducted in order to better understand the relationship between the dental health status of Canadian and foreign-born children.

The results of our study have implications for clinical practice because it indicates that children who reside in Vancouver inner-city area may require more dental care. Presently, few programs are in place for meeting the oral healthcare needs of children in inner-city Vancouver. Such programs include “BC Healthy Kids Program”, Strathcona Dental Clinic and “Adopt a school” at Florence Nightingale Elementary school in hopes to ameliorate this problem. However, children are only eligible for these programs if they are from low income families and if they do not have access to dental insurance (152). Not all immigrant children who come to Canada will meet these criteria. As a result, depending on the burden of dental disease presented by immigrant children, it may be important to create a program specific to screening and treating immigrant children for dental disease regardless of social status and income. Further research should also aim to determine the cause of the disparity, so that a more targeted approach can be taken to

improving oral health status. For example, if a language barrier is the cause of avoidance of dental care, these programs need to be made more user-friendly and multilingual. If a lack of awareness is the cause, then low-income families need to be made aware of the available programs specific to them.

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Appendices

Appendix 1 Dental examination form



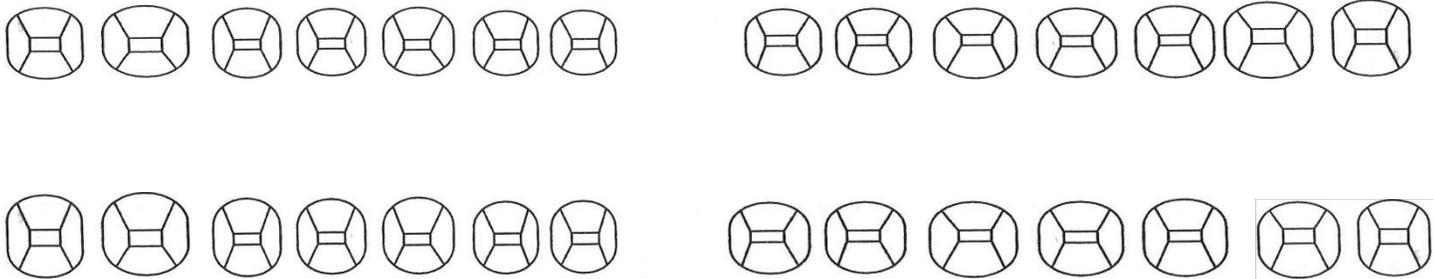
Project: **Dental Health Management in Inner-city Vancouver**

ID

Dental examination form for children (2011)

RU7 RU6 RU5 RU4 RU3 RU2 RU1 LU1 LU2 LU3 LU4 LU5 LU6 LU7

School	Grade/Division	Date
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- 0=Sound 1=Decay 2= Filled with decay 3= Filled, no decay (31=Amalgam, 32=Composite) 4= Missing due to caries
- 5= Missing, any other reason 6= Unerupted 7= SSC 8=Trauma 9=Exfoliated 10=Fissure sealant
- 11= Broken Fissure sealant
- 12=White spot

Treatment :



20 April, 2011

You are invited to participate in the project “**Integrated Community-Based Oral Health Care in Inner-City Vancouver based on the Adopted School Model**”.

The ultimate goal of the project is to improve oral health of inner-city Vancouver elementary school children. This project will be based on prevention of tooth decay as there is evidence showing that community-based oral health prevention programs lead to improvement of oral health in these communities.

Summary of the Project

The project comprises four stages:

Stage 1. Evaluation of baseline levels of dental health, treatment needs and their related factors in inner-city Vancouver school children. At this stage all children from inner-city Vancouver schools whose parents/guardians consented on behalf of their children will be examined by means of a simple dental examination (only dental mirrors are used). Both, children and their parents will be asked to complete dental health-related questionnaire.

Stage 2. Examination of different preventive strategies aiming to improve dental-health of inner-city Vancouver school children. The effectiveness of different preventive oral health-related

strategies (no treatment involved) will be tested in different inner-city schools. Children who need professional dental health will be referred to Community Dental Clinics.

Stage 3. Preparation of a standardized protocol for the community-based oral health prevention program in inner-city Vancouver. Based on results from two previous stages a standardized protocol will be prepared.

Stage 4. Implementation of community-based oral health prevention program for the inner-city Vancouver schoolchildren.

Stage 5. Evaluation of short-term and long-term results and preparation for program sustainability.

On behalf of the project team:

With best regards

Appendix 3 Summary of project for parents



18 May, 2011

Dear Parent/Guardian, your child is invited to participate in the project “**Integrated Community-Based Oral Health Care in Inner-City Greater Vancouver based on the Adopted School Model**”.

Goal: to improve oral health of inner-city Vancouver elementary school children.

Location: All activities kept in your child’s school and are FREE of CHARGE!

Summary of the Project

- Simple dental examination for all inner-city Vancouver schoolchildren is painless (only dental mirror is used).
- Children in need of dental treatment will be referred to Community Clinics.
- Children will receive a free oral hygiene kit.
- Different activities aim to improve dental health-related knowledge and behaviors.
- Even if you have your own dentist your child will benefit from this project.

On behalf of the project team:

With best regards



Faculty of Dentistry

The University of British Columbia
www.dentistry.ubc.ca

CONSENT FORM FOR PARENTS

Title of Study:
on the Adoption

Inner-City Vancouver based

If you are a parent or legal guardian of a child who may take part in this study, permission from you and the assent (agreement) of your child may be required. When we say “you” or “your” in this consent form, we mean you and/or your child; “we” means the doctors and other staff.

1. THE INVITATION

You and your child are invited to participate in a study being conducted by the UBC Faculty of Dentistry researchers.

2. YOUR PARTICIPATION IS VOLUNTARY

Your participation is entirely voluntary, so it is up to you to decide whether or not to take part in this study. Before you decide, it is important for you to understand what the research involves. This consent form will tell you about the study, why the research is being done, what will happen to you during the study and the possible benefits, risks and discomforts.

If you wish to participate, you will be asked to sign this form. If you do decide to take part in this study, you are still free to withdraw at any time and without giving any reasons for your decision.

If you and/or your child do not wish to participate, you do not have to provide any reason for your decision not to participate nor will you lose the benefit of any medical care to which you are entitled or are presently receiving.

Please take time to read the following information carefully and to discuss it with your family, friends, and doctor before you decide.

3. WHO IS CONDUCTING THE STUDY?

The Faculty of Dentistry, University of British Columbia is conducting the study. There are no conflicts of interests.

4. BACKGROUND

This research is being done in order to find efficient ways to improve oral health in inner-city Vancouver.

5. WHAT IS THE PURPOSE OF THE STUDY?

There are a few purposes of this study:

- 1) Explore different aspects of community's perspective about the value of the professional community-based dental service provided by dental students from the University of British Columbia.
- 2) Collect information necessary for improvement of the community-based dental service in the future.
- 3) Develop an integrated efficient community-based oral health promotion in inner-city Vancouver.

6. WHO CAN PARTICIPATE IN THE STUDY?

All schoolchildren from inner-city Vancouver elementary schools can participate.

7. WHAT DOES THE STUDY INVOLVE?

This study will take place in inner-city Vancouver schools. A total of 600 volunteer subjects will be enrolled for the entire study.

The information about you and your child will be used anonymously to plan strategies aiming to improve oral health in Inner city Vancouver, to educate dental students and to prepare research presentations.

In this study, your child's teeth will be examined by a dentist (using only dental mirrors). Photographs of your child's teeth (only) will be taken and help us to see how much dental plaque (deposits of food and bacteria) are attached on your child's tooth surfaces. You and your child will be asked to complete a questionnaire about different oral health-related aspects. The total examination of your child will last approximately 30 minutes; 15 minutes for clinical examination and 15 minutes for completing the child's questionnaire.

In later stages of this project your child will be invited to participate in different activities aiming to improve your child's dental health. These activities may last from 5 to 30 minutes.

The evaluation results will also be used to plan strategies aiming to improve oral health in inner-city Vancouver, to educate dental students and to prepare research presentations.

8. WHAT ARE THE POSSIBLE HARMS AND SIDE EFFECTS OF PARTICIPATING?

There are no risks related to this study.

9. WHAT ARE THE BENEFITS OF PARTICIPATING IN THIS STUDY?

Your child will directly benefit from participating in this study by:

- Receiving a free dental examination.
- Referral for dental treatment if problems are found.
- Receiving toothbrushes and toothpaste free of charge
- Acquiring knowledge and behaviors which lead to better dental health.

You will benefit from participating in this study by:

- Acquiring oral-health related knowledge

10. WHAT HAPPENS IF I DECIDE TO WITHDRAW MY CONSENT TO PARTICIPATE?

Yours and your child's participation in this research is entirely voluntary. You may withdraw from this study at any time. If you decide to enter the study and to withdraw at any time in the future, there will be no penalty or loss of benefits to which you are otherwise entitled, and your future medical care will not be affected.

If you choose to enter the study and then decide to withdraw at a later time, all data collected about you during your enrolment in the study will be retained for analysis. By law, this data cannot be destroyed.

11. WHAT HAPPENS IF SOMETHING GOES WRONG?

There will be no costs to the subject or legal representative for participation in this study. Signing this consent form in no way limits the legal representative's or subject's legal rights, against the sponsor, investigators, or anyone else.

12. AFTER THE STUDY IS FINISHED

Researchers may inform subjects when study results are likely to be available and whether or not subjects will be informed of them.

13. WHAT WILL THE STUDY COST ME?

There will be no reimbursement for study related expenses and you will not be paid for your participation.

14. WILL MY OR MY CHILD'S TAKING PART IN THIS STUDY BE KEPT CONFIDENTIAL?

Your confidentiality will be respected. No information that discloses your identity will be released or published without your specific consent to the disclosure. However, research records and medical records identifying you may be inspected in the presence of the Investigator or his or her designate by representatives

15. WHO DO I CONTACT IF I HAVE QUESTIONS ABOUT THE STUDY DURING MY PARTICIPATION?

If you have any questions or desire further information about this study before or during participation, you can contact, UBC, Department of Oral Health Sciences.

16. WHO DO I CONTACT IF I HAVE ANY QUESTIONS OR CONCERNS ABOUT MY RIGHTS AS A SUBJECT DURING THE STUDY?

If you have any concerns about your rights as a research subject and/or your experiences while participating in this study, contact the Research Subject Information Line in the University of British Columbia Office of Research Services by e-mail or by phone .

17. SUBJECT CONSENT TO PARTICIPATE

- I have read and understood the subject information and consent form.
- I have had sufficient time to consider the information provided and to ask for advice if necessary. I have had the opportunity to ask questions and have had satisfactory responses to my questions.
- I understand that all of the information collected will be kept confidential and that the result will only be used for scientific objectives.
- I understand that my participation in this study is voluntary and that I am completely free to refuse to participate or to withdraw from this study at any time without changing in any way the quality of care that I receive.
- I understand that I am not waiving any of my legal rights as a result of signing this consent form.
- I understand that there is no guarantee that this study will provide any benefits to me (if applicable).
- I have read this form and I freely consent to participate in this study.
- I have been told that I will receive a dated and signed copy of this form.

SIGNATURES

Printed name of a Parent/Guardian

Signature

Date

Printed name of witness

Signature

Date

Printed name of principal

Signature

Date

investigator/designated representative

Printed name of translator

Signature

Date

(if applicable)



SUBJECT ASSENT FORM
Children aged 7-13 years

Short Study Title: Oral Health in Inner-city Vancouver

Invitation

I am being invited to be part of a research study. A research study tries to find how to help children like me to have good oral health. It is up to me if I want to be in this study. No one will make me be part of the study. Even if I agree now to be part of the study, I can change my mind later. No one will be mad at me if I choose not to be part of this study.

Why Are We Doing This Study?

Dental Decay (cavities in teeth) affects many children in inner-city Vancouver. This study is trying to find out how to prevent tooth decay.

What Will Happen in This Study?

If I agree to be in this study, I will complete the questionnaire and see the dentist and he/she will examine my teeth using only dental mirrors. The dentist will take photographs of my teeth (only) to see how much dental plaque (deposits of food and bacteria) are attached on my teeth.

I agree that the total examination will last approximately 30 minutes.

If I do not like the examination, or if it makes me feel bad, then I will ask to stop the examination

Who Is Doing This Study?

Dentists from the University of British Columbia will be doing this study. They will answer any questions I have about the study. I can also call them, if I am having any problems and I cannot talk to my parents

Can Anything Bad Happen to Me?

Nothing bad can happen to you as dental mirrors will be used.

Who Will Know I Am in the Study?

Only my dentist and people who are involved in the study will know I am in it. When the study is finished, the dentists will write a report about what was learned. This report will not say my name or that I was in the study. My parents and I do not have to tell anyone I am in the study if we don't want to.

When Do I Have To Decide?

I have as much time as I want to decide to be part of the study. I have also been asked to discuss my decision with my parents.

Signatures:

If I put my name at the end of this form, it means that I agree to be in the study.

The subject's printed name, signature, and date.

.....



DENTAL REFERRAL FOR YOUR CHILD

Dear Parent/Guardian,

Thank you for permitting your child _____ to attend our Dental Health Promotion and Preventive Services program provided by UBC dental instructors.

We have noticed there are some areas of concern (_____) that should be attended to by a dentist. We have not taken any x-rays so we cannot determine the extent of the problem.

Below is a list of dental clinics that offer reduced fees. Please call first to see if your child can be seen by them (certain restrictions apply).

Your child may be eligible for up to \$1400 through the **MSP Healthy Kids Program: website – www.eia.gov.bc.ca/bchealthykids/**

To apply for MSP, contact the Ministry of Health Services at: **604 683-7151** or toll free at: 1-866-866-0800 Press 4 Press 2. More information available from Health Insurance BC website at: **www.HIBC.gov.bc.ca**.

If you have any questions, please contact your child's teacher.

Regards

Vancouver Dental Clinics with reduced dental fees

Mid-Main Community Health Centre 3998 Main Street, Van, BC 604-873-3602

REACH Community Health Centre 1145 Commercial Drive, Van, BC 604-254-5456

Strathcona Health Society 601 Keefer Street, Van, BC 604-713-5851

UBC Dental Clinic 2151 Wesbrook Mall, Van, BC 604-822-2112

Vancouver Community Dental Clinic

Grandview-Woodland Community Health Centre

1669 E Broadway, Van, B.C. 604-675-3980

Website: http://www.vch.ca/EN/find_services/find_services/?&program_id=10945

East Side Walk-in Dental Clinic 455 East Hastings Street, Van, BC 604-254-9900

UBC DENTISTRY



Date of dental examination: _____

Location:

To the Parents/Guardians of _____

Your child has been seen by a team of dental educators from University of British Columbia in the elementary school your child is attending and has been examined for visible dental decay.

We gave your child an oral hygiene kit and please assure that your child brushes his/her teeth everyday daily with a pea-size amount of fluoridated toothpaste.

At present, your child does not need urgently to be seen by a dental professional but every child needs a regular check-up at least once a year in a dental office.

Regards,

Appendix 8 Questionnaire

<p>Age..... Gender <input type="checkbox"/> Boy</p> <p style="padding-left: 150px;"><input type="checkbox"/> Girl</p> <p>HOW MANY YEARS HAVE YOU LIVED IN CANADA?.....</p> <p>Place of birth</p>	<p>yrs. ca</p>																								
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<p>Do you HAVE a DENTAL INSURANCE FOR YOUR CHILD? No <input type="checkbox"/> (0) Yes <input type="checkbox"/> (1)</p>	<p>Dent.ins</p>																								
<p>Your Family's LIVING EXPENSES are from:</p> <p style="padding-left: 40px;">Mother's paid position <input type="checkbox"/></p> <p style="padding-left: 40px;">Father's paid position <input type="checkbox"/></p> <p style="padding-left: 40px;">From other family members <input type="checkbox"/></p> <p style="padding-left: 40px;">From social assistance <input type="checkbox"/></p> <p style="padding-left: 40px;">Other sources and they are.....</p>	<p>No.inc Moth.inc Fath.inc Fam.inc Soc.ass Other.inc</p>																								
<p>What is your annual FAMILY INCOME BEFORE TAXES?</p> <p style="padding-left: 100px;">No income <input type="checkbox"/> 1</p> <p style="padding-left: 100px;">Less than 6,000 <input type="checkbox"/> 2</p> <p style="padding-left: 100px;">6,000-12,000 <input type="checkbox"/> 3</p> <p style="padding-left: 100px;">12,000-20,000 <input type="checkbox"/> 4</p> <p style="padding-left: 100px;">20,000-30,000 <input type="checkbox"/> 5</p>	<p>Income</p>																								

30,000-40,000 <input type="checkbox"/> 6 More than 40,000 <input type="checkbox"/> 7	
WHEN DID YOU SEE A DENTIST LAST TIME?	Dent.1
Reasons for your last Dental Visit (why did you see a dentist?)	Dent.2
Do you clean BETWEEN your teeth? No <input type="checkbox"/> (0) Yes <input type="checkbox"/> (1) If YES, HOW	Betw.teeth
How often do you brush? <input type="checkbox"/> Never <input type="checkbox"/> Not daily <input type="checkbox"/> Once a day <input type="checkbox"/> Twice a day <input type="checkbox"/> After every meal	Ferq. Brush