An investigation of the effect of neighbourhood characteristics on traumatic dental injuries among a sample of Quebec children

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Abstract

Introduction: Evidence suggests that neighbourhood characteristics are associated with health; however, this association has not been fully explored in regards to Traumatic Dental Injury (TDI) in Quebec. Objectives: To assess the prevalence and factors associated with TDI to permanent anterior teeth in children participating in the QUALITY cohort. Methods: Study participants (N=279) include children 8-10 years of age at risk of obesity, and their families. TDI was clinically evaluated using the same criteria of the Children's Dental Health Survey’s questionnaire, UK. Questionnaires completed by children and their parents collected data on socio-demographic, behavioural and environmental factors. Results: The prevalence of TDI was 12.9%. Children with incisal overjet greater than 5mm, from high socioeconomic backgrounds, and residing in neighbourhoods with high levels of social capital were more likely to have TDI. Conclusion: Neighbourhood characteristics, such as social capital and socioeconomic status may be associated with TDI experience.
Résumé

Introduction: Des études ont démontré que les caractéristiques des quartiers étaient associées à la santé; toutefois, cette association n'a pas été complètement explorée en regard du trauma dentaire (TD) au Québec. Objectifs: Évaluer la prévalence de TD ainsi que les facteurs associés au TD sur les dents antérieures chez les enfants participants à la cohorte QUALITY. Méthodes: Les participants (N=279) étaient des enfants, âgés de 8 à 10 ans et ayant un risque élevé de développer l'obésité, ainsi que leurs familles. TD a été cliniquement évalué en utilisant les mêmes critères du questionnaire de l'Enquête de Santé Dentaire des Enfants du Royaume-Uni. Les questionnaires complétés par les enfants et leurs parents ont permis de recueillir des données sociodémographiques, comportementales et environnementales. Résultats: La prédominance de TD s’élevait à 12.9 %. Les enfants ayant un surjet incisal plus grand que 5 millimètres, une position socioéconomique élevée et résidant dans les quartiers avec un niveau de capital social élevé étaient plus à risque de TD. Conclusion: Les caractéristiques des quartiers tels que le capital social et le statut socioéconomique pourraient être associées avec le TD.
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1. Introduction and Literature Review

1.1. Introduction

Traumatic dental injuries (TDI), defined as fractures to the anterior teeth (1), have become the most serious dental public health problem (1-3) in children since a remarkable decline in the prevalence and severity of dental caries in many countries (3).

Despite its importance, there is a lack of epidemiological data on TDI in developing and industrialised countries, in particular when compared to epidemiological data on dental caries and periodontal disease (3). While extensive research has been carried out on the biological consequences and the improvement of new technology for restorative treatment of TDI, data on its prevalence are lacking world-wide. Few publications reported the prevalence of TDI to range between 2.4 and 58.6% (Table1-1). In the last decade, a number of studies showed that the prevalence of TDI in Europe varied from 13.6 to 34%; while data from Latin America showed that the prevalence of TDI ranged from 13.6 to 58.6%. In North America, data from the last National Health and Nutrition Examination Survey (NHANES) show that the prevalence of TDI was 11.0% among American children 9-11 years of age (4). In a Canadian study involving 12-14 years old children from two communities in the province of Ontario the prevalence of TDI was 11.4% (5).

Although TDI is not a life threatening condition, its impact on individuals’ (mainly in adolescents since TDI occur early in life) overall health and well-being and its public health burden are enormous. TDI has social, psychological, emotional and functional impacts on people’s quality of life since it affects several functions such as smiling,
TDI is also expensive to treat, in both short and long terms. Direct costs include those for health care services, transportation, medications and pharmaceutical items, while the indirect costs refer to those due to loss of productivity. Therefore, TDI is considered a serious dental condition among children and its treatment costs are expected to surpass those of dental caries.

Most common sources of TDI are falls and collisions, sports activities, unsafe playgrounds in schools, road accidents or violence. The few population-based studies that have been carried out corroborate that sports, violence and traffic accidents are the main causes of dental injuries. “Falls”, which are commonly reported as the main cause of TDI, is a broad category that includes many other causes of TDI. For example, falls due to pushing are related to violence, but are generally recorded as “falls”.

Predisposing factors include increased incisal overjet of the teeth and inadequate lip coverage which are significant to TDI.

Environmental, biological, social, behavioural, and lifestyle factors are known to play a role in the etiology of TDI. It has been observed that boys have a tendency to experience more TDI compared to girls; in addition, children who are obese are at a greater risk of having TDI compared to their non-obese counterparts. It has also been reported that children from non-nuclear families and overcrowded homes have a greater

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1 Overjet is defined as the measure of the distance from the labial surface of the lower incisor to the labial incisal edge of the corresponding upper incisor.
risk of enduring TDI compared to those from nuclear families and living in homes that are not overcrowded (19, 28-30). Furthermore, children engaging in prosocial behaviour were less likely to sustain TDI (31). The relationship between indicators of socioeconomic status (SES) and the occurrence of TDI is not clear. First, there is a lack of information on SES in some studies. Second, among the studies that have included it, there are conflicting results.

There is growing evidence suggesting that neighbourhood characteristics, such as physical (services and amenities), social (safety and violence, social support and cohesion, social norms, and social capital), environmental (parks and access to physical activity resources) and socioeconomic characteristics (neighbourhood income, neighbourhood education and neighbourhood social capital) influence health (32-42). Although a few studies have investigated the association between neighbourhood characteristics and oral health outcomes including TDI, the evidence in the field remains equivocal (30, 32, 37, 38, 42-44).

As outlined above, TDI is an important dental public health problem. However, there is no information on its prevalence and main risk factors in a Quebec population. In addition, although some studies have reported an association between neighbourhood characteristics (e.g., SES and social capital) and TDI, more research is required to fully understand its underlying causal pathway.

The present project assesses the prevalence and associated risk factors of TDI among the children participating in the Quebec Adipose and Lifestyle InvesTigation in Youth
QUALITY Cohort) for three main reasons. First, despite the expense and substantial impact on quality of life, to date little research has been conducted in this area. Second, this will provide the first epidemiological data on TDI in a Quebec population. Third, there is a need to better understand the relationship between neighbourhood characteristics and TDI.

1.2. Literature Review

1.2.1. Introduction

This literature review is divided into ten sections and covers substantial evidence on topics related to the present study. Section 1.2.2 defines traumatic dental injuries. Section 1.2.3 presents the etiology and type of TDI. While section 1.2.4 presents an overview of the prevalence of TDI reported in population-based studies. Section 1.2.5 presents sex, age distributions and the etiology of TDI. Section 1.2.6 presents a general review on the association between clinical predisposing factors and TDI. Section 1.2.7 presents a general review on socioeconomic factors associated with TDI in adolescents. Section 1.2.8 presents a general review on psychosocial factors associated with TDI prevalence. Section 1.2.9 presents a general review on how neighbourhood characteristics are associated with general and oral health outcomes, including TDI. Finally, section 1.2.10 will provide a brief summary of the literature review.
1.2.2. Definition of traumatic dental injury

Traumatic dental injury, defined as fractures to the anterior teeth (45) is an irreversible process, once inflicted, it’s there and present; as a consequence, its prevalence increases with age in any cohort. However, this condition is treatable and its treatment may vary depending on the severity of the injury. Due to the high sensitivity of dental tissues, severe pain is typically associated with such injuries. TDI can occur as a result of falls, fights, sport mishaps, vehicle accidents, drinking hot beverages or eating hard foods, among other reasons. There are several ways to measure TDI, either through a questionnaire that gathers information on TDI or a clinical examination—oral exam of soft and hard tissue, and/or radiographic exam—these will assess the presence or absence of TDI.

1.2.3. Etiology and type of TDI

Common accidents which resulted in TDI include a range of factors such as: falls, physical activity, violence, collisions, traffic accidents and misuse of teeth among other unspecified accidents (12, 18, 19, 21-23, 46-48). In an English study, only sports and exercise related injuries were significantly more common in boys than girls (49). Depending on the age and type of accident, TDI may vary in number, type and severity (18). Many studies revealed that the main type of TDI to permanent teeth among children was simple enamel fracture without pulp exposure; moreover, the most prone teeth to dental injuries were the maxillary central incisors, followed by the maxillary lateral incisors (12, 18, 22, 50, 51). Teeth displacement were more common among young children with primary teeth because of the resilient characteristic of supporting structures,
such as alveolar bone and periodontal ligament (18). It has also been reported that TDI to primary teeth occur mainly within and around homes; whereas, homes and schools were the main sites of TDI to permanent teeth (12, 18, 22, 23, 47, 48).

**Figure 1.** Environmental and behavioural causes of TDI (1)

![Diagram showing Environmental Factors, Human Factors, Vector, and TDI](image)

1.2.4. **Reported prevalence of TDI in population-based studies**

Studies on TDI prevalence conducted world-wide may reflect real local differences in the proportion of injury or be the result of the different methodological approaches adopted. Like many other fields of research, the issue of case definition and indices to measure the disease/condition of interest makes comparison of data from different studies a major challenge. Although several epidemiological indices have been used to measure TDI (Andreasen’s classification, World Health Organization’s (WHO) classification Garcia-Godoy’s, Ellis classification, etc.), there is no consensus among researchers on the best instrument to measure this condition (18). In addition, some researchers have chosen to record only specific injuries and use their own classification, which makes the
comparison between studies even more difficult (18). Nevertheless, an overall epidemiological profile of this condition can be obtained.

Several international studies have found the prevalence of TDI among children worldwide to range between 2.4 and 58.6% (Table 1-1). Stockwell reported the incidence of TDI among a sample of Australian children 6-12 years of age was 1.7 patients/100 children/year, involving 2.1 teeth/100 children/year (46). A British study by Hamilton et al. reported the incidence of TDI as 4 cases/100 children/15 months (52).

Studies carried out in Brazil have shown a substantial variation in TDI prevalence between different regions. In four separate studies investigating TDI among children from distinct cities of Brazil, the prevalence of TDI ranged from 10.5 to 20.4% (19, 47, 48, 53). In North America, the prevalence of TDI varies between 11 and 18%. Data from the last NHANES show that 11.0% of American children had experienced TDI (4). Likewise, a Canadian study involving 12-14 years old school children from two communities in the province of Ontario found that the prevalence of TDI was 11.4% (5). In an earlier Canadian study by Locker, the prevalence of TDI among 3,010 Ontario school children was 18.5% (54).
<table>
<thead>
<tr>
<th>Author</th>
<th>Country</th>
<th>Year</th>
<th>Age</th>
<th>Sample size</th>
<th>Prevalence (%)</th>
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</thead>
<tbody>
<tr>
<td>Garcia-Godoy et al. (55)</td>
<td>Dominican Rep.</td>
<td>1986</td>
<td>7-16</td>
<td>1,200</td>
<td>18.9</td>
</tr>
<tr>
<td>Uji et al. (56)</td>
<td>Japan</td>
<td>1988</td>
<td>6-18</td>
<td>15,822</td>
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<td>Hunter et al. (57)</td>
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<td>Forsberg et al. (20)</td>
<td>Sweden</td>
<td>1993</td>
<td>7-15</td>
<td>1,635</td>
<td>30</td>
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<tr>
<td>Delattre et al. (58)</td>
<td>France</td>
<td>1994</td>
<td>6-15</td>
<td>2,020</td>
<td>13.6</td>
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<td>Hargreaves et al. (59)</td>
<td>Africa</td>
<td>1995</td>
<td>11</td>
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<td>15.4</td>
</tr>
<tr>
<td>Petti et al. (60)</td>
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<td>1996</td>
<td>6-11</td>
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<tr>
<td>Kania et al. (13)</td>
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<td>Hamilton et al. (61)</td>
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<td>1997</td>
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<td>Marcenes et al. (2)</td>
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<tr>
<td>Al-Majed et al. (50)</td>
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<td>Nicollau et al. (19)</td>
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<td>2001</td>
<td>13</td>
<td>652</td>
<td>20.4</td>
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<tr>
<td>Cortes et al. (14)</td>
<td>Brazil</td>
<td>2001</td>
<td>9-14</td>
<td>3,702</td>
<td>13.6</td>
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<tr>
<td>Marcenes et al. (62)</td>
<td>Brazil</td>
<td>2001</td>
<td>12</td>
<td>652</td>
<td>58.6</td>
</tr>
<tr>
<td>Marcenes et al. (30)</td>
<td>Britain</td>
<td>2001</td>
<td>14</td>
<td>2,242</td>
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</tr>
<tr>
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<td>Grade 3</td>
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<td>2.4</td>
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<tr>
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<td>12</td>
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<td>18.9</td>
</tr>
<tr>
<td>Tapias et al. (21)</td>
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<tr>
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<td>Brazil</td>
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<td>12</td>
<td>116</td>
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<tr>
<td>Traebert et al. (12)</td>
<td>Brazil</td>
<td>2006</td>
<td>12</td>
<td>260</td>
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<tr>
<td>Malikaew et al. (22)</td>
<td>Thailand</td>
<td>2006</td>
<td>11-13</td>
<td>2,725</td>
<td>35</td>
</tr>
<tr>
<td>Locker (7)</td>
<td>Canada</td>
<td>2007</td>
<td>11-14</td>
<td>370</td>
<td>37.5</td>
</tr>
</tbody>
</table>
Therefore, it can be seen from the above that the prevalence of TDI varies from one country to another, and even between different regions within the same country. The reported difference in TDI prevalence may be due to multiple factors, including: definition of TDI, indices used to measure the condition, the dentition studied, geographical, social and behavioural differences between different environments, study designs, among others (18).

1.2.5. Sex, age distribution and the etiology of TDI

1.2.5.1. Sex

There is an overwhelming amount of evidence suggesting that boys are at a higher risk of experiencing TDI to permanent teeth compared to girls; on the contrary, there was no apparent difference in TDI to primary teeth between both sexes (10, 14, 18-27). An English study reported that boys were 1.5 times more likely to endure major head and other injuries compared to girls (49). Similarly, a study from Ontario showed that boys (21.3%) had a significantly higher prevalence of TDI compared to girls (13.4%) which varied across the six communities involved (10.7-29.4%) (54). However, a study carried out in Damascus, Syria showed that the difference between boys and girls was not statistically significant (P>0.05) (2). This was in accordance with the results of a recent study carried out in South Brazil (12). Behavioural and cultural diversity may have accounted for the differences in these findings. Gender gradient in TDI prevalence is consistent with the evidence that risk behaviour are more common and boys than girls (42).
1.2.5.2. Age

Several studies investigating TDI among all age groups have suggested that the age group with the highest prevalence of TDI range from 9 to 12 years old; nevertheless, some variations were observed. For example, a Scandinavian study showed that the prevalence of TDI increased with age up to 11 years old and no clear increasing trend was noted after this age (65). In addition, another study reported different peak ages for TDI experience among boys and girls, and that above the age of 12 the prevalence was lower for both sexes (66). Moreover, an Italian study reported that the highest prevalence of TDI was among the 9-year-old children (60). Other studies did not report clear results in regards to the association between age and TDI prevalence (58, 67).

As discussed previously, comparisons between age groups in different studies have to be carefully performed since TDI studies use a wide range of mean age and age groups as shown in Table 1-1. Despite these difficulties, Andreasen and Andreasen suggested that the age of 12 is the best age to present the prevalence of injuries to permanent teeth (68). It is the age after the mixed dentition and the period of high incidence of TDI.

1.2.6. The association between clinical predisposing factors and TDI

Clinical predisposing factors associated with TDI prevalence include incisal overjet of the teeth and lip coverage (2, 14, 15, 17, 18, 22, 23, 48). Overjet is defined as the measure of the distance from the labial surface of the lower incisor to the labial incisal edge of the corresponding upper incisor. The concepts of normal, increased and extreme overjet varied in different studies but there is evidence to support the relationship between
protrusion (term used to indicate an increased overjet) of the incisors and TDI. Several studies have shown that children with an overjet larger than 3 mm are more likely to experience TDI than children with an overjet smaller than 3 mm (11, 27, 60, 69). In addition, it is suggested that risk of injury of anterior teeth tended to increase with increasing overjet size (11).

Inadequate lip coverage (the extent to which the upper lip covered the teeth) is another predisposing factor for TDI. It is suggested that children with a short upper lip lack soft tissue protection over the upper incisors making them more exposed at the moment of the injury. Several studies have demonstrated a positive association between inadequate lip coverage and TDI (2, 14-17).

1.2.7. Socioeconomic factors and TDI prevalence

The relationship between socioeconomic factors and TDI is equivocal. While some studies have found no association between SES and TDI (10, 19, 23), others have reported a negative association where TDI is higher at low SES (61, 70, 71) or a positive association where TDI is higher at high SES (14, 15) (Table 1-2).
Table 1-2 The association between socioeconomic status and TDI

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Type of Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jamani and Fayyad (71)</td>
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<td>Jordan</td>
<td>Negative</td>
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<tr>
<td>Hamilton et al. (61)</td>
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<td>Marcenes et al. (10)</td>
<td>2000</td>
<td>Brazil</td>
<td>No Association</td>
</tr>
<tr>
<td>Cortes et al. (14)</td>
<td>2001</td>
<td>Brazil</td>
<td>Positive</td>
</tr>
<tr>
<td>Nicolau, et al. (19)</td>
<td>2001</td>
<td>Brazil</td>
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<tr>
<td>Perheentupa et al. (70)</td>
<td>2001</td>
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<tr>
<td>Odoi et al. (15)</td>
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<td>Positive</td>
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<td>Brazil</td>
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<tr>
<td>Malikaew et al. (22)</td>
<td>2006</td>
<td>Thailand</td>
<td>Negative</td>
</tr>
<tr>
<td>Oliveira, et al. (51)</td>
<td>2006</td>
<td>Brazil</td>
<td>No Association</td>
</tr>
<tr>
<td>Fakhruddin, et al. (5)</td>
<td>2008</td>
<td>Canada</td>
<td>No Association</td>
</tr>
</tbody>
</table>

For example, a study carried out in the United Kingdom showed that the prevalence of TDI was 38% in children from lower socioeconomic group compared to 30% in middle and upper socioeconomic groups (61). Other studies have reported similar results (22, 70, 71). Jamani and Fayad have observed that Jordanian children from lower and middle SES experienced more TDI compared to those from higher SES (71). An American study by Kania et al. found the overall prevalence of TDI to be significantly higher among non-Caucasians (21.7%) compared with Caucasians (17.5%); race may be a proxy measure of SES, thus reflecting a social gradient in TDI experience (13). On the other hand, studies have reported that the prevalence of TDI was lower among children from low socioeconomic backgrounds compared to their counterparts (14, 15). Cortes et al. found that children from low SES were less likely to endure TDI compared to children from
high SES in a sample of Brazilian children (14). Finally, a few studies showed no association between SES and TDI (19, 62). These conflicting results may in part reflect the complexity and variation in the broader social conditions that contextualize different societies.

1.2.8. Psychosocial factors associated with TDI

There is evidence that psychosocial factors play a role in the etiology of TDI. For example, children from non-nuclear families and those who did not perform well at school had more TDI compared to those from nuclear families and those who did well at school. The later may be a proxy measure of behavioural problems. Similarly, Odoi et al. reported that children with peer relationship problems had an increased risk of experiencing TDI (31).

1.2.9. Neighbourhood characteristics and TDI prevalence

Since the early 1990’s has been increasing evidence showing that socioeconomic and cultural neighbourhood features influence health. For example, studies have shown that people living in more equal and affluent neighbourhoods have higher life expectancy, lower mortality rates, better perception of self-rated health, and are less violent (41). One of the hypotheses put forward to explain how neighbourhood income distribution influence health has been via social capital (72, 73). The concept of social capital, first introduced in the literature by Coleman in 1988 (74), was revived in 1993 by Putman’s work on social participation which suggest that community levels of social cohesion may
influence health (75). Social capital is an inherently ecological concept which focuses attention on properties of the communities. It is the connections among individuals and connections within and between social networks; the social network—shared norms, values and trust—can increase the productivity at both the individual and collective levels (76). Social capital comprised five different components: social trust (residents’ perception of trust, ties and solidarity in their neighbourhoods), social control (neighbours intervening when necessary; for example, when children are engaging in delinquent behaviours), empowerment (residents’ social actions to improve their neighbourhoods), neighbourhood security (residents’ perception of their area’s safety and security levels), and finally political efficacy (residents’ perception of their area’s political system and politicians) (42).

Although several studies have investigated the association between neighbourhood characteristics and general health outcomes (33, 35, 77-79), only a few studies have used oral health outcomes including TDI. Kawachi et al. in a cross sectional ecological study using data from 39 US states found that mortality rates from accidental injury were higher in states that were lacking social trust, fairness, and helpfulness between community members (80). However, the effect of social capital was reduced after introducing an area-based measure of poverty into the statistical model (80).

In a multi-level study, Pattussi et al. examined individual and neighbourhood effects on TDI prevalence among 14-15 year old children. The results showed that the prevalence of TDI was significantly lower in neighbourhoods with higher levels of social capital (42). Boys living in areas with high levels of social capital had a decreased risk of experiencing
TDI compared to boys living in areas with low levels of social capital (42). There was no statistically significant association between social capital and TDI prevalence in girls. In addition, poverty level was not statistically associated with TDI in either sex. However, those living in areas with a more favourable infrastructure (variables of infrastructure included: recreational facilities, religious establishments, security, educational and health facilities, and philanthropic and social organizations) were more likely to experience less TDI (42).

In a cross-sectional ecological survey, Moyses found that supportive policies (e.g. policies that support implementation of public day care centers, healthy food environments in schools, and adequate community dwellings) were statistically significantly associated with lower TDI prevalence (81). In addition, physical environment measurements obtained from public administration database (e.g. numbers of parks, sidewalks, etc.) was negatively associated with TDI prevalence. A 4% decrease in the risk of experiencing TDI was observed per each unit of improved physical environment (81).

Along the same line, studies have shown that school environments, which are influenced to some extent by neighbourhood factors, and may be indirect measures of broader neighbourhood characteristics, are associated with TDI prevalence. Moyses et al. found a 5% lower prevalence of TDI among children attending supportive schools [e.g. school participation in the community, school curriculum, school physical environment (e.g. green areas, conditions of play areas, etc.)] compared to those attending non-supportive schools (82). Similar results were reported in a Thai study (83). Malikaew et al. found
significantly lower rates of TDI in supportive compared to non-supportive schools, (Odds Ratio (OR) = 0.7; 95% Confidence Interval (CI) = [0.5-0.9]) (83).

1.2.10. Summary of the literature review

TDI is a very common dental condition across many countries of different socio-economical and cultural backgrounds. This costly and preventable condition can potentially contribute substantially to the public health burdens. The overall prevalence ranges from 2.4 to 58.6%. The main reported causes of TDI in the literature were falls and sports. Incisal tooth overjet and lip coverage are two anatomical factors that were highly associated with TDI experience among children. Most studies reported that ages 9-12 is the age group with the highest prevalence of TDI. Furthermore, TDI are more likely to occur to central incisors and affect one tooth. The evidence in the literature is not consistent regarding the relationship between SES and TDI prevalence. While some studies suggested a negative association, other studies observed either a positive association or no association. Other factors associated with TDI included gender, psychosocial factors (e.g. family structure, behavioural problems, etc.) and environmental factors (e.g. school and residence characteristics). Although a few studies have explored the association between neighbourhood characteristics and TDI prevalence, the evidence in the field remains unclear. This thesis may contribute to scientific knowledge and debate on our knowledge-base by (i) investigating the prevalence and main risk factors of TDI in a Quebec population, and (ii) investigating the association between neighbourhood characteristics and TDI among Quebec children.
2. Theoretical framework, aims and hypothesis

2.1. Conceptual framework of the study

Oral and general health tend to share common determinants; thus, the same risk factors, be it physical or social may cause bodily and/or TDI. According to the literature, there is evidence suggesting that neighbourhood characteristics (e.g. social capital) are associated with health outcomes. Such associations may depend on several factors acting separately or interactively to mediate them. For example, the health disparities (oral and general) seen across different neighbourhoods may be the result of compositional (individuals), contextual (physical and social environment) and collective (socio-cultural) differences in the areas (34). The collective explanations for the health gradient across neighbourhoods draw our attention on how psychosocial constructs, such as social capital/cohesion and the perceived SES in neighbourhoods can influence health (34).

The theoretical framework of this study assumes that compositional, contextual and collective component differences across Montreal neighbourhoods will affect the prevalence of TDI. Parent’s perception of neighbourhood safety determines the amount of children physical activity, as parents restrict their child’s physical activity due to their anxiety and concerns about their neighbourhood safety (84, 85). Neighbourhoods with higher levels of social capital and proportions of residents with high family incomes tend to have better social and environmental networks. In addition they have a better physical environment (e.g. neighbourhood encourages activity, sport facilities, well-kept, sport access) which in turn will encourage residents (children and adults) to go outdoors within
their residential areas and participate in social/community activities, including physical exercises. Parents perceive their neighbourhoods as safe places and trust their neighbours to be responsible for their safety and the safety of their family members, particularly during their absence. Therefore, allowing their family members to spend so much of unsupervised time outdoors in parks, outdoor sport activities and among other recreational centers. As a result of this psychosocial construct which highly promotes sports and physical activities by all members of the society, TDI are more common as the amount of exposure time outdoors increases. This outgoing behaviour, and shared traditions, values and norms may act as the mediating pathway between the neighbourhood characteristics (exposure of interest) and TDI (outcome of interest).

**Figure 2.** The causal diagram and potential confounders

<table>
<thead>
<tr>
<th>Potential Confounders:</th>
</tr>
</thead>
<tbody>
<tr>
<td>-SES</td>
</tr>
<tr>
<td>-Family structure</td>
</tr>
<tr>
<td>-Obesity</td>
</tr>
<tr>
<td>-Sex</td>
</tr>
</tbody>
</table>

Neighbourhood Characteristics → TDI
2.2. Aims

The aim of this study is to assess the prevalence and associated factors of TDI to anterior teeth in a sample of Quebec school children. In addition, it aims to investigate the association between neighbourhood characteristics and TDI.

2.3. Hypothesis

This study hypothesizes that there exists a relationship between neighbourhood characteristics (e.g. perceived social capital and perceived built environment) and TDI.
3. Methods

3.1. Introduction

This section is divided into three sections. Section 3.2 will provide a detailed overview of the study design, setting, how the subjects were recruited, and inclusion/exclusion criteria. Section 3.3 will introduce in detail the data collection, how the variables were managed and created, and statistical analyses and techniques used.

3.2. Study Design

3.2.1. Overview

This project was nested within the Quality Cohort study, an on-going large prospective study designed to investigate the natural history of obesity in youth. Data from the first visit only were used for this study; thus, the current analysis uses a cross-sectional design. The Quality Study assesses the cardiovascular health and related risk factors in a cohort of children aged 8 to 10 years at baseline. Repeat assessments are scheduled every two years, until the age of 20 years, and take place at the Clinical Research Units of Sainte-Justine Hospital (Montreal) and Laval Hospital (Quebec City). The study investigates prospectively how several exposures including biological, social, psychosocial, behavioral, nutritional and environmental may be associated with the development of obesity, diabetes type-2, cardiovascular disease, and chronic oral disease.
3.2.2. Setting

The study takes place in the clinical research units of Sainte-Justine Hospital in Montreal and Laval Hospital in Quebec City. The children together with both their biological parents are required to spend a full day at one of the two above mentioned units, where they undergo several steps in the process of providing data.

3.2.3. Subject Recruitment

This study uses a convenient sample of the Quality Cohort Study. The sample population includes 8-10 year old children and their families living within the areas of Montreal or Quebec cities. The majority of these children have been recruited through their schools (32 school boards and 1304 schools of both the private and public sectors) located within 75km of Montreal and Quebec cities. Participating schools distributed information pamphlets about the study to students in grades 2, 3, 4, and 5. Parents were invited to contact the study coordinator for further information. For families interested in the study who contacted the Quality Cohort personnel, a structured phone interview and a short pre-study clinic visit were conducted to determine whether they meet the eligibility criteria detailed in the next section. For families that satisfied the screening evaluation, further explanations about the study such as frequency of return visits, required physical and clinical examination, specimen collection and interviews were given. Families who met the eligibility criteria and accepted the study requirements were then invited to participate in the study and were asked to sign an informed consent form. The study has been approved by the ethical review committees of Saint Justine Hospital, University of
Montreal, Laval University, McGill University and INRS-Institut Armand Frappier (Appendix 7.1).

3.2.4. Inclusion Criteria

In order to be eligible to participate in the Quality Cohort, the following conditions must be met:

- One child who is available and is 8-10 years of age at the time of enrolment. This range covers the important time period for a natural history study on obesity and its metabolic and vascular consequences. It is the period just before puberty, an important time when developmental and hormonal changes occur.

- Both biological parents are available for the study. This criterion was included in order to investigate the genetic determinants of obesity.

- Families reside in either cities of Montreal or Quebec and surrounding areas; geographic proximity was important both to facilitate study logistics and to minimize loss to follow-up.

- At least one biological parent—father or mother—is obese (BMI ≥ 30 or waist circumference higher than 88cm for women and 102cm for men). This criterion was included to ensure that a sufficient number of children would present with or develop overweight/obesity, over the course of the follow-up period, that is, from the end of childhood to the end of adolescence. Considering the high prevalence of obesity among adults, this high risk population currently represents more than 1 in 3 children in Canada (86).

- Family of Caucasian origin at history to minimize genetic variations.
3.2.5. Exclusion Criteria

- Child known for type 1- or type 2-diabetes.
- Conditions that could interfere with the interpretation of the variables under study:
  - Treatment of the child with systemic corticosteroids, drugs for hypertension or for lipid disorders
  - Severe limitation of the child’s caloric intake (<600Kcal/day)
  - Chronic disease in the child such as cystic fibrosis, inflammatory bowel disease, renal insufficiency, others
- Conditions that could limit the ability of the parents or the child under study:
  - Serious chronic health conditions in parents or the child under study
  - Serious cognitive or psychological dysfunction in parents or the child under study (interviewer assessed)

3.3. Data Collection

3.3.1. Overview

The children and their families visited the clinical research unit, where they were given information regarding the day’s program (Appendix 7.1). Briefly, children had a topical anesthetic cream applied to their skin to reduce discomfort, before their weight, height, skin fold thickness, waist and hip circumferences, and Tanner staging were obtained; only weight and height measurements were obtained for the parents. Other data collected throughout the day included: blood tests, DNA sampling, blood pressure, oral clinical
examination, and questionnaires. Explanation regarding the 24-hour dietary recall and accelerometer also took place during this general visit.

3.3.2. Questionnaires

Four series of questionnaires were completed by selected family members. The first component was administered by a research assistant to the child, in the presence of a parent. Data were collected on personal and general information, physical activity and sports, lifestyle behaviours, general and dental health, stress and anxiety, and diet. The second part of the series comprised a self-administered questionnaire completed by both biological parents. Questions included socio-demographic characteristics, neighbourhood characteristics (social capital, safety, access to sports, etc.), child medical history, child’s dental and oral health, child’s school, friends, feelings and behaviors, parental lifestyle behaviors, parental health and health of other family members. The last set of questionnaires was completed by each biological parent; information was collected on their general and oral health, as well as on the general health of their ancestry.

3.3.3. Clinical Data

3.3.3.1. Dental Exams

As described in detail in the dental manual of procedure (Appendix 7.2), the dental examinations took place in a standardized, safe and sterile setting in compliance with the regulations and recommendations of the Centers for Disease Control, U.S. Public Health Service, and the National Institute of Occupational Safety and Health. In brief, the dental
team (dentist-graduate student) and a dental recorder (nurse) examined each study subject in an orderly manner, using the Federation Dentaire Internationale (FDI) two digit nomenclature, from one tooth or tooth space to the adjacent tooth or tooth space, and following the standard order, starting from the upper right first molar to the lower right first molar. The details of each dental examination were recorded on dental charts that were custom made for this survey. The criteria for the oral clinical exam were selected based on their validity, reliability, and comparability with other studies.

### 3.3.3.2. Clinical Measurements

The oral clinical examination assessed the caries experience (DMF index), periodontal health (presence and absence of bleeding upon probing and calculus), indicators of oral hygiene (presence or absence of plaque), microbiological and inflammatory indicators of periodontal diseases (plaque and gingival crevicular fluid (GCF) samples), and traumatic dental injuries (TDI). The latter was clinically evaluated by the presence and absence of trauma to upper and lower permanent incisors and recorded using the same criteria as the Children’s Dental Health Survey, United Kingdom. In the case where TDI was suspected or detected, a questionnaire was given to the subject that gathered detailed information pertaining to the observed injury (Appendix 7.3).

All permanent incisors and associated buccal and lingual or palatal soft tissue were examined in sequence from upper right to lower right, where the teeth were dried before the dental examination using cotton gauze. The initial assessment included both treated and untreated injuries. Several categories of dental trauma were identified during the
clinical examination: code 0 for no TDI, code 1 for treated TDI, code 2 for enamel fractures, code 3 for enamel and dentine fractures, code 4 for pulp involvement and code 5 for missing teeth due to TDI. However, in the final stages of determining the presence or absence of trauma, a summary variable representing TDI was created, by counting the values of all the different scores of TDI within cases, with each score ranging from 0-5. Scores of TDI count other than zero were recoded as ‘1’ which meant “TDI present”, while scores of zero remained as ‘0’ in the recode which meant “TDI absent”.

Two anatomical features—size of the overjet and type of lip coverage—were assessed since they are well known clinical predisposing factors for TDI. The assessment of incisal overjet was done using the CPI probe; the black line on the CPI probe was used to determine if the overjet size was less than 5mm (if the largest maxillary overjet is equal to or lower than 5mm) or more than 5mm (if the largest maxillary overjet is greater than 5mm). The type of lip coverage was assessed while the subject was not conscious of him/her being examined, and was recorded as adequate (if the lips completely cover the upper incisor at rest) or inadequate (if the lips do not completely cover the upper incisor at rest) (Appendix 7.4).

3.3.3.3. Other Measurements

Since body mass index (BMI) has been associated with both TDI and neighbourhood characteristics, this variable was included in this project as a potential confounding factor. Height and weight were measured up to three times, according to standardized protocols. A clinical technician measured body weight of children in light clothing and without
shoes to the nearest 0.1 kg on a digital scale. Body height was measured to the nearest 0.1cm using a stadiometer during maximal inspiration. The BMI was computed as weight/height$^2$ (Kg/m$^2$). BMI was then grouped into 3-categories using the age- and sex-specific percentiles of the US Centers for Disease Control and Prevention (CDC) 2000 growth charts: normal (BMI < 85th), overweight (BMI ≥ 85th to < 95th) and obese BMI (≥ 95th) (87). When more than two measures were available, the average of the two closest measures was used in the statistical analysis.

3.3.3.4. Census Data

In addition to the data on neighbourhood characteristics obtained from the questionnaire, we used 2001 Canadian Census data from Statistics Canada to derive neighbourhood indicators. Variables included proportion of homes with single parents, proportion of individuals at least 15 years of age with a Baccalaureate or more, proportion of individuals at least 15 years of age without grade nine education, proportion of people on welfare, proportion of people with low income, neighbourhood average family income, and neighbourhoods’ population. Census data were available by dissemination area; a dissemination area is a small and relatively stable geographic unit composed of one or more blocks, typically including a population of 400 to 700 persons. It is the smallest standard geographic area for which all census data are made available (88).

Indicators were computed for the 500m circular buffer zone surrounding each participant’s residential postal code. A postal code typically identifies a street segment,
and the residence is assumed to be in the middle of the segment. Indicators were computed as a weighted average of all dissemination areas intersecting the buffer zone.

3.3.4. Data Management

A special database was set up in one of Sainte-Justine’s secure servers specifically for storing the Quality Cohort data. The data collected (interview, dental exams or by other means) were entered into the database immediately after they were obtained, and compiled into a digital file. No one other than the primary researchers and research assistants had access to the data. Relevant data pertaining to this study were requested at different stages in time, according to the desired analysis procedures.

3.3.5. Study Status

The study began in the summer of 2005 and is ongoing; enrolment is scheduled to end in December 2008. The units are operating at full capacity, and the target of 650 families is expected to be attained. The 300 families included in the study sample for this project comprise the most recent available complete update of the study database, at the end of December 2007.

3.3.6. Statistical analysis, data editing and construction of the variables

This section describes the statistical techniques used in this study, as well as the procedures performed to transform the main variables used in the data analysis. Only our main outcome of interest TDI and independent variables related to the hypothesis and
objectives of the study were used in the analysis. Tables 4-1, 4-5, 4-6, 4-7, 4-8 and 4-9 display the sets of independent variables used in this study.

### 3.3.6.1. Dependent variable/outcome

The outcome of interest in this project was TDI. To create a summary variable representing TDI, we counted values of all the different scores of TDI within cases, with each score ranging from 0-5. Scores of TDI count other than zero were recoded as ‘1’ which meant “TDI present”, while scores of zero remained as ‘0’ in the recode which meant “TDI absent”.

### 3.3.6.2. Independent variables/exposures

We extracted a subset of variables of interest from the information collected in the questionnaires. These variables can be classified into 4 groups (i) clinical measurements, (ii) socio-demographic characteristics, (iii) perceived neighbourhood characteristics, and (iv) lifestyle factors. A fifth group comprised neighbourhood-level indicators obtained from census data.

Among clinical indicators, the variables considered were incisal overjet and lip coverage. Socio-demographic characteristics included age, level of education of the child’s parents, and family income. Perceived neighbourhood characteristics included items reflecting social capital (e.g. neighbourhood safety, trust among neighbours, etc.) and physical characteristics of the neighbourhood (e.g. neighbourhood well-kept, walkability, etc.). Census-based neighbourhood indicators included area-level socioeconomic measures.
Lifestyle variables comprised involvement in sport activities. The coding of each variable was carefully evaluated in view of substantive knowledge from the experience of our team and empirical data distribution.

3.3.6.3. Clinical measurements

Incisal overjet was entered in the database as either absent (recorded as 1) or present (recorded as 2). Similarly, lip coverage was classified as adequate lip coverage (recorded as 1) or inadequate lip coverage (recorded as 2).

3.3.6.4. Socio-demographic characteristics

Age at entry in the study was obtained from the database as a continuous measure. Level of education of the child’s parents was precisely recorded, making the difference among incomplete and complete primary school and secondary school, professional training, CEGEP and university degree (Appendix 7.5). However, because of small proportions of participants within the categories, we categorized (each parent’s) level of education as: completed high school or fewer years of schooling, vocational training or collegial studies, and university degree.

Annual family income was initially coded into 12 distinct categories (Appendix 7.5). Due to relatively small proportions of participants in some of the categories, mainly in the low family income categories, it was decided to dichotomized these variables into family income of <$80,000 and ≥$80,000 using the median as a cut off point.
3.3.6.5. Perceived neighbourhood physical characteristics

A set of questions collecting data on the different dimensions of neighbourhood physical characteristics, were available from the parents’ questionnaire (Appendix 7.6). In order to reduce the number of variables, we performed factor analysis on all items assessing perceptions about neighbourhood characteristics. This statistical technique identifies clusters of large correlation coefficients within a set of interrelated variables which may measure different aspects of the same underlying dimension or concept, i.e. ‘factors’ (89). In other words, it collapses a large set of variables into a more parsimonious numbers of indicators that represent correlated subgroups of the original set of variables. Factors are driven on the basis of the empirical links within a set of indicators, but also depend on analyst subjectivity and substantive knowledge (89).

The set of questions (variables) measuring different dimensions of the exposures of interest and similar concepts were included in the factor analysis. The results of factor analyses are presented after the rotation phase, since the rotated component matrix facilitates the interpretation of the results (89).

There are two types of rotations: orthogonal rotation (factors remain uncorrelated) and oblique rotation (factors are allowed to correlate) (89). Varimax rotation, one of the three methods of orthogonal rotations available on SPSS, was used for this analysis to discriminate between factors (89). This specific type of factor rotation method was chosen because it produces a rotated-matrix that explains the maximum amount of common variance and reveals the smallest number of explanatory concepts (89).
Graphical representation of factors facilitates the understanding and interpretation of the underlying concepts. For example, two uncorrelated factors could be illustrated by a typical two dimensional graph, with each factor being represented by one of the axes. The axis lines ranges from -1 to +1, the outer limits of a correlation coefficient (89). Variables can be plotted on to this graph, with co-ordinates of each variable representing its correlation to each of the factors. The graphical representation of factor analysis will confirm what was obtained from the rotated-matrix. In an ideal situation, a variable will fall mainly on one axis and not the others, suggesting that the variable is associated with only one particular factor (89). Factor loading is the term used to describe a variable’s co-ordinate along an axis (89). It is suggested that for a sample size of 300, as in the case of our study, an absolute value of more than 0.3 is considered significant in terms of factor loading (89).

There is some debate regarding how many factors should be extracted, and whether or not a factor is of substantive significance (89). The Scree plot is a tool which can be used to determine the correct number of factors to be identified (89). The argument made by Cattell was that the numbers of extracted factors should match that above the curve’s point of inflexion (89). Furthermore, Stevens suggested that the Scree plot is a reliable tool for determining the correct number of factors when the sample size is greater than 200 subjects (89).
Below is the description of the variables representing neighbourhood physical characteristics:

**Perceived neighbourhood physical characteristics**

A set of fourteen variables from the parents’ questionnaire (questions V1QB13A to V1QB13O; Appendix 7.6) measuring neighbourhood characteristics was used. These questions are characterized in terms of responses to a five Likert type items, which are rated on a five-point scale ranging from very true (1) to not at all true (5). Table 3-1 displays the results of factor analysis after the rotation phase. Four factors or dimensions of neighbourhood characteristics were identified: neighbourhood encouragement of physical activity (items: V1QB13E, V1QB13F, V1QB13G, V1QB13H, V1QB13J and V1QB13M), neighbourhood sport facilities (items: V1QB13D and V1QB13L), neighbourhood walkability (items: V1QB13A, V1QB13I, V1QB13K and V1QB13O), and neighbourhood well-kept/maintained (items: V1QB13C and V1QB13N).

A discrete variable for each of the above mentioned dimensions was constructed by summing the values of each variable obtained from each subject. For ‘neighbourhood encouragement of physical activity’, scores ranged from 6 to 12, with greater values representing lower levels of neighbourhood encouragement of physical activity. For neighbourhood sport facilities, scores ranged from 2 to 4, with the higher scores representing higher levels of neighbourhood sport facilities. Similarly, the scores for neighbourhood well-kept/maintained, ranged from 2 to 4, albeit with higher values representing lower levels of perceived neighbourhood maintenance, due to reverse coding. Finally, for neighbourhood walkability, scores ranged from 4 to 8, with the higher values representing more favourable walkability. Due to the relatively small numbers,
these variables were dichotomized at the median and categories representing low and high
levels of neighbourhood dimensions were created.

In addition to the information on neighbourhood physical characteristics, the
questionnaire includes a series of questions addressing social capital, and a list of items
on sports facilities. The factor ‘neighbourhood sport facilities’, provides a general
indication of the extent to which parents are satisfied with the quantity of facilities and
equipment in their neighbourhood (Appendix 7.6). In contrast, the list of items (V1Q14A-
T) assesses proximity, availability, and access to specific sports amenities, infrastructures,
and facilities, with respect to the child’s residence (e.g., on a scale from 1 to 5 (from very
c convenient to not at all convenient) how conveniently located are the following
places/facilities with respect to the child’s home? Public park or playground, basketball
court, bike path, etc.).

These variables were summarised as described below:

**Perceived neighborhood social capital**

A set of seven questions derived from the parents’ questionnaire (Appendix 7.6) was used
to measure neighbourhood social capital (two items on feelings of safety (V1QB11A,
V1QB11B) and five items on feelings of trust among neighbours (V1QB12A, V1QB12B,
V1QB12C, V1QB12D and V1QB12E)). While questions V1QB11A, V1QB11B are
characterized in terms of responses to a typical five-level Likert items, which are rated on
a five-point scale ranging from very safe (1) to not safe at all (5), questions V1QB12A,
V1QB12B, V1QB12C, V1QB12D and V1QB12E are characterized in terms of responses
to a four-level Likert type items, which are rated on a four-point scale ranging from
totally agree (1) to totally disagree (4). Due to small numbers in some of the categories, these questions were first dichotomized using their frequency distribution, ensuring that we have enough subjects within each individual cell to proceed with the data analysis.

Secondly, a discrete variable was constructed based on sum of values of each variable obtained from each subject. The scores ranged from 7 to 14, with greater values representing lower levels of social capital. Since some of the categories presented low numbers, we further categorized this variable into low and high levels of neighbourhood social capital using the median as cut off point.

**Perceived neighbourhood sports availability**

Since practicing sports have a major impact on the risk of TDI, this information was also used in the study. In order to compute an overall measure for sports availability in the neighbourhood we used 20 questions which are characterized in terms of responses to a five Likert type items, which are rated on a five-point scale ranging from very convenient (1) to not at all convenient (5). A discrete variable was then constructed by summing the values of each variable obtained from each subject. The scores ranged from 20 to 100, with the lower values meaning more availability to sports and recreation facilities and the higher values meaning lack of conveniently located sports and recreational activities in the neighbourhood. The small proportions of participants within the categories made it unfeasible to keep the variable in its original forms. Thus, the variable was recoded into two categories based on the median.
Table 3-1 Results of factor analysis of parents’ self reported answers to 15 questions about their neighbourhood characteristics

<table>
<thead>
<tr>
<th>Variables</th>
<th>1: N. encourages Activity</th>
<th>2: N. Sport facilities</th>
<th>3: N. Walkability</th>
<th>4: N. Well-kept/Maintained</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Side Walks</td>
<td>.018</td>
<td>.260</td>
<td>-.547</td>
<td>-.070</td>
</tr>
<tr>
<td>Dogs are Well Attended</td>
<td>.249</td>
<td>.087</td>
<td>.108</td>
<td>.683</td>
</tr>
<tr>
<td>Lack of Equipment or Facilities to Incite Children to be Active</td>
<td>-.148</td>
<td>.673</td>
<td>-.180</td>
<td>-.117</td>
</tr>
<tr>
<td>There are lots of Safe Places to be Active</td>
<td>.639</td>
<td>-.376</td>
<td>-.055</td>
<td>.117</td>
</tr>
<tr>
<td>People Walk or Exercise Frequently</td>
<td>.573</td>
<td>-.123</td>
<td>-.039</td>
<td>.143</td>
</tr>
<tr>
<td>Parents are very involved in Watching their Children Participate in Sports</td>
<td>.658</td>
<td>-.057</td>
<td>.022</td>
<td>-.115</td>
</tr>
<tr>
<td>There are Many Supervised and Organized Activities for Children</td>
<td>.609</td>
<td>-.412</td>
<td>.225</td>
<td>-.089</td>
</tr>
<tr>
<td>Many People Walk to the Local Grocery Store</td>
<td>.175</td>
<td>.095</td>
<td>.697</td>
<td>.073</td>
</tr>
<tr>
<td>The Neighbourhood is Attractive</td>
<td>.609</td>
<td>.304</td>
<td>-.135</td>
<td>.181</td>
</tr>
<tr>
<td>It is a High Crime Area</td>
<td>-.191</td>
<td>.049</td>
<td>.583</td>
<td>.057</td>
</tr>
<tr>
<td>There are Few Local Sports Facilities</td>
<td>-.099</td>
<td>.732</td>
<td>.228</td>
<td>.090</td>
</tr>
<tr>
<td>Children can Play Safely outdoors</td>
<td>.464</td>
<td>.087</td>
<td>-.314</td>
<td>.321</td>
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<tr>
<td>Street Lights are often Burned Out</td>
<td>.200</td>
<td>.342</td>
<td>-.055</td>
<td>-.637</td>
</tr>
<tr>
<td>There is Heavy Traffic</td>
<td>-.181</td>
<td>-.204</td>
<td>.495</td>
<td>-.403</td>
</tr>
</tbody>
</table>

Rotation Method: Varimax with Kaiser Normalization.
3.3.6.6. Neighbourhood characteristics – Census data

Census data were imported into an SPSS file where analysis took place. The data included: proportion of homes with single parents, proportion of individuals at least 15 years of age with a Baccalaureate or more, proportion of individuals at least 15 years of age without grade nine education, proportion of people on welfare, proportion of low income people, and average family income. This data were used in their original forms, that is, as continuous variables.

3.3.7. Statistical Procedures

Data analysis was carried out in three stages. Initially, a descriptive analysis was undertaken to assess the frequency distributions of the variables. In the next stage, bivariate analysis (chi square tests, student t-tests and one-way analysis of variance (ANOVA)) were used to assess the relationship between the outcome of interest (TDI) and the independent variables, including: proportion of homes with single parents, proportion of individuals at least 15 years of age with a Baccalaureate or more, proportion of individuals at least 15 years of age without grade nine education, proportion of people on welfare, proportion of low income people, and average family income. Finally, the association between neighbourhood characteristics and TDI was examined using multiple linear regression analysis. For all statistical tests, significance was considered when P<0.05. For the regression models, p-values were obtained from the Wald test, and estimated odds ratios and their 95% confidence limits were determined. A description of the steps carried out in the regression modelling is presented below.
Multiple regression analysis is a mathematical technique used to describe the relation between two or more variables, by predicting one variable from other variables. The concept of regression does not imply any causal relation between the outcome and the explanatory variables. It investigates the joint influence of the explanatory variables or predictors, taking account of possible correlations among them (89).

Multiple regression encompasses a vast array of techniques. In the present study, logistic regression method was used for the data analysis. This technique is used when the outcome is dichotomous. It predicts a transformation of the outcome variable, or the probability of an outcome to occur for any combination of the explanatory variables in the model (89). Adjusted estimates of odds ratios of the factors of interest are obtained, which are adjusted for confounders.

The starting point for modelling was to examine the simple relation between explanatory variable and the outcome of interest. For this, unadjusted regression analyses with neighbourhood characteristics and TDI was performed. All the variables with a p-value of 0.25 or less in the simple logistic regression analysis, and the ones identified in previous research were considered for the multivariate model as suggested by Hosmer and Lemeshow (90). Since evidence suggests that the use of more traditional levels of significance often failed to identify variables of known importance, we use a higher p-value for selection of potential independent variable (91).
The models were built in steps. First, all variables identified using these approaches were entered in the models. They then were removed from the models one at a time based on lack of statistical significance and lack of change in the parameters for the variables which were still in the model (90). In the final, best fitted model, the following variables were included: neighbourhood social capital, proportion of individuals with low family income, neighbourhood walkability, neighbourhood well-kept/maintained, family income, family structure, sex, age, and lastly tooth overjet.
4. Results

4.1. Introduction

This chapter presents the findings of the study. Section 4.2 describes results pertaining to recruitment, response and participation in the study. In section 4.3 the frequency distribution of the variables studied are presented. Section 4.4 describes the results of bivariate analyses on the relationships between socio-demographic, clinical factors and TDI. Section 4.5 describes the results regarding the relationship between neighbourhood characteristics and TDI. Finally, section 4.6 presents the results of the multivariate analysis.

4.2. Recruitment and Participation

As of April 2007, 2778 schools had been contacted, with close to 90% agreeing to participate. To date, 350,750 pamphlets have been distributed to all students in grades 2, 3, 4 and 5 in participating schools. A total of 3120 calls had been received as of this same date, leading to completed evaluations for 388 families, with 80 more scheduled for a visit, and 50 remaining to be scheduled. Baseline recruitment and evaluation is scheduled to end in December 2008. The study sample is based on the first 300 families recruited into the study (data on the complete sample will not be available until recruitment has ended). Due to missing data on the oral health component of the study, the total sample for this project was 279 subjects.
4.3. Descriptive Statistics

Socio-demographic characteristics of the study population are shown in Table 4-1. Complete data were available for a total of 279 children, with ages ranging from 8-10 years (X=9.68, SD=0.87), and included 156 boys (55.9%) and 123 (44.1%) girls. Approximately 51% of the children were from families with annual income lower than $80.000 and the majority of the children’s mothers and fathers had completed vocational school/college (41.2% and 43.9%) or university (43.4% and 32.4%) respectively.

Table 4-1 Descriptive statistics on the socio-demographic variables in a sample of Quebec children (N=279)

<table>
<thead>
<tr>
<th>Socio-demographics</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>156 (55.9)</td>
</tr>
<tr>
<td>Girls</td>
<td>123 (44.1)</td>
</tr>
<tr>
<td><strong>Family Income</strong></td>
<td></td>
</tr>
<tr>
<td>&lt; $80,000</td>
<td>142 (51.1)</td>
</tr>
<tr>
<td>≥ $80,000</td>
<td>136 (48.9)</td>
</tr>
<tr>
<td><strong>Father’s Education</strong></td>
<td></td>
</tr>
<tr>
<td>Up to high school</td>
<td>66 (23.7)</td>
</tr>
<tr>
<td>Vocational/trade school or college</td>
<td>122 (43.9)</td>
</tr>
<tr>
<td>University</td>
<td>90 (32.4)</td>
</tr>
<tr>
<td><strong>Mother’s Education</strong></td>
<td></td>
</tr>
<tr>
<td>Up to high school</td>
<td>43 (15.4)</td>
</tr>
<tr>
<td>Vocational/trade school or college</td>
<td>115 (41.2)</td>
</tr>
<tr>
<td>University</td>
<td>121 (43.4)</td>
</tr>
<tr>
<td><strong>Family Structure</strong></td>
<td></td>
</tr>
<tr>
<td>Nuclear families</td>
<td>237 (85.0)</td>
</tr>
<tr>
<td>Non-Nuclear families</td>
<td>42 (15.0)</td>
</tr>
<tr>
<td><strong>Overcrowding</strong></td>
<td></td>
</tr>
<tr>
<td>Up to 1 person per room</td>
<td>219 (78.5)</td>
</tr>
<tr>
<td>More than one person per room</td>
<td>60 (21.5)</td>
</tr>
</tbody>
</table>
The prevalence of TDI was 12.9%. The most common type of injury found in this study was enamel fracture (4.3%) followed by fracture involving enamel and dentine (0.4%) (Table 4-2). Of the children identified as having received treatment due to TDI, the majority had composite restoration (8.2%).

Table 4-2 The frequency distribution of the types of TDI in a sample of Quebec children (N=279)

<table>
<thead>
<tr>
<th>TDI Type</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No TDI</td>
<td>243</td>
<td>87.1</td>
</tr>
<tr>
<td>Treated TDI</td>
<td>23</td>
<td>8.2</td>
</tr>
<tr>
<td>Enamel Fractures</td>
<td>12</td>
<td>4.3</td>
</tr>
<tr>
<td>Enamel and Dentine Fractures</td>
<td>1</td>
<td>.4</td>
</tr>
<tr>
<td>Total</td>
<td>279</td>
<td>100</td>
</tr>
</tbody>
</table>

The most common type of teeth affected was the maxillary central incisors. Children experience more TDI on the left maxillary incisor (56.0%) compared to the right side (44.0%) (Table 4-3). Most of the children had one tooth affected (63.9%) followed by two teeth affected (33.3%), and only one child had three teeth affected (2.8%). No children had more than three teeth affected.
**Table 4-3** The frequency distribution of the dentition with TDI in a sample of Quebec children (N=279)

<table>
<thead>
<tr>
<th>TDI of teeth</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Maxillary</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>Left Maxillary</td>
<td>23</td>
<td>46</td>
</tr>
<tr>
<td>Right Mandibular</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Left Mandibular</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

The causes of TDI were mainly due to falls (13.9%), followed by sport (5.6%). Similarly to other TDI studies, a large number of children did not recall the cause of their TDI (61.1%) (Table 4-4).

**Table 4-4** The etiology of TDI in a sample of Quebec children (N=279)

<table>
<thead>
<tr>
<th>Causes of TDI</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>By playing with other or being pulled</td>
<td>1</td>
<td>2.8</td>
</tr>
<tr>
<td>During physical activities of free time</td>
<td>1</td>
<td>2.8</td>
</tr>
<tr>
<td>In a road accident</td>
<td>1</td>
<td>2.8</td>
</tr>
<tr>
<td>Falls</td>
<td>5</td>
<td>13.9</td>
</tr>
<tr>
<td>Sports</td>
<td>2</td>
<td>5.6</td>
</tr>
<tr>
<td>Other reasons</td>
<td>4</td>
<td>11.1</td>
</tr>
<tr>
<td>Do not know</td>
<td>22</td>
<td>61.1</td>
</tr>
</tbody>
</table>
4.4. Relationship between socio-demographic, clinical factors and TDI

Boys (12.8%) and girls (13.0%) experienced similar amount of TDI; however, this was not statistically significant (P=0.55) (Table 4-5). There was no statistical difference between age of children and TDI experience (P=0.45).

Total family income was found to be strongly associated with TDI prevalence, that is children from families with high income (≥ $80,000) experienced more TDI (20.6%) compared to their counterparts (5.6%) from families with lower family income (< $80,000) (P=0.00) (Table 4-5). In addition, TDI were more common among children whose fathers had high levels of education (15.6%) compared to those with lower levels of education (6.1%) (P=0.10) (Table 4-5). A similar picture is seen for mother education level (Table 4-5). Moreover, children living in overcrowded homes experienced more TDI (14.6%) compared to their counterparts (6.7%) (P=0.07) (Table 4-5). Finally, children from nuclear families had significantly more TDI present (14.3%) compared to children from non-nuclear families (4.8%) (P=0.06) (Table 4-5).
The majority of children had an overjet equal to or less than 5mm (71.3%). Lip coverage was considered adequate for 225 (80.6%) of the children and inadequate for 54 (19.4%) (Table 4-6). Children with incisal overjet size greater than 5mm were more likely to experience TDI (22.5%) compared to those with overjet size equal or lower than 5mm (9.0%) (P=0.00). Similarly, children with inadequate lip coverage had more TDI (18.5%) compared to those who had adequate lip coverage (11.6%) (P=0.13), although this was not statistically significant at 5% level (Table 4-6). BMI was not associated with TDI. Children in the normal BMI range experienced more TDI (13.8%) compared to overweight and obese children (9.4%) and (13.4%) respectively (P=0.81) (Table 4-6).
Table 4-6  Bivariate analysis of several variables and TDI in a sample of Quebec children (N=279)

<table>
<thead>
<tr>
<th>Variables</th>
<th>TDI N (%)</th>
<th></th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Incisal Overjet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>181 (91.0)</td>
<td>18 (9.0)</td>
<td>0.00</td>
</tr>
<tr>
<td>Greater than 5mm</td>
<td>62 (77.5)</td>
<td>18 (22.5)</td>
<td></td>
</tr>
<tr>
<td>Lip Coverage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate</td>
<td>199 (88.4)</td>
<td>26 (11.6)</td>
<td></td>
</tr>
<tr>
<td>Inadequate</td>
<td>44 (81.5)</td>
<td>10 (18.5)</td>
<td>0.13</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>137 (86.2)</td>
<td>22 (13.8)</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>48 (90.6)</td>
<td>5 (9.4)</td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>58 (86.6)</td>
<td>9 (13.4)</td>
<td>0.81</td>
</tr>
</tbody>
</table>

4.5. Relationship between perceived neighbourhood characteristics and TDI

Table 4-7 shows the bivariate relationship between neighbourhood characteristics and TDI. Children from neighbourhoods with higher levels of perceived social capital experienced more TDI (19.0%) compared to those with lower levels of perceived social capital (9.5%) (P=0.02). In addition, children living in neighbourhoods which were better maintained/well-kept and with more sports access had more TDI (compared to those living in neighbourhoods that were less maintained and with less sports access (15.3% vs. 5.6%, P=0.02) and (15.5% vs. 10.7%, P=0.15) respectively.
Table 4-7 Bivariate analysis of neighbourhood characteristics and TDI in a sample of Quebec children (N=279)

<table>
<thead>
<tr>
<th>Variables</th>
<th>TDI N (%)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td>p-value</td>
<td></td>
</tr>
<tr>
<td>Neighbourhood Social Capital</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>81 (81.0)</td>
<td>19 (19.0)</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>162 (90.5)</td>
<td>17 (9.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighbourhood Encourages Activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>140 (85.9)</td>
<td>23 (14.1)</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>102 (88.7)</td>
<td>13 (11.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighbourhood Sport Facilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>180 (87.4)</td>
<td>26 (12.6)</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>63 (86.3)</td>
<td>10 (13.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighbourhood Walkability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>77 (84.6)</td>
<td>14 (15.4)</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>165 (88.7)</td>
<td>21 (11.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighbourhood maintained/well-kept</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>172 (84.7)</td>
<td>31 (15.3)</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>68 (94.4)</td>
<td>4 (5.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighbourhood Sports Access</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>109 (84.5)</td>
<td>20 (15.5)</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>134 (89.3)</td>
<td>16 (10.7)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results of the neighbourhood characteristics obtained from the census data are shown in Table 4-8. Participations living in neighbourhoods with high average family income (P=0.09), low proportion of people with low incomes (P=0.04), and low proportion of people without grade nine education (P=0.08) were more likely to have experienced TDI compared with participants living in less favourable neighbourhoods.
Table 4-8 One-way ANOVA analysis of neighbourhood’ socioeconomic characteristics: census data for a sample of Quebec children (N=279)

<table>
<thead>
<tr>
<th>Variables</th>
<th>TDI N (%)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No (N=243)</td>
<td>Mean (SD)</td>
<td>p-value</td>
<td></td>
</tr>
<tr>
<td>Proportion of single parent households in neighbourhood</td>
<td>243 (15.1 (6.5))</td>
<td>0.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Absent</td>
<td>15.1 (6.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Present</td>
<td>13.6 (7.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of individuals (15+) with Baccalaureate or more</td>
<td>243 (15.5 (10.9))</td>
<td>0.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Absent</td>
<td>15.5 (10.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Present</td>
<td>16.4 (9.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of individuals (15+) without grade 9 education</td>
<td>243 (11.7 (6.6))</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Absent</td>
<td>11.7 (6.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Present</td>
<td>9.6 (6.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of people on welfare</td>
<td>243 (3.9 (1.6))</td>
<td>0.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Absent</td>
<td>3.9 (1.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Present</td>
<td>3.6 (1.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of low income people</td>
<td>242 (14.2 (9.6))</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Absent</td>
<td>14.2 (9.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Present</td>
<td>10.6 (9.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average family income</td>
<td>242 (65,200 (17,900))</td>
<td>0.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Absent</td>
<td>65,200 (17,900)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI Present</td>
<td>70,500 (17,400)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.6. Regression Analysis

The results of the multiple logistic regression analysis are shown in Table 4-9. These results suggest that participants living in neighbourhoods with high levels of social capital were more likely to experience TDI, (OR = 2.39; 95% CI = [1.08-5.31]). Similarly, children living in neighbourhoods which were well maintained had an increased likelihood of experiencing TDI (OR = 2.84; 95% CI = [0.90-8.98]). Furthermore, children from high income families (≥$80,000) had an increased likelihood of experiencing TDI (OR = 3.40; 95% CI = [1.39-8.34]). These results were independent of age, gender, incisal tooth overjet, and lip coverage.
Table 4-9 Logistic regression for the association between neighbourhood characteristics and TDI in a sample of Quebec children (N=279)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unadjusted OR (95%CI)</th>
<th>Adjusted OR (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neighbourhood % of Low Family Income</td>
<td>0.95 (0.91-1.00)</td>
<td>0.97 (0.92-1.02)</td>
</tr>
<tr>
<td>Neighbourhood Social Capital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>2.24 (1.10-4.53)</td>
<td>2.39 (1.08-5.31)</td>
</tr>
<tr>
<td>Neighbourhood Walkability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1.43 (0.69-2.96)</td>
<td>1.43 (0.61-3.33)</td>
</tr>
<tr>
<td>Neighbourhood Well-Kept/Maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>3.06 (1.04-9.01)</td>
<td>2.84 (0.90-8.98)</td>
</tr>
<tr>
<td>Family Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; $80,000</td>
<td>4.34 (1.90-9.92)</td>
<td>3.40 (1.39-8.34)</td>
</tr>
<tr>
<td>≥ $80,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.17 (0.78-1.76)</td>
<td>1.23 (0.77-1.96)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girls</td>
<td>1.02 (0.50-2.06)</td>
<td>1.14 (0.52-2.52)</td>
</tr>
<tr>
<td>Incisal Overjet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤5mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;5mm</td>
<td>2.92 (1.43-5.96)</td>
<td>2.84 (1.30-6.20)</td>
</tr>
<tr>
<td>Family Structure</td>
<td></td>
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<tr>
<td>Non-Nuclear</td>
<td></td>
<td></td>
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<tr>
<td>Nuclear</td>
<td>3.35 (0.77-14.51)</td>
<td>1.62 (0.34-7.79)</td>
</tr>
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Hosmer and Lemeshow test=0.893
5. Discussion

5.1. Introduction

This chapter is divided into seven sections. Section 5.2 presents an overview of the most salient findings of the study. Section 5.3 discusses the current study’s results in light of previous research. Neighbourhood characteristics and TDI is discussed in greater depth in section 5.4. Section 5.5 addresses the strengths and limitations of this study. Section 5.6 presents the conclusion. Finally, section 5.7 presents the recommendations.

5.2. Overview of Results

The aim of this study was to assess the prevalence and risk factors associated with TDI to anterior teeth in a sample of Quebec children. In addition, we aimed to investigate the association between neighbourhood characteristics (perceived social capital and built environment and TDI). We found that children from families of high socioeconomic backgrounds, residing in wealthier neighbourhoods which likely benefit from more favourable social and built environments will have more TDI compared to those living in less wealthy neighbourhoods presenting worse social and built environments.

While we had no specific hypothesis as the direction of the association, the results of our study support our hypothesis that neighbourhood factors are associated with TDI. We found that those living in neighbourhoods with lower SES and lower social capital had lower TDI. This finding may seem counter-intuitive, but one possible explanation is that more favourable social environment is capturing to some extent increased opportunities
for selected high impact sports (such as hockey), for which the risk of experiencing TDI is increased.

5.3. Results in relation to previous studies

In this study of 279 Quebec school children, the prevalence of TDI to permanent incisors was 12.9%. This finding is consistent with those of other North American studies. In the last NHANES, the prevalence of TDI was 11.0% among same aged children (4); a Canadian study by Fakhruddin et al. found the prevalence of TDI among Ontario children to be 11.4% (5). Our reported prevalence of TDI was also quite similar to international studies. Delattre et al. found the prevalence of TDI among a sample of school children in France to be 13.6% (58). Cortes et al., who used the same criteria for TDI assessment as the one used in this study (Children’s Dental Health Survey in the UK) reported that the prevalence of TDI in a sample of Brazilian school children was 13.6% (14). However, many other studies reported much higher or lower TDI prevalence, ranging between 2.4 and 58.6% (Table 1-1).

These differences in TDI prevalence may be due to variations in study designs (cohort, case-cohort, case-control, cross-sectional, clinical trials), methodological techniques (data collected through an actual dental exam or a questionnaire (self reported TDI), and the type of dentition examined), classifications (the coding for the different types of TDI), sample selection (population-based study or hospital/clinical), and the differing age groups of children assessed adopted in different studies. Although the sample in the current study is population-based, it is not representative of the Quebec population given
the criteria for selection (i.e. at least one obese parent). Nevertheless, this sample presented with a prevalence of TDI consistent with that of current provincial estimates.

Similar to other epidemiological surveys in developed and developing countries, enamel fracture was the most frequent injury identified in this study (2, 12, 22, 24, 47, 48, 50). Although fractures involving enamel and dentine were the second most prevalent injury, it accounted for only minor proportions. While the most common treatment provided was acid-etch composite, crowns, dentures or bridges were not found in this sample of Quebec children. These results are similar to those reported in population based surveys (12, 17, 30).

The central upper incisors were the most commonly affected dentitions; it constituted 60% of all traumatized teeth. Only 10 children had dental injuries in teeth other than maxillary incisors. Also in accordance with the literature, most of the children who experienced TDI had only one tooth injured (46, 51, 58, 92, 93).

The main reported causes of the TDI were falls (13.9%), followed by sports (5.6%). These findings corroborate what is reported in the literature (5, 18, 19, 21, 42, 47, 48, 94). In line with other studies, a large proportion of subjects reported that they did not know the cause of their TDI.

In the current study, statistically significant associations were found between the size of overjet and the occurrence of TDI. Children with an overjet greater than 5mm were more likely to have TDI than children having an overjet equal or lower than 5mm. These results
are supported by other studies across different populations (2, 11, 12, 18, 21, 61). Indeed, results from a systematic review of the relationship between the overjet size and TDI show that children with an overjet larger than 3mm were approximately twice as likely to sustain TDI than children with an overjet smaller than 3mm (11). Inadequate lip coverage was not found to be statistically significantly associated with TDI. This is in accordance with the results of some studies (23, 30, 62), but in contradiction with others which did observe an association between lip coverage and TDI (48, 53).

Although several studies have found that boys are more at risk of TDI when compared to girls (10, 19, 21-24, 30, 54, 62), there was no gender gradient for TDI experience in this study. However, our results are similar to those reported by Marcenes et al. and Traebert et al., among others (2, 12, 47, 63, 94, 95). This may reflect the fact that in North American societies, girls and boys were exposed to the same potential TDI risk factors such as sports and physical activities.

This study has found a significant association between individual SES and TDI experience. Children from higher socioeconomic backgrounds either measured by family income or fathers’ education level, had a higher risk of experiencing TDI compared to those from lower socioeconomic backgrounds. Although our result is similar to those reported by Cortes et al. (14) and Odoi et al. (15), the literature on the association between SES and TDI experience is not consistent. While some studies reported associations between TDI prevalence and low SES (61, 70, 71), other studies have shown no statistically significant association between SES and TDI (10, 19, 51).
As mentioned previously, a positive association between SES and TDI prevalence was observed. This may be explained in part by the fact that children living in higher SES are involved in sports to a greater extent, and/or are involved in different types of sports, notably higher-cost, higher impact sports that are more likely to lead to TDI, such as ice-hockey or downhill skiing. Indeed, sports injuries are the main cause TDI. Stockwell and Martin et al. reported that one of the main causes of TDI was falls from bicycles (46, 96).

Despite the fact that general accidents are higher among children of low SES compared to those of high SES (97), it is possible that an inverse association exists for sports-related injuries. Generally, children from disadvantaged families tend to be involved in fewer physical activities compared to their less disadvantaged counterparts (98, 99). They may also live in neighborhoods with poorer access to sport and physical activity opportunities. Although our study did not find a statistically significant association between neighborhood sport access and TDI (P=0.15), the direction of the association was as expected, and lack of significance may be due to the study’s limited power. Further research is required in order to better understand the relationship between SES and TDI experience, and the mediating or moderating role of sports involvement and access to facilities.

Children who belonged to nuclear rather than non-nuclear families were more likely to experience TDI. This result is in contradiction with other studies which reported higher TDI prevalence among children from non-nuclear families (19, 28). It should be noted that, by design, study participation required the availability and presence of both biological parents. Thus, children living in single-parent or reconstituted households are
likely underrepresented, and more importantly, appear to benefit from two highly invested biological parents despite their family circumstances (typically divorce).

In the present study, we did not find a statistically significant association between obesity and TDI. While these results are similar to some previous studies (42, 47), it is in contradiction with the results of some studies which found a significant association between obesity and TDI experience (19, 69).

A detail worth mentioning, seasonal changes are well-appreciated in Canada. Different seasons have different sports and activities associated with it. Thus, accidents due to sports and physical activities, such as winter skating and skiing, may have been under-reported due to recall bias since there may be a huge time gap between the incidence of TDI and its clinical measurement.

5.4. Neighbourhood characteristics and TDI

Several indicators of perceived neighbourhood social and built environment were found to be statistically significantly associated with TDI. In particular, children from neighbourhoods with higher levels of perceived social capital had more TDI compared to those from neighbourhoods with lower levels of perceived social capital. In addition, children residing in neighbourhoods perceived to be maintained and well-kept had more TDI. As discussed in the previous section, perceived access to neighbourhood sports facilities was not found to be statistically significant associated with TDI at the 5% level, but a tendency relating greater access to more TDI was observed (P=0.15). Finally,
aggregated indicators based on census data for education and income were associated with TDI prevalence, such that more favourable neighbourhood SES was associated with greater TDI. In particular, higher average household income, lower proportion low income households, and lower proportion of people without grade nine education were associated with a higher TDI prevalence.

In multivariate analyses, perceived and census-based neighbourhood indicators remained associated with TDI, after adjusting for individual and family characteristics including age, gender, family income, and family structure.

Our finding relating greater neighbourhood social capital to higher TDI is contrary to those reported by Pattussi et al., who observed less frequent TDI among boys living in neighbourhoods with higher levels of social capital, compared to boys living in neighbourhoods with lower levels of social capital (42). The same study did not find an association between neighbourhood’s level of social capital and TDI among girls (42). The mechanisms underlying the possible influence of social capital on general or oral health are not fully understood (100). It has been suggested that social capital and social networks may influence general and oral health via their mediating effects on emotional and behavioral problems, which may lead to stress among other health outcomes (101), which may include TDI. Deviant behaviours and stress may also be linked to TDI. This was supported by two studies reporting a significant association between stress and dentofacial injuries (102, 103). Both of these factors have been associated to major and minor injuries in general (29, 49, 104) and to TDI (31).
Pattussi et al. suggest that observed gender difference in TDI experience may be a function of the environment (42). This is supported by the fact that TDI in girls occurred mostly at home, while about a third of all TDI in boys occurred in public streets or pathways (42). Pattussi’s study was carried out in Brazil, and where the effect of social capital was stronger among boys than girls, possibly reflecting gender differences in the social and physical environments to which boys and girls are exposed, as well as their differing behaviours, with boys possibly more likely to be involved in potentially injurious risk-taking behaviour, in addition to play and sports. Although there was no gender gradient for TDI experience in our study; it is possible that gender differences (notably in behavioural responses to environmental cues) are not as important in urban, North American societies.

Marcenes et al. observed that TDI was higher in deprived areas compared to more affluent areas (30). TDI was also found to be highly prevalent in two deprived areas in the North West of England, Bury and Salford (34.4%), compared to the overall prevalence of TDI in the UK (61). These studies are opposing to our results, which were supported in the literature by Cortes et al. (14) and Odoi et al. (15) suggesting a positive association between SES and TDI. These conflicting findings highlight the complexity of this field of research and the need for a better understanding with regards to SES and oral health outcomes.

Perceived level of maintenance in the neighbourhoods was associated with TDI. Neighborhood aesthetics are likely associated with the socio-economic conditions of residents within neighborhoods, and to some degree with perceptions of safety and social
Neighbourhood safety may influence the extent to which children use neighbourhood resources for physical activity. Indeed, parents’ more favourable perception of neighbourhood safety is associated with the amount of time that children engage in physical activity (84, 85).

5.5. Strengths and limitations of the study

This section will highlight this study’s methodological strengths and weaknesses relevant to our results. Section 5.5.1 discusses the strengths, while section 5.5.2 discusses the limitations.

5.5.1. Strengths of the study

Data on TDI were collected via clinical examination; thus, an objective measurement of TDI was used compared to subjective measurements, in which parents or children report past TDI experience. There were several variables available for analysis at both individual- and neighbourhood-levels, providing a unique opportunity for exploring the relationship between neighbourhood characteristics and TDI. We used multiple sources to describe neighbourhood characteristics, including both census based indicators and parent reported perceptions.

This study is based on 279 cases recruited within the Quality cohort study, which is a prospective study where the total sample size will be approximately 650 children. These subjects will be followed throughout their adolescence, for a period of 10 years, during
which data will be collected at 2-year intervals. Collected data will include both individual and census-based measures of SES and neighbourhood characteristics. Furthermore, dental examinations will be performed to gather information on dental injuries. Future analysis will provide an opportunity to further understand the relationship, identify the associated factors, and most importantly establish the underlying causal mechanism between neighbourhood characteristics and TDI.

5.5.2. Limitations of the study

5.5.2.1. Study design
The cross-sectional design of this analysis precludes any causal statements between neighbourhood characteristics and TDI, only identifying the associated factors in this relationship since it analyses the data of the sample at a particular point in time. Thus, the study design is limited to identifying the prevalence of TDI and not the incidence. In addition, it is not possible to uncover any temporal association between neighbourhood characteristics and TDI; hence the exposure preceded the outcome, or vice-versa.

5.5.2.2. Sample size and power
At the time of analysis, baseline data involving 300 subjects were available. However, data on only 279 subjects were included in the analysis because 21 subjects did not undergo dental examinations. The relatively small sample size of 279 subjects may have reduced the power of the statistical tests, failing to reveal potentially significant associations and providing less precise findings.
5.5.2.3. Misclassification

In addition to the use of census data in the analysis, there were self-reported data obtained from the children and their parents using questionnaires. As with most self-reported data, information collected is subject to recall bias, and to social desirability. Assuming misclassification of ‘exposures’ and of ‘outcomes’ to be independent from each other, its effect would lead to under-estimate any actual effects.

TDI are classified by their causes and are categorized as intentional or unintentional (105). For a substantial number of TDIs, causes were unknown/could not be recalled, likely because of the time lag between the assessment and the occurrence of the injury. Furthermore, children and their families may have relocated and changed neighbourhoods between the time of the injury and the time of assessment, so that the neighbourhood characteristics assessed would no longer be relevant. Because this type of misclassification of exposure is likely non-differential, the net effect would be to bias measures of effect towards the null.

5.5.2.4. External validity

Participants comprise the first 300 children who were recruited to an ongoing study, the QUALITY cohort. The overall aim of the QUALITY cohort is to investigate the natural history of obesity in children and adolescents. Children and their parents were recruited through fliers distributed to schools within 75 km of 2 large urban areas. At least one parent had to be obese in order for the family to participate. Although 1 in 3 children are currently in this situation, based on current prevalence estimates of adult obesity, the
sample is not representative of the general Quebec population. Furthermore, participating families were generally more advantaged with respect to income and education (106). Nevertheless, a wide range of individual, family, and neighbourhood characteristics were represented, and it is likely that observed associations could extend to the general population.

5.6. Conclusion

- The prevalence of TDI was almost 12% in this sample of Quebec children and it is similar to other North American study.
- The most common type of TDI was enamel fracture alone, followed by enamel and dentine fractures; furthermore, TDI were mainly to the maxilla.
- The main cause of TDI was due to falls.
- There was no gender difference in regards to TDI experience.
- There was a positive association between SES indicators and TDI prevalence.
- Neighbourhood characteristics seem to be associated with TDI, and may possibly explain the TDI inequalities among this sample of schoolchildren.
5.7. Recommendations

5.7.1. Recommendations for future research

This study is the first to investigate the association between neighbourhood characteristics and TDI among a sample of Quebec children. The analysis should be repeated using the complete set of data (larger sample size) from the QUALITY cohort; improved power and possible a greater range of neighbourhood types may yield more definitive findings. In addition, data measuring more detailed neighbourhood characteristics obtained through direct observation and through GIS databases will be available (aspects of transportation infrastructure, availability of grocery shops within the areas, proximity to parks and fast food restaurants, etc.). These more detailed characteristics will make it feasible to test a range of hypotheses related to the possible influence of the built and social environment on the presence, and, in prospective analyses, the occurrence of TDI. Our paradoxical findings regarding SES and TDI support the need for more research in order to shed light on the potential mediating role of neighbourhood characteristics.

5.7.2. Recommendations for public health

This study aimed to investigate the correlates of TDI for a sample of Quebec children and, in particular, to explore the effects of neighbourhood characteristics in the built and social environment on TDI experience. The literature suggests that TDI are known to cause a huge burden on both the individuals and health care system, since they are usually expensive to treat and have an enormous impact on one’s self-esteem and well-being (6-9).
Based on the literature and results of this study, we suggest the promotion of public health interventions, such as oral health awareness programs which advise children, parents, teachers (mainly physical education) in schools and health care professionals in clinics and hospitals to encourage the use of mouth and face guards in sports and other sorts of physical activities. Especially that several studies demonstrated the importance of the use of mouth guards in reducing the risk of TDI (107-109) and a Canadian study revealed that athletes who sustained TDI were not wearing mouth guards during the games (110). This may be a good starting point if sports were one of the prime accomplices for TDI.

Moreover, there exist combined individual (SES) and perceived neighbourhood socio-environmental conditions (social capital and neighbourhood safety) that may affect the occurrence of TDI, possibly mediated by the amount of time spent outdoors in the neighbourhood, as well as physical activity involvement. This suggests that health policies that target both individual behavioural factors, as well as broader social conditions within the neighbourhood levels, may be most beneficial to improving general health and oral health in particular.
6. References

7. Appendix

7.1. An overview of data collection

7.1.1. Ethical Approval

April 29, 2008

Dr. Gilles Paradis
Department of Epidemiology and Biostatistics
1140 Pine Avenue West
Montreal, Quebec
H3A 1A3

Dear Dr. Paradis,

We have received your request for continuing review by the Institutional Review Board of the research study A03-M25-05B entitled "Étude familiale sur la prévention des maladies cardiovasculaires et du diabète de type 2 chez l’enfant et l’adolescent"

The progress report was reviewed and we are pleased to inform you that full board re-approval for the study was provided by the Board on April 28, 2008, valid until March 23, 2009. The certification of approval is enclosed.

It is the responsibility of the investigator to assure that the approved research protocol and consent form is deposited with the Research Ethics Board of each hospital where patient recruitment or study data will be collected.

We ask you to take note that review of all research involving human subjects is required on an annual basis in accord with the date of initial approval. Should any modification to the study or unanticipated development occur prior to the next review, please advise IRB promptly.

Yours sincerely,

[Signature]

Serge Gauthier, M.D.
Chair
Institutional Review Board

cc: Dr. Marie Lambert – Ste Justine Hospital
A03-M25-05B
7.1.2. Schematic representation of data collection

7.1.2.1. Family visit to the clinical research unit

1. Welcome and information regarding the program of the day (10 min)
2. Application of topical anesthetic cream for parents and child (10 min)
3. Weight, height, skin fold thickness, waist and hip circumferences, Tanner staging for child and weigh, height for parents (30 min)
4. Events a) and b) take place simultaneously (4 hrs),
   a) Blood tests and DNA sampling for parents ➔ Breakfast for parents ➔ Questionnaires for parents ➔ BP for parents ➔ Skin fold thickness and waist circumference for parents ➔ Obtain weight and height recorded in child’s “health booklet”
   b) Blood tests, DNA sampling, 3h-0GTT, 3h-Holter monitoring for child
5. Lunch for parents and child (30 min)
6. Child questionnaire (45 min)
7. Child BP (10 min)
8. Explanations regarding 24-hour dietary recall by telephone (10 min)
9. Explanation regarding accelerometer (10 min)
10. Assessment of child’s body composition (DEXA, 20 min)
11. Assessment of child’s carotid IMT and compliance (ultrasound, 20 min)
12. Exercise testing for child (60 min)

7.1.2.2. Week 1 after the visit to the clinical research unit

1. Child carries the accelerometer from day 1 to 7 (day 0 is the day of the visit to the clinical research unit).
2. Phone call to the family on day 2 to ensure that the child understands how to use the accelerometer.

3. Phone call to the family on day 8 to remind to return the accelerometer and that the child will receive three phone calls from the dietician in the coming month to complete the 24-h dietary recalls.

7.1.2.3. Weeks 2 to 6 after the visit to the clinical research unit

1. Three (2 week days, 1 week-end day) 24-h dietary recalls including specific questions to assess where the foods were obtained (at home, fast food/restaurant, vending machine, etc.).

7.2. Dental Examination

7.2.1. List of materials for dental examination

- Reclining chair
- Adjustable stool for the inspector
- Headlights
- Cotton pliers
- Gauzes 2×2
- Plastic container (to soak the instruments)
- Paper points
- Sterile plastic tubes
- Toothpicks
- Mirror with flat surface
- CPI periodontal probes
- Explorer #23
- Chair cover
- Lab coat
- Examination gloves (latex without powder)
- Face mask
- Protection goggles
- Restore (to soak instruments in)
- Antibacterial disposable towels
- Biohazard waste container
- Hand soap dispenser
- Plastic container (to place various items)
- Scissors
- Band aid
- Hand paper towel
- Hand Soap
- Hand lotion
- Pencil

7.2.2. Procedures of dental examinations

7.2.2.1. Start of the examination

1. Hands were washed
2. The examination light was turned on and had to work properly
3. The room was prepared for examination: (All disinfecting procedures were done)

7.2.2.2. End of Examination

1. Examination light was shut down
2. The instruments used were placed in a plastic container
3. The room was cleaned

7.2.2.3. The Examination Room

- The equipment was arranged in a way that the child could move with safety around the room.
• The disinfecting solutions and the other liquids had to be covered and away from the reach of the child.
• The examination room must have been cleaned
• The sterilization packet of the instruments had to be opened and placed in a way that the packet became the instrument’s platform for the child to be examined.
• Two plastic containers with a cover which have an opening for the instruments used had to be placed in the examination space. The mirrors used were placed in one of the containers and the probes, explorers in the second container. This would protect the mirrors from getting scratches.
• The cover of the biohazard waste container had to be closed except when throwing in the wastes.

7.2.3. List of materials for infection control

The following list summarizes the materials for the control of infections which will be used for the different items of the examination room:
• Light: adhesive barrier on head and controls; surface disinfectant.
• Instrument tray: plastic chair cover, surface disinfectant.
• Counter: surface disinfectant.
• Instruments: the instruments must have been carefully used. After the dental exam, they had to be placed in the plastic container and at the end of the day they had to be sterilized.
• Wastes: Biohazard waste container.
• Examiner: lab coat, mask, protection goggles with side protectors, examination gloves.

Instruments

All the mirrors, explorers and periodontal probes had to be sterilized before the first use and after every use. The availability of a sufficient number of instruments sterilized for each dental examination session was the responsibility of the dentist.
7.3. Assessing traumatic dental injuries (TDI)

The dental examination for traumatic dental injuries will include only upper and lower permanent incisors. The great majority of injuries occur on front teeth and the prevalence including all teeth is very similar to the one including only incisors. The criteria used to record traumatic dental injuries will be those from the Children’s Dental Health in the United Kingdom (Pendry et al., 2003). Two anatomical features—size of the overjet and type of lip coverage—will be assessed due to their highly significant association with TDI.

The assessment includes both treated and untreated injuries. All permanent incisors and associated buccal and lingual or palatal soft tissue will be examined in sequence from upper right to lower right. The teeth should be dried before dental examination using cotton gauze.

**Code 0: No TDI**  
No evidence of treated or untreated TDI.

**Code 1: Treated TDI**  
There is a range of types of treatment provided due to a TDI. All should be recorded as treated TDI. The most common types of treatment provided are: acid etch restoration, restoration located in the palatal/lingual surface of the crown suggesting root canal treatment and replacement of a missing teeth by denture or bridge element (pontic).  

**Note 1**: Composite restoration may be difficult to recognize and can be easily missed if the restoration is of good quality. It is crucial to use the CPI probe to detect any loss in continuity in the labial and lingual/palatal surfaces to identify whether or not the tooth was restored. Repeating this procedure in an adjacent sound tooth may help to sense the difference. In addition the mirror may be used to reflect light through the tooth from inside the oral cavity. The difference in translucence helps to identify a tooth-colored restoration placed on injured incisors.
Note 2: Replanted teeth are also difficult to recognize. Discoloration and abnormal position in the tooth socket may suggest the tooth has been replanted. The examiner must ask the subject about the history of avulsion of the tooth due to a harmful event.

**Code 2: Enamel fractures**

It is characterized by a loss of a small portion of the crown, including only the enamel. A fracture is considered to be limited to the enamel if it is small and of homogenous color when observed from the incisal angle with the aid of a mouth mirror.

**Note:** Attrition can be easily mistaken by enamel fracture in epidemiological surveys. In order to differentiate enamel fractures from attrition, the subject should be asked to go into lateral jaw excursion and protrusion.

**Code 3: Enamel and dentine fractures**

It is characterized by a loss of a portion of the crown, including enamel and dentine without pulp exposure. If the exposed central area of the fracture looks darker and more yellowish than the surrounding enamel and there is no evidence of pulp involvement, a dentine fracture should be recorded.

**Code 4: Pulp involvement**

There are four signs of pulp involvement that can be easily identified in a survey. They are crown or root fractures with pulp exposure, sinus tract, swelling and discoloration.

→ Fracture with pulp exposure is characterized by a loss of a portion of the crown or/and root, including a visible direct contact of the pulp horns or pulp chamber with the oral cavity due to a tooth fracture.

**Note:** A probe should never be inserted into the depth of a cavity to confirm the presence of a suspected pulp exposure.

→ Sinus tract is characterized by a visible sinus tract in the labial or lingual vestibule due to a TDI. The examiner must check whether the sinus tract was due to caries (presence or treated or untreated caries lesion), and also ask the subject whether they have a history of a harmful involving the front teeth/mouth.
Swelling is characterized by the presence of swelling in the labial or lingual vestibule due to a TDI. The examiner must check whether swelling was due to caries (presence of treated or untreated caries lesion), and also ask the subject whether they have a history of a harmful event involving the front teeth/mouth.

Discoloration of the crown is characterized by a homogenous discoloration of the tooth due to a TDI as compared with an adjacent permanent sound tooth. It may range from yellow to dark grey when compared to other teeth. The examiner must check whether discoloration was due to caries (presence of treated or untreated caries lesion), and also ask the subject whether they have a history of a harmful event involving the front teeth/mouth.

**Note:** Often subjects do not recall a history of a harmful event. Therefore, in the absence of any evidence that pulp involvement was due to caries, sinus tract, swelling and discoloration should be recorded as pulp involvement due to TDI.

**Code 5: Missing teeth due to TDI**
It is characterized by the absence of a tooth due to a complete avulsion. The examiner must ask the subject if the avulsion was due to harmful incident involving the front teeth/mouth or if the tooth has been extracted due to caries or orthodontic reasons, as well as whether the tooth is unerupted or absent congenitally.

**Code 9: Excluded tooth**
Signs of TDI cannot be assessed, i.e.: presence of appliances, all permanent incisors missing due to caries.

**Note:** After the clinical exam for TDI the examiner should ask the child or their parents, the following question:

“**Have you (child’s name) ever had an injury to your (his/her) front teeth?**”
If the child/parents indicate that one or more injuries have occurred, code 1 in the first question questionnaire attached to the clinical form and ask the 3 other questions.

**Note 1:** The question should be asked regardless of the results of the clinical examination.
7.4. Assessing incisal overjet and lip coverage

7.4.1. Assessment of incisal overjet

The CPI probe will be used to measure the size of the incisal overjet because it is practical. Measurement of the horizontal relation of the incisors is made with the teeth in centric occlusion. The first step is to identify the most prominent labio-incisal edge of upper incisors. Next, the distance from the labial-incisal edge of the most prominent upper incisor to the labial surface of the corresponding lower incisor measured with the CPI probe parallel to the occlusal plane. The black line on the CPI probe is used to demarcate between overjets less than 5mm and more than 5mm.

**Code 1: Less than 5mm**

It is recorded if the largest maxillary overjet is equal to or less than 5mm (The most prominent labio-incisal edge of upper incisors is within the black band of the CPI probe).

**Code 2: Greater than 5mm**

It is recorded if the largest maxillary overjet is greater than 5mm (The black band of the CPI probe is not visible).

**Note 1:** If in doubt, the examiner should record greater than 5mm (Code 2).

**Note 2:** If the incisors occlude edge to edge or are in lingual crossbite, code 1 should be recorded.

7.4.2. Assessment of type of lip coverage

The type of lip coverage should be assessed while the subject is not conscious of being examined. This may be done while greeting the subject and introducing yourself. Alternatively, you may ask the subject to lick their lips, swallow and relax their mouth, and then make the observation. The type of lip coverage is recorded as adequate or inadequate.
**Code 1: Adequate**

It is recorded if the lips completely cover the upper incisor at rest.

**Code 2: Inadequate**

It is recorded if the lips do not completely cover the upper incisor at rest.

**Note:** If in doubt, the examiner should record adequate lip coverage (code 1).

### 7.5. Assessing socioeconomic status

#### 7.5.1. Parent’s level of education

What is the highest level of education completed by the biological mother or the biological father of the child participating in this study?

1. No education or incomplete primary education
2. Completed primary education
3. Completed half of secondary school (secondary I to IV)
4. Completed Secondary school (secondary V or 12th year)
5. Vocation/technical school completed
6. Completed College (CEGEP)
7. Completed University
7.5.2. Annual family income

Approximately what was the total income of your household (i.e. the total income of all the people living more often in the same house as the child and who share the expenses) within the past year without taxes?

1. Less than $10,000
2. $10 000 - $14 999
3. $15 000 - $19 999
4. $20 000 - $29 999
5. $30 000 - $39 999
6. $40 000 - $49 999
7. $50 000 - $59 999
8. $60 000 - $79 999
9. $80 000 - $99 999
10. $100 000 - $119 999
11. $120 000 - $139 999
12. $140 000 and more
7.6. Assessing neighbourhoods characteristics

Questions measuring neighbourhood characteristics (Variables V1QB)

11. How safe do you feel walking in your neighbourhood?
     Please answer for each item on a five-level Likert scale, from very safe to not at all safe.
     A. during the day
     B. at night

12. Tell us whether you strongly agree, agree, disagree, or strongly disagree about the following statements when thinking of your neighbours
     Please answer for each item.
     A. If there is a problem around here, the neighbours get together to deal with it.
     B. There are adults in the neighbourhood that can be role models for the children.
     C. People around here are willing to help their neighbours.
     D. You can count on adults in this neighbourhood to watch out that children are safe and don’t get in trouble.
     E. When I am away from home, I know that my neighbours will keep their eyes open for possible trouble.

13. How true is each of the following statements in regard to the neighbourhood where the child lives most of the time?
     Please answer for each item in a five-level Likert scale.
     A. There are no sidewalks.
     B. There are lots of hills.
     C. Dogs are well attended.
     D. There is a lack of equipment or facilities to incite children to be active.
     E. There are lots of safe places to be active.
     F. People walk of exercise frequently.
     G. Parents are very involved in watching their children participate in sports.
     H. There are many supervised and organized sports activities for children.
     I. Many people walk to the local grocery store.
     J. The neighbourhood is attractive.
     K. It is a high crime area.
     L. There are few local sports facilities.
     M. Children can play safely outdoors.
     N. Street lights are often burned out.
     O. There is heavy traffic.
14. On a scale from 1 to 5 (from very convenient to not at all convenient) how conveniently located are the following places/facilities with respect to the child’s home?

Please answer for each item.

A. Public park or playground
B. Basketball court
C. Bike path or lane
D. Golf course
E. Mini golf
F. Playing field for soccer or football
G. Playing field for baseball
H. Tennis court
I. Sports classes
J. Public recreation center
K. Public indoor swimming pool
L. Public outdoor swimming pool
M. Walking/hiking trails
N. Dance studio/classes
O. Racquetball/squash court
P. Grocery store/shops
Q. Public gym
R. Indoor skating rink/arena
S. Outdoor skating rink
T. Fitness exercise club