Developing and Testing a Theoretical Model to Determine Children's Adherence to Oral Health Behaviours

By

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Abstract

Background: Adherence to health care advice is a complex health concern especially when it involves children. Dental caries has been identified as the most common chronic childhood disease that occurs in a continuum. At the same time, it can be prevented by adherence to proper oral health behaviours including proper oral hygiene care, restricting the amount and frequency of sugar intake, and adopting a regular check-up. Orthodontic treatments for child patients are also therapeutic measures requiring full adherence of patients to oral health treatments for ideal clinical outcome because of the prolonged nature of the treatment. Orthodontic treatments proceed mostly in outpatient settings, requiring patients to engage in self-care with the involvement of their parents. Theory-driven tools may help the practitioners identify the causes of children's poor adherence and develop effective interventions. The Theory of Planned Behaviour (TPB) is a well-established theory that has been rigorously applied to predict health behaviours; however, its application in children's oral health research is relatively new. TPB is capable of accepting additional constructs contributing to the elicitation of a particular behaviour. One of the important psychosocial factors rarely analyzed in adherence behaviours is the patient's ability to cope with daily life-stressors enabling them to identify and mobilize resources to adhere to healthy practices. This concept can be evaluated through the construct of Sense of Coherence (SOC).

Objectives: The overall aim of this research was to build and test a theoretical model to predict children's adherence to oral health preventive measures. The goal was to develop a theory-based model to identify the determinants of children's adherence to preventive oral health

care practices in a population-based setting. The developed model was also tested in a clinical setting with children undergoing orthodontic treatments for future authenticity of our results.

Methods: This multi-center cross-sectional study was granted ethics approvals from the University of Alberta (UofA) Research Ethics Board and Alberta Health Services. Followed by a systematic review on the impact of SOC on oral health behaviours, an expanded TPB model was developed to measure adherence to preventive behaviours among parents of children aged 2-6 years attending community health centers for immunization. Questionnaires included items to measure the TPB and SOC constructs as the psychological determinants of adherence behaviours. Information regarding participant's demographics and self-reported behaviours including tooth brushing frequency, sugary intake frequency, as well as frequency and pattern of dental visits for their children were collected. As the second stage and to set the grounds for our future research, we conducted a prospective longitudinal single-center study of patient adherence to orthodontic treatment at the UofA Orthodontic Clinic. The expanded TPB model was tested in a clinical setting by predicting adherence behaviours among parents and their children aged 12-18 years old undergoing orthodontic treatments. Questionnaires were developed to assess the psychological determinants of adherence to orthodontic treatments based on the TPB and SOC constructs. Adherence to orthodontic treatment was measured directly by monitoring appointment keeping and oral hygiene behaviours, and indirectly through measuring buccal white spot lesions. Measurements were done at the time of fitting the fixed appliance, after six months, and 12 months following the baseline. Structural Equation Modeling (SEM) analysis was applied to investigate the direct and indirect relationships between SOC (the proposed added construct), attitudes, subjective norms, perceived behavioural control, and intention (the TPB original constructs) using the TPB model as the prior framework. Regarding the future steps for

the second phase of this research, SEM will be applied to specify the scale items, perform reliability and validity tests, and specify the measurement and structural models.

Results: 378 mothers (34.41 ± 8.1 years) participated in phase 1 of the study. 75.9% of children (3.92 ± 1.8 years) had dental insurance. SEMA showed that predisposing factors (child and mother's birthplace) significantly predicted enabling resources (family income and dental insurance); both predicted TPB components (PBC, SN, and attitude). TPB components, in turn, predicted behavioural intention. However, intention did not predict dental attendance. Parent's SOC significantly predicted TPB components and dental attendance. Overall, 56% of the variance in dental attendance was explained by the expanded TPB model. For the second phase of this research, 168 pair of orthodontic patients with the mean age of 14.47±1.52 years and their parents with a mean age of 44.65±5.1 years were recruited and followed up for one year. Among patients, 90 (53.6 %) were girls and about 40% had other siblings in orthodontic treatment before or at the same time. Among parents whose children participated in this research, 135 (80.4 %) were mothers, 43% of families had a monthly income of $5000 or higher and 80% of parents had post-secondary or college degree. 76% of parents reported their children brushed their teeth twice a day or more which was very close to the percentage reported by their children of about 73%. One year into the treatment, about 60% of patients had buccal white spot lesions with moderate to severe demineralization observed in 48% of those.

Conclusions: The expanded TPB model explained a great deal of variance in preschooler's dental attendance. These findings suggest that the expanded model could be used as the framework for designing interventions or strategies to enhance dental attendance among preschoolers. In particular, such strategies should focus on enhancing parental SOC and

providing more enabling resources. The results of both phases of this research will aid the construction and psychometric evaluation of surveys that will be used as valid and reliable screening tools for non-adherence among pediatric and orthodontic patients. Finally, this theory-based model can be applied to measure treatment adherence in other pediatric chronic health conditions, such as diabetes and asthma.

Preface

This thesis is an original work by Maryam Elyasi. The research project, of which this thesis is a part, received two research ethics approval from the University of Alberta Research Ethics Board, Project Name “Preschool children's oral health behaviors and their parents' sense of coherence”, Protocol No. 00047287, April 24, 2014 (Appendix I) and Project Name “Developing a model to determine adherence to orthodontic treatments”, Protocol No. Pro00074659, Aug 02, 2017 (Appendix II).

Some of the research conducted for this thesis has been published in peer-reviewed journals.

A version of Chapter 2 of this dissertation has been published as Elyasi M, Guimarães Abreu L, Badri P, Saltaji H, Flores-Mir C, Amin M: Impact of Sense of Coherence on Oral Health Behaviors: A systematic review. PLOS One Journal, 2015; 10(8): e0133918, doi: 10.1371/journal.pone.0133918. I was responsible for the study design, data extraction and analysis as well as the manuscript composition. Guimarães Abreu L, Badri P assisted with the data extraction and contributed to manuscript edits. Saltaji H, Flores-Mir C, Amin M assisted in study design, and contributed to manuscript edits.

A version of Chapter 3 of this thesis has been published as Elyasi M, Guimarães Abreu L, Olsen C, Baker S, Lai H, Major P, Amin M: “Parent’s Sense of Coherence and Children's Oral Health-Related Behaviors: Is There an Association? ”Journal of Pediatric Dentistry, 2018 Jan 1;40(1):23-29. I was responsible for the data collection and analysis as well as the manuscript composition. Guimarães Abreu L and Olsen C assisted with the data collection and contributed

to manuscript edits. Amin M, Major P, Lai H and Baker S were the supervisory authors and was involved with concept formation and manuscript edits.

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Dedication

This work is dedicated to my only brother, **Mohammad Mahdi Elyasi,** an ethereal passenger of flight PS752.

You will always stay loved and remembered in every way.

Acknowledgments

I extend my deepest thanks to my love, **Masoud**, for the beautiful ways you touch my life every day. It was impossible to reach the point that I am now without your love, support and care. The most wonderful thing that happened in my life was to share my life and heart with you. Thank you for making me smile even in the saddest days, and holding my hands tight even when you were facing many challenges. You are a promise that I will have a soulmate forever.

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1. Chapter One: Introduction

1.1 Background

1.1.1 Adherence Behaviours

Adherence is defined by the World Health Organization as the extent to which a person's behaviour such as following a medical regimen, proper diet, or modified lifestyle corresponds with recommendations provided by a health care professional (Rich et al. 2015; Sabaté 2003). Without adherence, even the most sophisticated and costly preventive or treatment initiatives will fail, resulting in poorer quality of life, financial cost and overuse of the healthcare system (Kohler and Baghdadi-Sabeti 2011; West, DuRant, and Pendergrast 1993). Adherence is a multidimensional phenomenon determined by the interaction of five sets of factors, termed "dimensions" by the World Health Organization (Sabaté 2003). These dimensions were called: social & economic, health care system or provider-patient, condition-related, therapy-related, and patient-related. According to Gast and Mathes characterized these factors into two categories: *i.* factors that can affect intentional non-adherence (such as conscious decision not to take the medication due to costs) and *ii.* factors that can affect non-intentional non-adherence (such as amnesia due to mental disorders) (Gast and Mathes 2019). Exploring the abovementioned factors that might negatively affect an individual's adherence, are imperative due to several facts. First, these factors can help to identify and support patients who are at a higher risk of non-adherence. Second, they can enable researchers and healthcare policy makers to identify possible barriers towards adherence that might be eliminated. Third, they can guide the development of effective

interventions to enhance individual's adherence to health care (Gast and Mathes 2019). Despite all the efforts, lack of adherence in medicine has been estimated to be 50% in chronic diseases and long-term therapies (Gast and Mathes 2019; Sabaté 2003).

1.1.2 Adherence Behaviours in Children

In children, non-adherence to professional healthcare advice is a major health concern and a complicated issue given that it involves both children and their parents (Ashkenazi, Cohen, and Levin 2007; Taddeo, Egedy, and Frappier 2008). Therefore, pediatric health providers deal with two distinct audiences - children and their parents - who may or may not be working together (Rand and Scudder 2013). No matter how effective preventive or therapeutic regimens are, if children and parents do not adhere to instructions, the healthcare will be compromised (Chappell 2015). For example, child and parent beliefs about the disease, its therapy, their healthcare providers, and their potentials affect their strategies to prevent or manage the disease (Schwartz and Axelrad 2015).

1.1.3 Adherence to Oral Health in Children

In the oral health domain, children's lack of adherence to preventive oral health measures and treatment protocols has been particularly frustrating for oral health care professionals (Gardiner and Armbruster 2006). Oral health behaviours are established in childhood, and their development is mediated by parental behaviours (Talekar et al. 2005). Parents, particularly mothers, have a significant influence on their children's oral health-related behaviours. As such, their adherence to professionally recommended oral health measures such as tooth brushing and regular dental attendance plays a prominent role in maintaining and improving their children's

oral health (Ashkenazi, Bidoosi, and Levin 2012; Kirschstein and Slavkin 2000). Adherence in children has been studied in both preventive and therapeutic health care settings.

1.1.3.1 Adherence to Preventive Measures

The most common chronic disease in children, dental caries, is a behaviour-associated multifactorial chronic disease (Petersen 2009). Its prevalence is five times more than asthma, four times more than early childhood obesity, and 20 times more than diabetes (American Academy of Pediatric Dentists 2015). Dental caries is almost entirely preventable through satisfactory adherence to oral health behaviours including proper oral hygiene, dietary habits, and regular dental checkups (Ashkenazi et al. 2012; Kirschstein and Slavkin 2000). Nevertheless, about 40% of children have tooth decay by the time they reach kindergarten (Pierce, Rozier, and Vann 2002). Therefore, prevention of dental caries at younger ages, similar to any other chronic health conditions, could reduce the emergence of many serious dental problems that would compromise children's general health and well-being and their quality of life over their lifespan (Kirschstein and Slavkin 2000).

Adherence to a healthy diet and feeding practices, such as using unsweetened foods and beverages and to oral hygiene practices, such as toothbrushing twice a day, are examples of professional recommendations for preventing dental caries in children (American Academy of Pediatric Dentists 2015; Ashkenazi et al. 2012; Harris et al. 2004). These daily preventive measures are complemented by attending regular dental visits (Badri et al. 2014), which not only lead to early detection and management of oral diseases but also raise parental awareness regarding the causes and prevention of oral disease (Badri et al. 2014). Also, the long-term adherence to oral health practices will be reinforced during regular dental check-ups, when the

dentist discuss the importance of adherence to preventive measures with parents and children, and encourage the correct behaviours using appropriate compliments (Ashkenazi et al. 2012).

1.1.3.2 Adherence to Therapeutic Measures

Orthodontic treatments for child patients are ideal therapeutic measures for studying the adherence to oral health treatments because of the prolonged nature of the treatment (2-3 years) (Trenouth 2003). Although orthodontic treatment requires a high technical standard, patient's psychology and compliance are considered equally important factors in the treatment protocol (Lee, Ahn, and Kim 2008). Orthodontic treatment proceeds mostly in outpatient settings, which requires the patient's self-care behaviours and parents' involvement. Better self-care behaviours are associated with shorter treatment duration and enhanced orthodontic treatment outcome (Li et al. 2015). In 2005, Larsson and Bergstrom surveyed 151 Swedish orthodontic patients and found that 52% admittedly did not follow all treatment recommendations from their orthodontist (Larsson and Bergström 2005). A number of studies in the field of orthodontics have shown the impact of patient adherence on a range of outcomes such as treatment efficacy, loss of chair time, and frustration (Bos, Hoogstraten, and Prahl-Andersen 2005b; Skidmore et al. 2006).

Notably, the lack of adherence resulted in discontinuation of active treatments by 17.6% (Trenouth 2003). Therefore, nonadherence to orthodontic therapies is a healthcare concern from the perspective of quality of life and health economics (Mobley et al. 2008; Trenouth 2003). Further, the child patients under orthodontic treatment, are considered as moderate to high risk to caries development due to the difficulties and restrictions they have to clean their teeth properly (Ashkenazi et al. 2007). Patients with inadequate adherence during active treatment are likely to

remain in treatment longer. Therefore, they have the potential to experience more detrimental side effects such as the development of white spot lesions (Lindauer et al. 2009).

1.1.4 Adherence among children and adolescents

Pediatric adherence has been observed as a transaction between parent and child and it becomes challenging to study and explore (Schwartz and Axelrad 2015). It has been recommended that in pediatrics, the care must be family-centered instead of patient-centered (Yu et al. 2002). In younger children, problems with adherence are problems with parents who administer the health care (Schwartz and Axelrad 2015). For this age, mothers are the front line of health care, the future of a healthy society depends on the health of children and their mothers (Togari et al. 2012). Children acquire the norms, values, and behaviours of the group in which they are raised, usually from their parents (Schwartz and Axelrad 2015). Parents, particularly mothers, are the primary care givers who administer the oral health care for their young children (Schwartz and Axelrad 2015). Even in adolescence, the parental effect on child's health behaviour does not seem to decrease significantly with increasing age of the child (Freire M, Hardy R 2003).

1.1.5 Importance of identifying non-adherence

It is imperative to understand and evaluate the possible causes for children's poor adherence in oral health since most of the dental diseases can be virtually eliminated if children and their parents adhere to dental advice. It also helps to find strategies to enhance adherence through developing effective interventions (Ashkenazi et al. 2012). Since orthodontic treatment requires relatively extensive oral health resources, the providers need to be able to predict patient

adherence and to enhance it, if required. If we can identify patient characteristics associated with cooperative treatment behaviour, we may be able to remove some of the barriers to treatment or to defer treatment until treatment readiness has been achieved (Sinha, Nanda, and McNeil 1996). To make this practice happens, practitioners must have access to theory-driven measurement tools to identify the causes of children's poor adherence and develop effective interventions (Sabaté, 2003). Adopting a theoretical model while studying the determinants of adherence behaviours will serve as a framework to define which possible variables need to be analyzed, and which possible interactions between variables may be expected (Rich et al., 2015). It is necessary to know which theories can be successfully applied to study adherence to design and implement efficacious interventions to enhance adherence. There are several social-cognitive theories applied to predict behaviours, such as the health belief model, Trans-theoretical Model, social-cognitive theory, and Theory of Planned Behaviour (TPB) (Sabaté 2003). Among which, the TPB is a well-established and most frequently used theory applied to predict a wide range of adherence behaviours (Rich et al. 2015).

1.1.6 Theory of planned behaviour

The Theory of Planned Behaviour (TPB) is a well-established social cognitive theory. TPB has been found to be useful in predicting a range of adherence behaviours including dietary adherence, exercise adherence, and medication adherence in both acute and chronic health conditions (Rich et al. 2015; Ried and Christensen 1988). This theory has mainly been applied to the prediction of behaviours that promote individual health (Rich et al. 2015). According to this theory, the behaviour is a function of intention towards that behaviour, modified by the Perceived Behavioural Control (PBC). Intention, which is considered the immediate antecedent

of behaviour, is itself based on attitudes toward the behaviour, subjective norms, and PBC (**Figure 1.1**). TPB has demonstrated a relatively high degree of standardization of measures based on published recommendations and compatibility principles (Conner, Mark and Norman 2005).

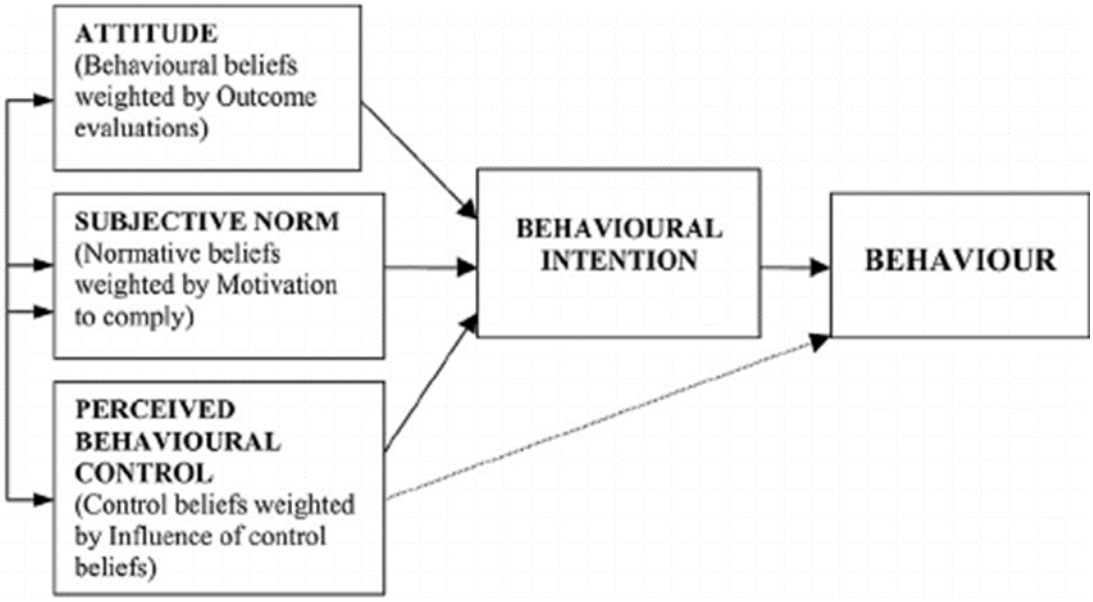


Figure 1.1. Theory of Planned Behaviour (Ajzen 1991).

Finally, evidence from hundreds of studies, summarized in numerous meta-analyses and reviews, has shown that the constructs of TPB (attitude, subjective norm, and perceived control) are designed to successfully explain a large proportion of the variance in behavioural intention (Ajzen 2010; Lange, Kruglanski, and Higgins 2012). These constructs can also predict a number of different health-related behaviours, including health food consumption, physical activities, and adherence behaviours (Armitage and Conner 2001; Lange et al. 2012; Rich et al. 2015; Sheeran 2002). TPB was also successful in exploring individuals' decisions for others' health,

including parents' behaviours to promote the health of their children (Hamilton, Griffith, and Dongen 2019). A meta-analysis of studies, revealed the effectiveness of the theory of planned behaviour in identifying the determinants of parent-for-child health behaviours (Hamilton et al. 2019).

1.1.6.1 Theory of Planned Behaviour constructs

1.1.6.1.1 Intention

According to Ajzen, behavioural intention is an indication of an individual's readiness to perform a given behaviour, and intention is assumed to be an immediate antecedent of behaviour (Ajzen 1991). This means that all actions or activities will have a designed plan in advance, and human beings are aware of the type of action needed to achieve the goal (Ajzen 1991). The theory of planned behaviour assumes that "a central factor to perform[ing] behaviours of different kinds can be predicted with high accuracy from attitudes toward the behaviour, subjective norms; and these intentions, together with perceptions of behavioural control" (Ajzen 1991). Intention is also linked to individual motivation, which predicts behaviour by understanding how much a person desires the perceived outcome and how much effort that person is willing to dedicate to performing the behaviour (Ajzen 2010). In other words, theory predicts that an individual is most likely to intentionally adopt, maintain or change behaviour only if, for instance, he/she perceives a health benefit, and if performing the act or exhibiting/modeling the behaviour is socially rewarding (Ajzen 2010).

1.1.6.1.2 Attitude

Attitudes, as a predictor of behavioural intention, are determined by an individual's belief that desired outcomes can be achieved as a consequence of specific actions, especially those that are beneficial to health (Ajzen 2010). Ajzen defined as the beliefs about the likely outcomes of the behaviour and the positive or negative evaluations of these expected outcomes (Ajzen 2010). Attitude is recognized as a salient function of behavioural belief as it links the behaviour to the anticipated outcome. A behavioural belief is the subjective probability that the behaviour of interest will lead to a particular outcome or a given experience (Ajzen 2019; Armitage and Conner 2001).

1.1.6.1.3 Subjective norms

Subjective norms, as the only social component of the TPB, is considered a function of normative beliefs, which refers to an individual's perceptions or beliefs about specific people's thoughts or preferences around the performance of certain behaviours (Ajzen 2010). Essentially, individuals who are motivated to meet the expectations of others are more likely to accept a new action if they perceive that the action would be appraised positively by significant others in that individual's life. Conversely, individuals who are less motivated to comply with the opinions of significant others remain neutral in their actions (Ajzen 1991). These two above components, addressed by the TPB, become more comprehensive when the third component, perceived behavioural control construct, is added to the model (Ajzen 2010).

1.1.6.1.4 Perceived behavioural control

As mentioned earlier, the TPB is an adjusted version of the original model. It adds perceived behavioural control as a construct that deals with numerous factors beyond volitional control (Ajzen 1991; Nutbeam, Harris, and Wise 2010). Perceived behavioural control judgments are under the influence of beliefs about accessibility to necessary resources and opportunities to successfully perform the behaviour, which is weighted by each factor's perceived power (Ajzen 1991). On the other hand, control beliefs refer to the perception of facilitating or inhibiting factors that one perceives towards performing a behaviour (Ajzen 2010). Adding perceived behavioural control is a recognition of the greater significance of intention, in that an individual feels that he/she has more control over enacting a behaviour when mediated by a person's perceived power in relation to a specific situation (Nutbeam et al. 2010). Including the construct of perceived behavioural control in the TPB places it within a more general framework that comprises relations among beliefs, attitudes, intentions and behaviour. In contrast, this construct, together with behaviour intention, can also directly predict behavioural intention (Ajzen 1991, 2010).

1.1.6.2 Theory of Planned Behaviour and health behaviours

The Theory of Planned Behaviour (TPB) has been successfully applied to predict a range of adherence behaviours including dietary adherence, exercise adherence, and medication adherence in both acute and chronic health conditions (Ajzen 2010; Armitage and Conner 2001; Nutbeam et al. 2010; Rich et al. 2015). TPB provides a strong account of the proximal psychological influences on behaviour that may mediate these other influences, and so constitute an appropriate focus for interventions (Nutbeam et al. 2010). In this regard, TPB has been

provided with an excellent framework to conceptualize, identify, and evaluate the determinants of behaviour (Nutbeam et al. 2010).

1.1.6.3 Theory of Planned Behaviour and oral health behaviours

TPB has been found to be a successful theoretical model for application in oral health studies (Scheerman et al. 2016). TPB is the most frequently used theory for the design of the theory-based studies due to its superior predictive utility (Scheerman et al. 2016). TPB components have explained a significant proportion of the variance in predicting oral health-related behaviours in adults. The studies revealed that the TPB explained about 30% to 50% of the variance associated with adherence to oral health behaviours (Anderson, Noar, and Rogers 2013; Buunk-Werkhoven, Dijkstra, and Van Der Schans 2011; Dumitrescu et al. 2011, 2013, 2014; Hajiagha, Saffari, and Hajiagha 2012; Luzzi and Spencer 2008; Scheerman et al. 2016; Simpriano, São-João, and Mialhe 2015). This range of 30% to 50% demonstrated the proportion to which TPB model accounted for the variation in predicting oral health behaviours. Nevertheless, despite what appears to be an increase in the application of the TPB in oral health research, applications of the TPB in children's oral health studies is still new. One study showed that TPB components were accounting for 41% to 46% of the variance of parent's adhere to dental attendance and toothbrushing behaviours in children (Van den Branden et al. 2013). In the behavioural sciences, 0.5 is quite good, and even 0.3 or 0.4 is an acceptable level of explained variance (Henseler, Ringle, and Sinkovics 2009).

One privilege of the TPB is that it can accommodate the inclusion of new constructs contributing to the elucidation of a particular behaviour. This flexibility can increase the proportion of the explained variance and allow for generalization to varied research contexts to

predict different types of behaviours (Ajzen 1991; Rich et al. 2015). The proposed construct should be behaviour-specific and demonstrate an independent causal effect in determining intention or behaviour (Ajzen 2019).

1.1.7 Theory of Planned Behaviour and adherence behaviours

Adherence is a behavioural concern performed by patients, but with causes beyond the patient (Sabaté 2003). It occurs in preventive or therapeutic self-care demands that the patient needs to cope. These demands include learning new behaviours, modifying routine lifestyle, endure difficulties and inconveniences, and keep on doing while trying to function efficiently in their life roles (Sabaté 2003). One of the important psychosocial factors in adherence behaviours is patient's ability to cope with daily life stressors that play a significant role in identifying and mobilizing resources to adhere to healthy practices (Antonovsky 1987). Although TPB has elucidated the ways in which patients conceptualize health-threatening conditions and evaluate possible facilitators and barriers toward adherence, it does not address behavioural coping skills well (Sabaté 2003).

1.1.8 Sense of coherence

The concept of Sense of Coherence (SOC), the core concept of Salutogentic Model, seeks to elucidate the association between coping with life stresses and preserving health (Antonovsky 1993; Watt 2002). Salutogenesis, is a stress resource orientated model, which focuses on resources, maintains and facilitates the movement towards health. Salutogentic approach has a different perspective from the pathogenic concept where the focus is on the obstacles and disease (Antonovsky 1987). According to this theoretical model, every human being experiences stress

at some of the time in life; however, people have internal and external resources which they can adopt to manage stressful circumstances, and stay healthy (Antonovsky 1984). The Salutogenic model is the main research objective of the Health Promotion Research Programs (Antonovsky 1987). An individual's sense of coherence (SOC) is a global orientation that expresses the extent to which the person has a pervasive, enduring but a dynamic feeling of confidence enabling the person to apply general resistance resources (GRRs). GRRs are more than a specific coping skill for a particular event. Individual's SOC relies on the three key competencies: comprehensibility, manageability and meaningfulness (Figure 1.2); these competencies have dynamic interactions (Antonovsky 1993). It means that people who have a higher level of SOC are more capable of perceiving typical stressors coming from their society (e.g., racial segregation, employment rate, and family relationships) and environment (e.g., housing condition, traffic patterns, and environmental tobacco smoke) as non-stressors (comprehensibility) (Suglia, Duarte, Sandel, & Wright 2010). They are also able to utilize available resources efficiently to control stressful circumstances (manageability) and to cope with stressors by having more enthusiasm, intention, and dedication (meaningfulness) (Antonovsky 1993). SOC is a health-promoting psychological resource that strengthens one's capacity to deal with environmental strain and the dynamic feeling of confidence enabling the person to apply the general resistance resources to cope with stressful situations (Eriksson 2006). This enables them to benefit from an increased feeling of well-being (Antonovsky 1987). SOC is a cross-cultural concept that is not influenced by age, sex, ethnicity, nationality, and study design (Antonovsky 1993). Antonovsky claimed that sense of coherence develops until the age of about 30 years, remains relatively stable until retirement, and decreases afterwards (Antonovsky 1993). Long-term longitudinal studies revealed that stable over time, but not as stable as Antonovsky assumed (Nilsson et al. 2010). SOC is an essential

protective factor in all cultures when facing a stressful situation; however, levels of SOC are varied among different cultural groups (Braun-Lewensohn and Sagy 2011).

Individual's sense of coherence is not only related to a particular coping scheme but to the determinants on which the strategy of handling a stressor is based (Antonovsky 1984). Thus, in people with a stronger SOC, there is a higher expectation for superior health status and quality of life with fewer symptoms in case of existing illness (Eriksson and Lindström 2007). A strong association between higher SOC and lower incidence of chronic diseases (Veenstra, Moum, and Røysamb 2005) and better quality of life (Moons and Norekvål 2006; Eriksson and Lindström 2007).

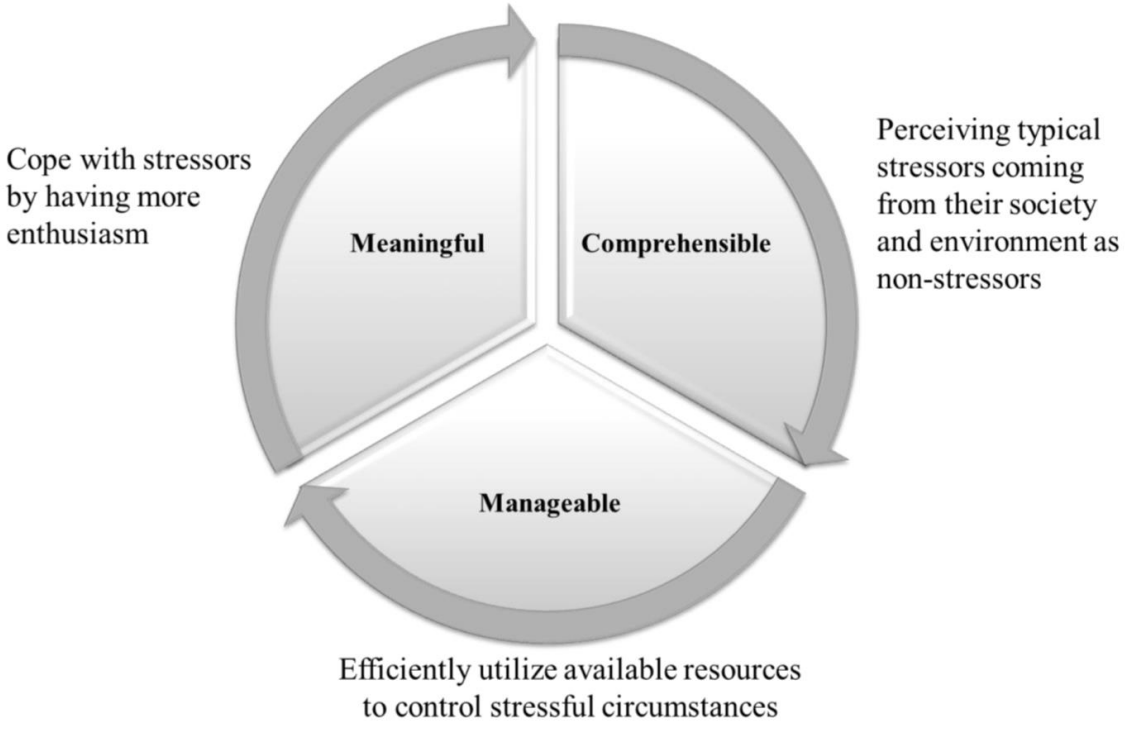


Figure 1.2. The concept of Sense of Coherence (Antonovsky 1987).

1.1.8.1 Sense of coherence and oral health

In oral health, the incidence of chronic diseases such as dental caries and periodontitis is not only associated with biological factors. Still, it may also be affected by non-biological factors such as oral health behaviours (Wigen and Wang 2015). There is also a growing interest in the role of stress and coping as a determinant of oral health outcomes (Ayo-Yusuf, Reddy, and Van Den Borne 2009). It has been suggested that people's SOC can have life-course influences on their oral health status and behaviours (Ayo-Yusuf et al. 2009; Nammontri, Robinson, and Baker 2013). This concept is considered as a practical model emphasizing the psychosocial aspect of oral health promotion rather than the risk of the disease (Antonovsky 1993).

1.1.8.2 Sense of Coherence and adherence to oral health behaviours

An individual's behaviour is the manifestation of several determinants, such as psychosocial and environmental factors that can be influenced by the SOC concept (Lindmark and Abrahamsson 2015). The SOC has been recently received empirical research support as a determinant of oral health care measures among different age groups (Bernabe et al. 2010). Individuals who have a stronger SOC are more intended to attend regular dental check-ups, clean their teeth more often, and have healthier dietary habits as compared to their counterparts who have lower levels of SOC (Bernabé et al. 2009; Dorri et al. 2010; Freire, Sheiham, and Hardy 2001).

Studies have shown the influence of parents' SOC on their children's oral health-related behaviours (Bernabé et al. 2009). Besides, oral health perceptions as well as oral-health related quality of life (OHRQoL) of both children and adolescents were significantly affected by their parents' SOC (Bonanato et al. 2009; Freire and Hardy 2002). Mothers with higher SOC are more

likely to have more positive attitudes and behaviours towards their children's oral health than those with lower SOC (Bonanato et al. 2009; Freire and Hardy 2002; Perazzo et al. 2017). It is indeed conceivable that parents with a high SOC having stronger intention to comply with professional advice regarding preventive measures for their children.

Recently, adherence studies in orthodontics have also shed light on the important role of coping skills among orthodontic patients and their parents (Ferry-Brown and Moerenhout 2003). For the patients' part, the challenge of coping with pain and discomfort during the orthodontic treatment and adherence to oral health care practices were seen as the primary causes of discontinuance of treatment (Ferry-Brown and Moerenhout 2003). From the parents' part, their ability to support and encourage their children to adhere to their therapy and recommended oral health measures is critical to the treatment success (Albino et al. 1991; Prabakaran et al. 2012).

1.2 Problem statement

Adopting a theoretical model is required while studying the determinants of adherence to oral health behaviour among children. It serves as a framework to define which possible variables need to be analyzed, and which possible interactions between variables may be expected. In the oral health domain, only 39% of the studies grounded their research based on a behavioural theory and the most dominant theoretical framework used to design and implement the included studies was the 'Theory of Planned Behaviour' (Scheerman et al. 2016). The TPB is a flexible model, which is open to the inclusion of additional constructs aiming to increase the proportion of the explained variance and allow for more applicability of this model to predict a wide range of behaviours. The WHO global project of adherence to long-term therapies revealed that adopting social cognitive theories such as TPB has elucidated the ways in which patients

conceptualize health-threatening conditions and evaluate possible facilitators and barriers towards adherence. However, these theories do not always address behavioural coping skills well. These skills may be effectively evaluated using the concept of Sense of Coherence (SOC), which is the core concept of the Salutogenic Model seeking to explain the relationship between coping with life stresses and maintaining health. The SOC has recently received empirical research support as a determinant of oral health care measures. Therefore, further research has also been recommended to introduce SOC as a psychological construct that could be considered in oral health models.

The overall aim of this research was to build and test a theoretical model to predict children's adherence to oral health preventive measures. The goal was to develop a theory-based model to identify the determinants of children's adherence to preventive oral health care practices in a population-based setting. The developed model was also tested in a clinical setting with children undergoing orthodontic treatments for future authenticity of our results.

1.2.1 Research Questions

1. To which extend does the literature support the association between SOC and oral health behaviours?
2. What is the relationship between parents' SOC and children's oral health behaviours?
3. Does the developed expanded TPB model, by adding SOC, could enhance the predictive power of the original TPB while studying on adherence to preventive oral health behaviours in children?
4. How can the expanded TPB model be cross-validated through studying the determinants of adherence to orthodontic treatments among children?

1.2.2 Specific objectives

1. To critically analyze the empirical evidence on the association between SOC and oral health behaviours by conducting a systematic review.
2. To assess the impact of parents' SOC on their adherence to preventive oral health behaviours for their children.
3. To examine the predictive power of an expanded TPB model by adding SOC, to predict parents' adherence to preventive oral health behaviours in children.
4. To set the ground for our future research aiming to cross-validate the expanded TPB model to predict children's adherence to orthodontic treatments through a prospective approach.

2. Chapter Two: Impact of Sense of Coherence on Oral Health Behaviours: A systematic review

2.1 Abstract

Objectives: The aim of this review was to critically analyze the empirical evidence on the association between Sense of Coherence (SOC) and oral health behaviours through a systematic approach.

Methods: A systematic search up to April 2015 was carried out using the following electronic bibliographic databases: PubMed, Ovid MEDLINE; ISI Web of Science; and Ovid PsychInfo. Studies were included if they evaluated the relationship between SOC and oral health behaviours including tooth cleaning, fluoride usage, dietary habits, dental attendance, and smoking. We excluded studies that only assessed the relationship between oral health status and SOC without evaluating oral health behaviours. The New Castle Ottawa (NOS) quality assessment checklist was employed to evaluate the methodological quality of included studies.

Results: Thirty-nine potential papers met the preliminary selection criteria and following a full-text review, nine papers were finally selected for this systematic review. Results provided by the included studies indicated different levels of association between SOC and oral health behaviours. The most frequent behaviours investigated were tooth brushing and dental attendance pattern. The impact of SOC on performing positive oral health behaviours, to some extent, was related to demographic and socio-economic factors. In addition, mothers' SOC influenced children's oral health practices.

Conclusions: A more favorable oral health behaviour was observed among those with a stronger SOC suggesting that the SOC can be a determinant of oral health-related behaviours including tooth brushing frequency, daily smoking, and dental attendance.

2.2 Introduction

During the last three decades, theoretical approaches have been introduced to the public health literature to explain the importance of social context and its association with biological and psychological determinants of health and illness (Newton and Bower 2005; Watt 2002). For instance, public health-related studies have identified "stress" as an important social determinant of patient's adherence to medical advice and health promotion programs (Antonovsky 1987; Deinzer et al. 2005).Consequently, the "Salutogenic" theory, which is a social health-related theory, was developed to explain the correlations between health, stress, and coping (Antonovsky 1987). This theory, therefore, emphasizes the role of psychosocial determinants in maintaining human well-being rather than causing the diseases (Antonovsky 1993).

Sense of coherence (SOC) is the main constituent of the Salutogenic theory. It evaluates the individual's capability to use existing resources in order to overcome difficulties and cope with life stressors to perform healthy behaviour and stay well (Antonovsky 1993). People with stronger SOC can better cope with existing stressors in their social life (Antonovsky 1984). This enables them to benefit from an increased feeling of well-being (Antonovsky 1987; Watt 2002). SOC is a cross-cultural concept that is not influenced by age, sex, ethnicity, nationality, and study design (Antonovsky 1993). It relies on the following three key competencies: comprehensibility, manageability and meaningfulness (Antonovsky 1993). These competencies have dynamic interactions (Antonovsky 1987). It means that people who have higher level of SOC are more capable

of perceiving typical stressors coming from their society (e.g., racial segregation, employment rate, and family relationships) and environment (e.g., housing condition, traffic patterns, and environmental tobacco smoke) as non-stressors (comprehensibility) (Suglia et al. 2010). They are also able to efficiently utilize available resources to control stressful circumstances (manageability), and to cope with stressors by having more enthusiasm, intention, and dedication (meaningfulness) (Antonovsky 1993). Thus, in people with a stronger SOC, there is a higher expectation for a superior health status and quality of life with fewer symptoms in case of existing illness (Eriksson 2006; Eriksson and Lindström 2007).

A strong association between higher SOC and lower incidence of chronic diseases (Veenstra et al. 2005; Wainwright et al. 2007) and better quality of life (Moons and Norekvål 2006; Motzer and Stewart 1996) has been reported in several studies. In the field of oral health, the incidence of chronic oral diseases such as dental caries and periodontitis is not only related to biological factors, but may also be influenced by non-biological factors such as oral health behaviours (Wigen and Wang 2015; Zaborskis et al. 2010). An individual's behaviour is the manifestation of several determinants such as psychosocial and environmental factors that can be influenced by the SOC concept (Freire et al. 2001; Lindmark and Abrahamsson 2015). This concept is considered as a practical model emphasizing the psychosocial aspect of oral health promotion rather than the risk of the disease (Antonovsky 1987). SOC has also been considered as a psychosocial determinant of oral health behaviours in adults (Bernabé et al. 2009). In other words, individuals who have a stronger SOC are more intended to attend regular dental check-ups (Freire et al. 2001), clean their teeth more often (Dorri, Sheiham, and Watt 2010), and have healthier dietary habits (Bernabé et al. 2009) as compared to their counterparts who have lower levels of SOC. In addition, oral health perceptions as well as oral-health related quality of life (OHRQoL) of both children and adolescents are significantly

affected by their parents' SOC (Bonanato et al. 2009; Freire and Hardy 2002). However, a few related studies failed to report any specific association between SOC and some oral health behaviours (e.g., frequency of sugar intake and tooth brushing) (Freire et al. 2001; Qiu et al. 2013) or OHRQoL in different age groups (Emami 2009).

To the best of our knowledge, there is no critical analysis in the dental literature that has attempted to summarize the existing evidence regarding the association between the SOC and oral health-related behaviours. The purpose of this article is, therefore, to critically analyze the association between SOC and oral health behaviours by a systematic review of the available data. This critical appraisal of evidence is needed to update the oral health community about the impact of SOC on oral health behaviours, which may ultimately help with developing effective oral health promotion strategies and interventions when the SOC is considered as a variable of interest in the future studies.

2.3 Materials and Methods

This systematic review is reported, whenever applicable, in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) statement checklist (Liberati et al. 2009).

2.3.1 Protocol and registration

This systematic review's protocol was not registered in advance.

2.3.2 Eligibility criteria

We included studies in the domain of oral health that evaluated the relationship between SOC and oral health behaviours including tooth cleaning, fluoride usage, dietary habits, dental attendance, and smoking. No restrictions were applied regarding language, study design, age, sex, culture or socio-economic status. We excluded studies that only assessed the relationship between SOC and oral health status without evaluating the impact of SOC on oral health behaviours. The reviews of the literature, meeting abstracts, editorial letters and qualitative studies were excluded.

2.3.3 Data sources and search strategy

Comprehensive searches up to April 1, 2015 were carried out using the following electronic bibliographic databases: PubMed (1966 to April 2015, week 1), Ovid MEDLINE (1980 to 2015, week 12); ISI Web of Science (1965 to April 1, 2015); and Ovid PsychInfo (1980 to April 2015).

The search strategy was designed with the assistance of a health sciences librarian. Keyword and their combinations were first chosen and used in PubMed (Table 2.1). Then, the terms were adapted to run the search in other databases (Table 2.2). Hand searches were made on the reference lists of the selected articles for any potential papers not identified through the electronic search. A partial gray literature search was finally performed by using Google Scholar and Google search engine.

Table 2.1. Search Strategy (in PubMed).

#1 "sense of coherence"[All Fields] OR "sense of coherence scale"[All Fields]) OR "salutogenic model"[All Fields]) OR "salutogenic approach"[All Fields]) OR "salutogenic theory"[All Fields]) OR "salutogenic concept"[All Fields])
#2 ("Oral Health"[All Fields] OR "oral hygiene"[All Fields]) OR "tooth brushing"[All Fields]) OR "dental attendance"[All Fields]) OR "dental education"[All Fields]) OR "dental"[All Fields]) OR "dentistry"[All Fields]) OR ("dental caries"[MeSH Terms] OR ("dental"[All Fields] AND "caries"[All Fields]) OR "dental caries"[All Fields] OR "caries"[All Fields])) OR "oral habit"[All Fields])
#3 #1 AND #2

Table 2.2. Search strategies and results from different electronic databases.

Database	Keywords	Results
PubMed (1966 to April 2014, week 1)	(((((("sense of coherence"[All Fields] OR "sense of coherence scale"[All Fields]) OR "salutogenic model"[All Fields]) OR "salutogenic approach"[All Fields]) OR "salutogenic theory"[All Fields]) OR "salutogenic concept"[All Fields]) AND ((((((((("Oral Health"[All Fields] OR "oral hygiene"[All Fields]) OR "tooth brushing"[All Fields]) OR "dental attendance"[All Fields]) OR "dental education"[All Fields]) OR "dental"[All Fields]) OR "dentistry"[All Fields]) OR ("dental caries"[MeSH Terms] OR ("dental"[All Fields] AND "caries"[All Fields]) OR "dental caries"[All Fields] OR "caries"[All Fields])) OR "oral habit"[All Fields])	52
Ovid MEDLINE(R) (1946 to April Week 1)	exp "Sense of Coherence" OR "sense of coherence".ti,ab. OR "(salutogen* adj2 (model* or concept*)).mp." AND "exp Oral Health/ or exp Oral Hygiene/ or exp Periodontal Diseases/ or exp Dental Caries/ or exp Dental Health Surveys/ or exp Tooth Diseases/ or exp Health Education, Dental" OR ((oral or dental) adj2 (health or hygiene or medicine or care)).mp. OR "(dental adj2 caries).ti,ab. OR "((tooth or periodontal) adj2 disease*).ti,ab."	43
ISI Web of Science (1965 to April 1, 2014)	Topic=(sense of coherence OR salutogenic OR salutogenesis) AND (TS=oral AND (health OR hygiene) OR TS=(dental OR dentist* OR caries OR cavities OR gingivitis)) Timespan=1985-2014. Databases=SCI-EXPANDED. Lemmatization=On	147
PsychInfo (1980 to April 2014)	(((((("sense of coherence"[All Fields] OR "sense of coherence scale"[All Fields]) OR "salutogenic model"[All Fields]) OR "salutogenic approach"[All Fields]) OR "salutogenic theory"[All Fields]) OR "salutogenic concept"[All Fields]) AND ((((((((("Oral Health"[All Fields] OR "oral hygiene"[All Fields]) OR "tooth brushing"[All Fields]) OR "dental attendance"[All Fields]) OR "dental education"[All Fields]) OR "dental"[All Fields]) OR "dentistry"[All Fields]) OR ("dental caries"[MeSH Terms] OR ("dental"[All Fields] AND "caries"[All Fields]) OR "dental caries"[All Fields] OR "caries"[All Fields])) OR "oral habit"[All Fields])	5
Total databases searches		247
Duplicates		32
Final		215

2.3.4 Study selection

The study selection was performed in two phases. In phase one, three reviewers (M.E, L.A, P.B) independently evaluated the list of the titles and abstracts of potentially articles to be included. If the abstract was judged to contain insufficient information for a decision of inclusion or exclusion, the full article was obtained and reviewed before a final decision was made.

For phase two, the full texts of potentially relevant abstract were retrieved, and the selection criteria were applied again to confirm the final selection. Discussion between reviewers regarding any inconsistency in the inclusion of articles was done until agreement was reached. As a third reviewer was involved when discrepancies arose, the final agreement was of 100%.

2.3.5 Data extraction and data items

Data were extracted from each of the selected articles separately by the same three examiners on the following items: author and year of publication, study design and aim of the study, demographic characteristics, oral health behaviours, and SOC scale used, sampling, statistical analysis and the main findings of the study were also collected and summarized (Table 2.3). Disagreements between investigators were resolved by reexamining the studies until consensus was reached. In the case of any missing information or uncertainty in evaluating the articles, efforts were made to contact the authors for clarification.

Table 2.3. Summary of descriptive characteristics of finally selected studies.

Author Year	Article characteristics	Participants demographics and characteristics:	Method details			Main results
	Study design Aim of the study	No Country Age (mean±SD) Sex	Sense of coherence scale Version of scale SOC-13 Modified SOC-13 Language Rating scale Cronbach's α Participants' SOC (mean±SD)	Oral health behaviours outcome measure	Statistics analysis method Sampling	
Ayo-Yusuf 2008	Longitudinal Investigated the association between adolescents' sense of coherence (SOC) and their tooth-brushing behaviour	1025 South Africa 14.4±1.5 Males 47.2% Females 52.8%	SOC-13 English* Seven-point Likert-type 0.63 26.3 (7.2)**	Tooth brushing frequency	Chi-square t-tests Step-wise multiple logistic Regression Two-Stage random cluster sampling	Adding baseline intention state to a multivariate model attenuated the influence of baseline SOC to a statistically insignificant level. However, increasing within subject SOC changes ($P < 0.01$) remained associated with the transition to twice-daily tooth brushing.
Bernabe et al. 2009	Cross-sectional Assessed the associations between SOC and childhood socio-economic status with adult oral health-related behaviours	5,399 Finland 49.60±12.78 Males 49.2% Females 50.8%	Modified SOC-13*** Finnish Seven-point Likert-type 0.85 5.48±0.81****	Dental attendance Tooth brushing frequency Dietary habits Smoking habits	Binary logistic regression analysis Two-Stage stratified cluster sampling	SOC was significantly associated with the four oral health-related behaviours. ($P < 0.006$) Interaction among income, SOC, and gender was statistically significant for dental attendance and tooth brushing frequency ($P = 0.042$ and 0.001, respectively).

Da Silva et al. 2011	Cross-sectional Investigated the relationship of low-socioeconomic status mother's SOC and their child's utilization of dental care services	190 Brazil 11.6± 0.95 Girls 56.3%, Boys 43.7%	SOC-13 Portuguese Five-point Likert-type 0.78 47.9± SD = 6.82	Dental attendance	Multivariate logistic regression analysis Convenience sampling	Children whose mothers had higher levels of SOC were more likely to utilize dental care services ($P < 0.05$) and visit a dentist mainly for check-ups (except for dental treatment) ($P < 0.05$) than those whose mothers had lower levels of SOC.
Dorri et al. 2010	Cross-sectional Assessed the association between SOC and tooth brushing behaviours in adolescents	911 Iran 12.42±0.79 Males 59.2% Females 40.8%	SOC-13 Persian Seven-point Likert-type 0.87 48.6 SD±10.7	Tooth brushing frequency:	Binary (multivariate) logistic regression analysis Two-Stage stratified cluster sampling	Higher SOC scores were significantly associated with more frequent tooth brushing behaviours ($p<0.01$). The association was significant only for girls ($p<0.02$). However, the interaction between sex and SOC was not significant. ($p<0.56$) Boys had a significantly stronger SOC than girls. ($p<0.04$)
Freire et al. 2001	Cross-sectional Assessed the relationship between adolescents' sense of coherence (SOC) and oral health	664 Brazil 15 Males 48.9% Females 51.80%	SOC-13 Portuguese Seven-point Likert-type 0.81 57.5	Dental attendance Tooth brushing frequency Dietary habits Fluoride use	Multiple logistic regression analysis Polytomous ordered regression analysis Stratified random sampling	Adolescents with higher SOC were more likely to visit for mainly check-ups compared with those with lower SOC. ($p<0.05$) Other measures of oral health status and behaviours were not significantly associated with SOC. ($p>0.05$)
Freire et al. 2002	Cross-sectional Studied the relationship between mothers' SOC and their adolescent children's oral health	664 Brazil 40.1±5.3 Females 100%	SOC-13 Portuguese Seven-point Likert-type - 63.9±13.4	Dental attendance Tooth brushing frequency Dietary habits	Multiple logistic regression analysis Polytomous ordered regression analysis Stratified random sampling	Adolescents whose mothers had significantly higher levels of SOC score were less likely to visit the dentist mainly when in trouble than those whose mothers had lower levels of SOC. ($p=0.001$) Mothers' SOC was associated with their children's pattern of dental attendance even after adjustment for social class and gender.

Lindmark et al. 2011	Cross-sectional Investigated the relationship between SOC, oral health–related behaviour and knowledge of and attitudes towards oral health	525 Sweden 20-80*****[1] Males 49.7% Females 50.3%	SOC-13 Swedish Seven-point Likert-type 0.86 ******	Dental attendance Tooth cleaning habits (Tooth brushing and proximal cleaning frequencies) Dietary habits Smoking habits	Student's t-test One-way ANOVA Tukey test Multivariate logistic regression analysis Stratified random sampling	Individuals with higher total mean SOC scores and subcomponent scores were statistically significantly associated with fewer sweet drinks and a lower frequency of snacks and drinks between meals, compared with individuals with lower total mean SOC scores. ($p<0.01$) In the bivariate analysis, total SOC was not significantly associated with tooth brushing twice a day or more. Regular dental visiting and smoking habits also did not display any statistically significant relationship with SOC in this study.
Peker et al. 2012	Cross-sectional Examined the associations between health practices and SOC among dental students at Istanbul University	566 Turkey 21.05±1.62 Males 45.2% Females 54.8%	SOC-13 Turkish Seven-point Likert-type 0.75 56.89±10.68	Dental attendance Tooth brushing frequency Use of dental floss Dietary habits Smoking habits	t-test Chi-square test Binary multiple logistic regression Convenience sampling	Students with a strong SOC reported brushing their teeth more frequently ($p=0.008$), sugar intake between meals less frequently ($p=0.009$), and smoking less frequently ($p<0.001$) than those with a low SOC. ($p<0.05$) Participants' age and sex were not significantly associated with their SOC. ($p= 0.24$ and $p=0.65$ respectively)
Qiu et al. 2013	Cross-sectional Studied the relationship between caregiver's SOC and oral health-related behaviours of 5-year-old children	1332 China - Mothers 85.7% Fathers 5.4% Grandparents 8.9%	SOC-13 Chinese Seven-point Likert-type scale 0.86 61.1±10.5	Dental attendance Tooth brushing frequency Dietary habits	t- test Chi-square Multiple logistic regression analysis Two-stage stratified cluster sampling	There was no statistically significant difference in the total SOC scores among the different caregivers ($p=0.065$). (significant level: $p<0.05$) No association was found between the children's sugary snack intake and the mother's or the father's SOC. ($p<0.05$) 8.9% of the children whose grandparents (as caregivers) had significantly higher SOC scores had a lower frequency of sugary snack intake ($p=0.008$)

* The original English questionnaires were translated into two local languages, namely Afrikaans and Sepedi for use with a few learners who were not proficient in English; otherwise, the surveys were conducted in English. ** Although all the items of the SOC-13 loaded on three factors, the original three-factor structure of the SOC-13 could not be replicated in this adolescent population. Only six out of 13 items were replicated for this population; however, the internal consistency coefficient was similar to that of the SOC-13 when comparing them as a unidimensional scale. ***These studies employed an abbreviated form of SOC-13 scale by removing one item to provide equal number of 4 items to measure three constructs of SOC. **** This study reported SOC score on a 7-point range. ***** Participants have a wide age range, which categorized into groups: Participants were classified into of the following age groups: 20, 30, 40, 50, 60, 70 and 80 years

of age. No mean for total or each age group has provided. The age was classified into four categories, 30-39 years old, 40-49 years old, 50-59 years old and 60-64 years old. No mean for total or each age group has provided. The age was classified into four categories 40-49, 50-59, 60-69, and 70- 80. No mean for total or each age group has provided. ****** For each behaviour SOC was mentioned separately. Refer to table 2 of the article (Lindmark, Hakeberg, and Hugoson 2011).

2.3.6 Risk of bias in individual studies

The assessment of methodological quality was performed by the same three researchers using the Newcastle-Ottawa Scale (NOS) for cohort studies and modified Newcastle-Ottawa Scale for cross-sectional studies (Hermont et al. 2014; Sue et al. 2013; Terwee et al. 2007). For the cohort studies, a quality score was calculated based on three categories: group selection (four items), comparability between groups (one item), and outcome and exposure assessment (3 items). A maximum of one point could be awarded for each item in the group selection and outcome and exposure assessment categories. A maximum of two points could be awarded for comparability. Thus, the maximum score was nine points and represented the highest methodological quality. For the cross-sectional studies, the score was calculated based on the same three categories. However, those categories had a different number of items: group selection (four items), comparability (one item), and outcome and exposure assessment (one item). Therefore, the maximum score was seven points and indicated the highest methodological quality. Studies were considered high quality if they were scored above median: five points for cohort studies and four points for cross-sectional (Hermont et al. 2014). Disagreement between the reviewers was discussed until consensus was reached.

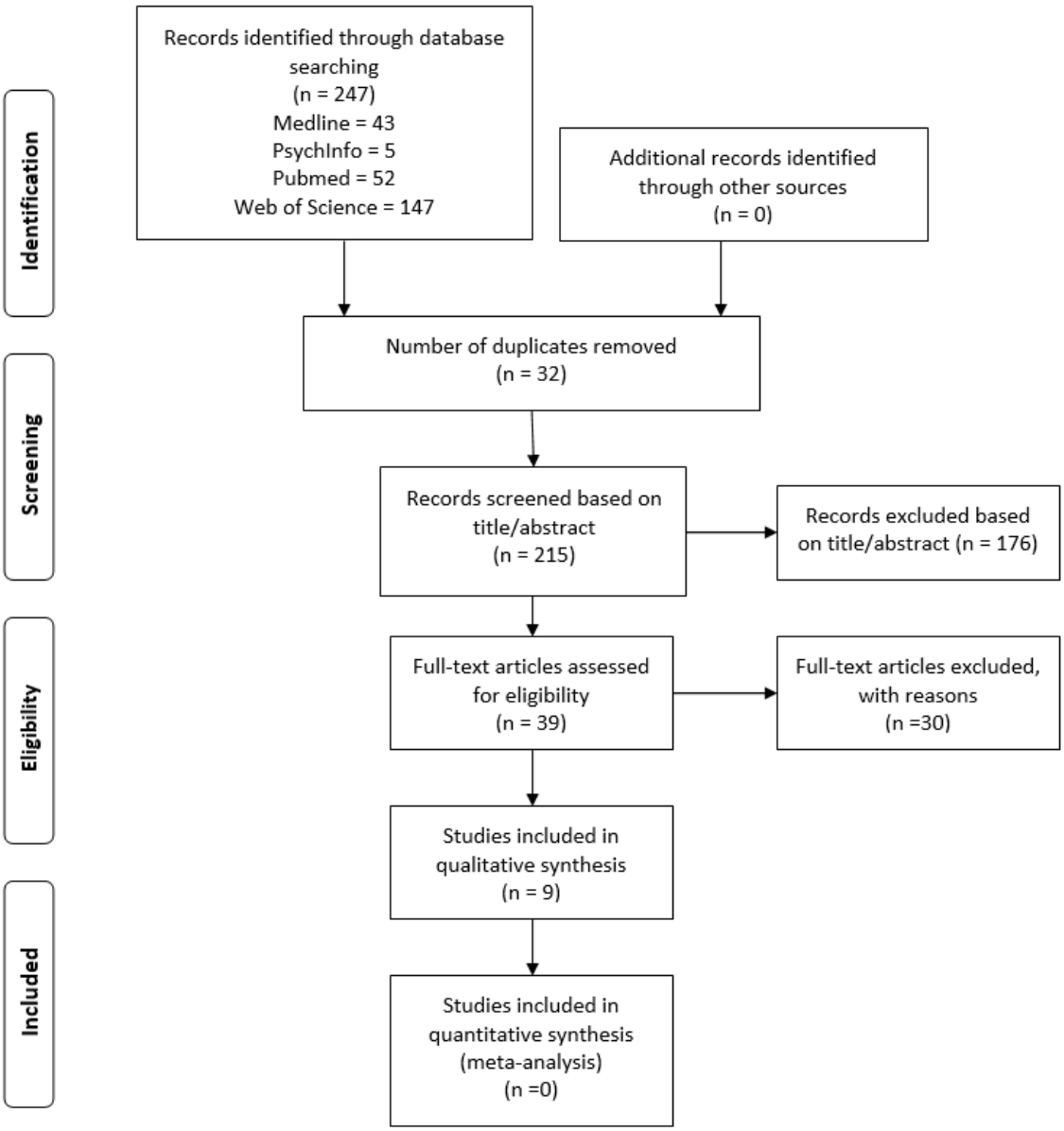
2.3.7 Synthesis of the results

Findings were evaluated in a descriptive manner based on the information provided by each of the included studies. A meta-analysis was not conducted due to the heterogeneity across the studies.

2.4 Results

2.4.1 Study selection

The selection process of articles included in this study is presented in the flow chart (



). A total of 247 records were identified through online searching in the four databases, 46 of which were duplicates. By removing the duplicates, 215 records were screened based on title/abstract. A total of

176 studies were excluded following abstract/title assessment. Therefore, only 39 references were subsequently selected for a full-text analysis.

Of the total 39 full-text articles retrieved and reviewed, 30 studies were later excluded because they were reviews of other studies (6 articles), shared the same population (data source) and outcome variables with another larger study included in this review (7 articles), or their objectives did not meet our inclusion criteria (17 articles); (for instance, they examined the association between SOC and oral health status without evaluating the impact of SOC on oral health behaviours). **Table 2.4** displays a summary of the excluded papers and the reasons for their exclusion.

Table 2.4. Excluded articles and the reasons for their exclusion.

Authors/ Year	Resason for exclusion
Ayo-Yusuf , et al., 2009	2
Ayo-Yusuf , et al., 2008	2
Baker, et al., 2010	1
Bernabe, et al., 2012	2
Bernabe, et al., 2009	2
Bernabe, et al., 2012	2
Bernabe, et al., 2012	2
Boman, et al., 2012	3
Bonanato, 2009	3
Chang, et al., 2010	3
Dorrir, et al., 2010	4
Dumitrescu, et al., 2010	2

Emami, et al., 2010	3
Holister, et al., 2004	1
Johahanson, et al., 2012	3
Karla, et al., 2013	3
Lindmark, et al., 2011	3
Lindmark, et al., 2010	2
Mattila, et al.,2011	2
Morita, et al., 2007	3
Morita, et al., 2008	2
Nammontri, et al., 2013	3
Rivera, et al., 2013	1
Savolainen, et al., 2005	3
Silva, et al., 2008	1
Sirkka, et al., 2013	3
Slade, et al., 2013	1
Watt, 2002	1
1. Not original study (review stidies); 2. They did not measure the association between SOC and oral health behaviours. SOC had a mediating role on the association between another independent variable, such as socioeconomic status, and oral health behaviours; 3. The objective of study did not meet the inclusion criteria; 4. This study shared the same population and outcome of interest with another article reported in this review.	

2.4.2 Study characteristics

The included studies were eight cross-sectional studies and one longitudinal study, published between 2001 and 2013, and conducted in Brazil (Freire and Hardy 2002; Freire et al. 2001; Da Silva, Mendonça, and Vettore 2011), China (Qiu et al. 2013), Iran (Dorri, Sheiham, and Watt 2010), Sweden (Bernabé et al. 2009), South Africa (Ayo-Yusuf et al. 2009), Finland (Lindmark, Hakeberg, and Hugoson 2011), and Turkey (Peker, Bermek, and Uysal 2012). All selected articles were written in English.

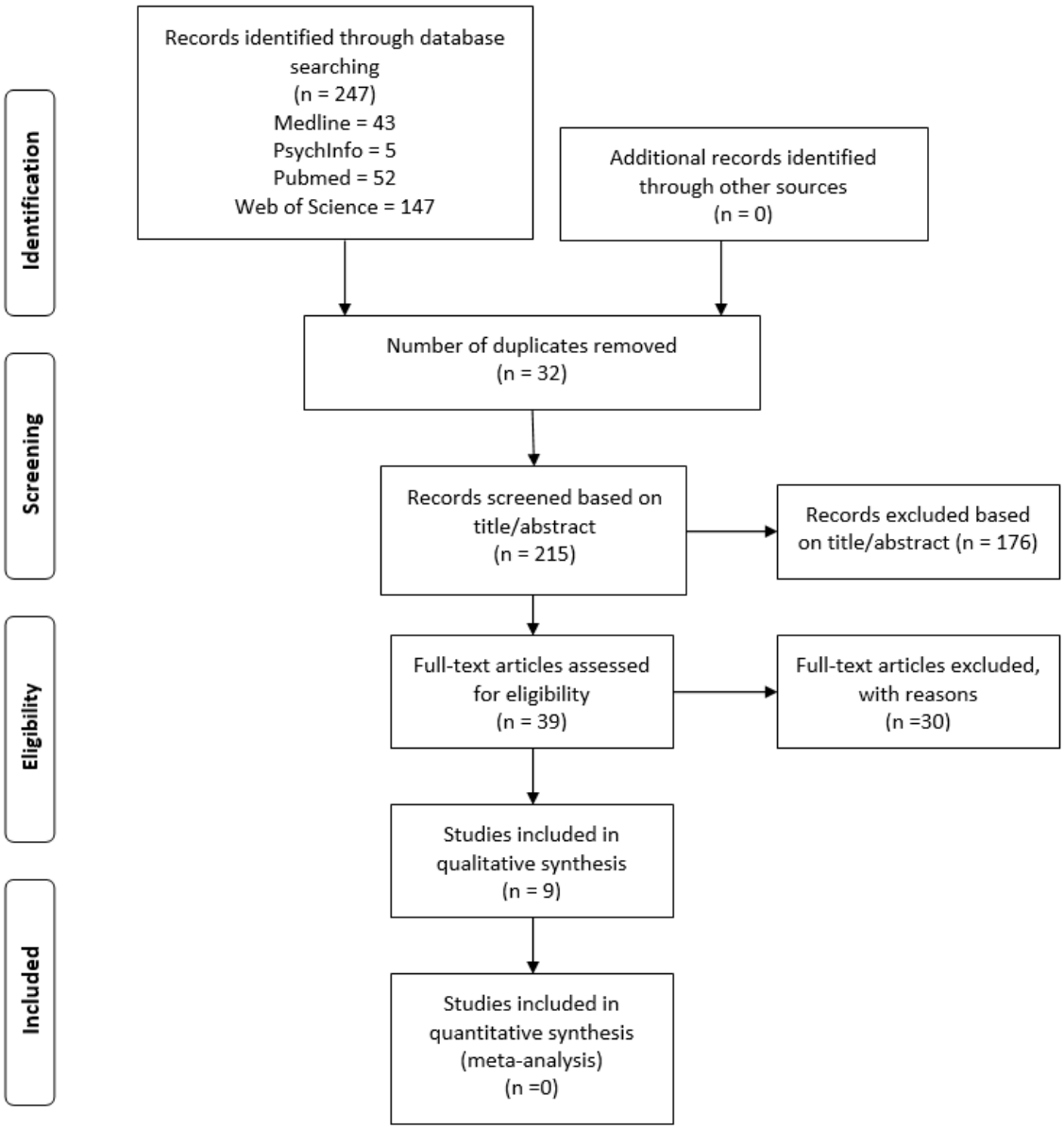


Figure 2.1. Flow diagram of data search according to PRISMA (Liberati et al. 2009).

2.4.3 Sample characteristics

Sample size ranged from 190 to 5,399 participants. Eight out of nine reviewed articles involved samples of over 500 participants, and half of those studied on over 1,000 participants (**Table 2.3**). One study employed the available national representative data provided by the National Public Health Institute of Finland (Bernabé et al. 2009). Three studies used two-stage stratified cluster sampling (Bernabé et al. 2009; Buunk et al. 2011; Da Silva et al. 2011); four studies used stratified random sampling (Freire and Hardy 2003; Freire et al. 2001; Lindmark et al. 2011; Qiu et al. 2013), and two used convenience sampling (Peker et al. 2012; Da Silva et al. 2011).

Six studies assessed the association between SOC and different oral health behaviours in individuals aged 17 and older (Bernabé et al. 2009; Lindmark et al. 2011; Peker et al. 2012). Three studies examined this association in adolescents, between 11 and 16 years (Ayo-Yusuf, Reddy, and Van Den Borne 2008; Dorri, Sheiham, and Watt 2010; Freire et al. 2001). The relationship between mothers' SOC and their adolescent children's oral health behaviours was evaluated in two other reports (Freire and Hardy 2003; Da Silva et al. 2011). Finally, one study investigated the correlation between caregivers' SOC and their preschoolers' oral health behaviours (Qiu et al. 2013).

2.4.4 Statistical analysis used

For the data analysis, 8 of the 9 studies used bivariate tests as a first step in the analysis strategy in order to test the association between SOC and oral health-related behaviours. The applied methods were t-test (Lindmark et al. 2011; Peker et al. 2012; Qiu et al. 2013), chi-square (Bernabé et al. 2009; Lindmark et al. 2011; Peker et al. 2012; Qiu et al. 2013), simple unadjusted regression analysis (Emami 2009; Freire et al. 2001), and unadjusted association (Da Silva et al. 2011). One study used descriptive statistics and fit models instead of bivariate test (Dorri, Sheiham, and Watt 2010).

In the second step, multivariate analysis was performed in all studies to examine the association of SOC, controlling variables and oral health-related behaviours. Two studies applied binary logistic regression adjusted for gender, age, marital status and urbanization (Bernabé et al. 2009); sex and father education (Dorri, Sheiham, and Watt 2010); gender and age (Lindmark et al. 2011). Five studies used multiple logistic regression model adjusted for sex and social class (Freire and Hardy 2003; Freire et al. 2001); oral health knowledge and attitude (Qiu et al. 2013); maternal schooling, marital status, familial income, type of bathroom, and water supply (Da Silva et al. 2011); age (Ayo-Yusuf et al. 2009). And one study used unadjusted binary logistic regression analysis (Peker et al. 2012).

2.4.5 Version of SOC questionnaire and reliability

The original questionnaire developed by Antonovsky (1987) contains 29 items named SOC-29 scale (with an average Cronbach's α of 0.88) (Antonovsky 1987; Rivera et al. 2013) that was later shortened into 13 items namely SOC-13 with acceptable reliability (with an average Cronbach's α of 0.82) (Rivera et al. 2013). All selected studies employed SOC-13 scale. One study (Bernabé et al. 2009) used an abbreviated form of the Finnish SOC-13 scale by removing one item to provide equal number of 4 items to measure three constructs of SOC including comprehensibility, manageability, and meaningfulness.

Cronbach's alpha, used as the measure of internal consistency, ranged from 0.63 to 0.87. One study used the original English version of the questionnaire (Ayo-Yusuf et al. 2009) while other studies used the questionnaire translated and validated into Finnish (Bernabé et al. 2009), Turkish (Peker et al. 2012), Persian (Dorri, Sheiham, and Watt 2010), Portuguese (Freire and Hardy 2003; Freire et al. 2001; Da Silva et al. 2011), Chinese (Qiu et al. 2013) and Swedish (Lindmark et al. 2011) languages.

For measuring the SOC, seven studies sum up the scores given to each item in the questionnaires in order to calculate SOC mean and standard deviation (Dorri, Sheiham, and Watt 2010; Freire and Hardy 2003; Freire et al. 2001; Lindmark et al. 2011; Peker et al. 2012; Qiu et al. 2013; Da Silva et al. 2011). One study grouped participants into weak, moderate and strong based on their SOC scores and then in the logistic regression, the model was tested with and without SOC (Bernabé et al. 2009). In the study done in adolescents (Ayo-Yusuf et al. 2009), only six out of 13 items were replicated for this population; however, the internal consistency coefficient was similar to that of the SOC-13 when comparing them as a unidimensional scale. All studies employed seven-point Likert scale, except for one (Da Silva et al. 2011) with a five-point Likert scale.

2.4.6 Oral health behaviours and SOC

2.4.6.1 Tooth cleaning

Among seven studies (Bernabé et al. 2009; Dorri, Sheiham, Hardy, et al. 2010; Freire and Hardy 2003; Freire et al. 2001; Lindmark et al. 2011; Peker et al. 2012) examining the association between SOC and tooth brushing behaviour, five studies (Bernabé et al. 2009; Dorri et al. 2010; Peker et al. 2012) reported a significant association meaning that individuals with a strong SOC were more likely to brush their teeth twice or more per day compared with those who had lower levels of SOC. In one study this association was significant for only one subcomponent of SOC, meaningfulness (Lindmark et al. 2011). The correlation between SOC and tooth flossing behaviour was investigated in two studies (Lindmark et al. 2011; Peker et al. 2012). No significant association was reported in these studies.

2.4.6.2 Fluoride usage

Three articles assessed the influence of participants' SOC on their utilization of fluoride products (e.g., mouthwash and gel) and no significant association was reported by any of them (Freire and Hardy 2003; Freire et al. 2001; Peker et al. 2012).

2.4.6.3 Dietary habits

Six studies aimed to assess the impact of SOC on dietary habits (Bernabé et al. 2009; Freire and Hardy 2003; Freire et al. 2001; Lindmark et al. 2011; Peker et al. 2012; Qiu et al. 2013), among which, three (Bernabé et al. 2009; Lindmark et al. 2011; Peker et al. 2012) reported that individuals with a strong SOC were less likely to consume sugar between meals than those with a poor SOC. One of these studies (Peker et al. 2012) found that among different oral health behaviours, low frequency of between-meal sugar intake was the most important indicator of strong SOC. In another study (Qiu et al. 2013), no correlation was found between children's sugar snaking and their parents' SOC; however, among 8.9% of children whose grandparents were their caregivers lower sugar intake observed in those whose grandparents had stronger SOC ($p = 0.008$).

2.4.6.4 Dental attendance

Among seven papers (Bernabé et al. 2009; Dorri et al. 2010; Freire and Hardy 2003; Freire et al. 2001; Lindmark et al. 2011; Peker et al. 2012; Silva, Mendonça, and Vettore 2008) explored the correlation between SOC score and pattern of dental attendance, four studies (Bernabé et al. 2009; Freire and Hardy 2003; Freire et al. 2001; Qiu et al. 2013) reported that individuals with a strong SOC were more likely to visit dentists regularly for check-ups. Two of the studies (Freire and Hardy 2003;

Da Silva et al. 2011) investigated the association between mothers' SOC and their children's regular dental visits reported positive significant association.

2.4.6.5 Smoking habits

The relationship between SOC and smoking was investigated in three papers (Bernabé et al. 2009; Lindmark et al. 2011; Peker et al. 2012), two of them (Bernabé et al. 2009; Peker et al. 2012) found a significant correlation indicating that SOC has a positive association with less frequent smoking. One study (Lindmark et al. 2011) reported a significant association for only one subcomponent of SOC, meaningfulness.

2.4.7 Risk of bias within studies

For cross-sectional studies, the methodological quality scores range from three to six points (maximum of seven) (Bernabé et al. 2009; Dorri et al. 2010; Freire and Hardy 2003; Freire et al. 2001; Lindmark et al. 2011; Peker et al. 2012; Da Silva et al. 2011). The cohort study scored seven points (maximum of nine) (Ayo-Yusuf et al. 2009). The critical appraisal details are presented in Table 2.5 and

Table 2.6. Seven out of the eight included cross-sectional studies scored 4 points and were considered high quality studies. The cohort study was also considered a high quality study.

Table 2.5. New Castle Ottawa (NOS) Quality Assessment.

	Bernabe et al. 2009	Da Silva et al. 2011	Dorri et al. 2010	Freire et al. 2001	Freire et al. 2002	Lindmark et al. 2011	Peker et al. 2012	Qiu et al. 2013
Sample selection Criteria (maximum of 4 stars) 1) Representativeness of the sample: a) Truly representative of the average in the target population* (all subjects or random sampling); b) Somewhat representative of the average in the target population* (non-random sampling; c) Selected group of patients; d) No description of the sampling strategy. 2) Sample size: a) Justified and satisfactory*; b) Not justified. 3) Non-respondents: a) Comparability between respondents and non-respondents characteristics is established, and the response rate is satisfactory*; b) The response rate is unsatisfactory, or the comparability between respondents and non-respondents is unsatisfactory; c) No description of the response rate or the characteristics of the responders and the non-responders. 4) Measurement of the sense of coherence: a) Validated measurement tool*; b) Non-validated measurement tool; c) No description of the measurement tool.	a* * c a*	b* * c a*	a* * c a*	a* * c b	a* * c b	a* b b b	b* b c a*	a* * a a*
Comparability (Maximum 2 stars) 1) Control for confounders a) Participant's SOC adjusted for one confounder *; b) Participant's SOC adjusted for two or more confounders **; c) No description related to the adjustment analysis for confounding factors	**	**	**	**	**	**	c	**
Outcome: (Maximum 1 stars) 1) Assessment of the outcome from participants: a) Self-report*; b) No description.	a*	a*	a*	a*	a*	a*	a*	a*

Summary score (maximum of 7 stars)	6	6	6	5	5	4	3	6

Note: NOS adapted for cross-sectional studies. A study can be awarded a maximum of one star (representing “yes”) for each numbered item within the Selection and Outcome categories. A maximum of two stars can be given for Comparability.

Table 2.6. Quality assessment of included cohort studies based on the Newcastle-Ottawa scale.

Author	Selection*				Comparability**	Outcome***			Score****
	Representativeness of the exposed cohort1	Selection of the non-exposed cohort2	Ascertainment of exposure3	Demonstration that outcome of interest was not presented at start of study4	Comparability of cohorts on the basis of the design or analysis5	Assessment of outcome6	Was follow-up long enough for outcomes to occur?7	Adequacy of follow-up of cohorts8	
Ayo-Yusuf et al.	a*	a*	b*	*	**	c	*	c	7

*a maximum of 1 point for each item; **a maximum of 2 points for each item; ***a maximum of 1 point for each item ****a maximum of 9 points

*1 point 1 a) truly representative of the average individuals in the community *, b) somewhat representative of the average individuals in the community *, c) selected group of users, d) no description of the derivation of cohort

2 a) drawn from the same community as the exposed group *, b) drawn from a different source, c) no description of the derivation of the non-exposed-group

3 a) secure record *, b) structured interview or questionnaire *, c) written self-reports, d) no description

4 a) yes *, b) no

5 a) study control for one confounding variable *, b) study control for 2 or more confounding variables **

6 a) independent blind assessment *, b) record linkage *, c) self-reports d) no description

7 a) yes (select an adequate follow up period for outcome of interest *, b) no

8 a) complete follow up – all subjects accounted for *, b) subjects lost to follow up are unlikely to introduce bias - ≤20% loss or ≥80% follow up, or description provided of those lost *, c) ≥20% loss or ≤80% follow up, or no description of those lost, d) no statement

2.5 Discussion

There is compelling evidence to support that positive health behaviours could be influenced by psycho-social factors (Antonovsky 1987). SOC is a psychosocial determinant of peoples' health behaviour (Antonovsky 1993). It appears that individuals with a strong SOC may be more predisposed to a healthy lifestyle and more likely to respond to health-related advice as compared to their counterparts with a weak SOC (Lindmark et al. 2011). In the oral health domain, several studies attempted to investigate the association between individual's SOC and performance of oral health behaviours such as regular dental check-ups, tooth brushing and healthy dietary habits. The studies arrived at distinctly different conclusions. Therefore, given the importance of SOC in performing healthy behaviours, this systematic review looked to integrate the research findings with evidence on the impact of SOC on important components of oral health-related behaviours. This topic is particularly important because SOC is considered as a potential theoretical framework to study and better understand oral health behaviours (Da Silva et al. 2011).

In eight of the included studies in this systematic review (Ayo-Yusuf et al. 2009; Dorri et al. 2010; Freire and Hardy R 2003; Freire et al. 2001; Lindmark et al. 2011; Peker et al. 2012; Da Silva et al. 2011), SOC was assessed using a 13-item scale, which was also the most frequently used version of the questionnaire in 54% of the studies included in another systematic review (Rivera et al. 2013). This version has been validated and translated into different languages (Eriksson and Lindström 2005). The Cronbach's alpha of included studies in our review ranged from 0.63 to 0.87, which is in the same range as other systematic reviews of studies using SOC-13 [(0.70 to 0.92) and (0.55 to 0.87)] (Eriksson and Lindström 2005; Rivera et al. 2013). For scoring the SOC scale, in some studies instead of summing up the score assigned to each item

(Antonovsky 1987). SOC was reported on a 7-point range in one study (Bernabé et al. 2009) which was different from the scoring method originally proposed by Antonovsky (Antonovsky 1987). For this reason, we could not retrieve the mean and standard deviation of SOC and compare them with other studies, which resulted in inconsistency in reporting and comparing the results of this review. In one study (Bernabé et al. 2009), SOC measured using SOC-12, an alternative version of SOC-13, scale. This modified version has been used in several health (Eriksson 2006; Eriksson and Lindström 2005) and oral health studies (Kline 2011; Bernabe et al. 2010; Bernabé et al. 2009) and showed a reasonable validity and internal consistency (Bernabé et al. 2009).

A positive significant association was found between SOC and healthy diet in adults (Bernabé et al. 2009; Peker et al. 2012) while in adolescents, this association was not significant (Freire et al. 2001). The lack of association may be a result of including a young age group, when oral health behaviours are more likely to be influenced by the parents than arise from the adolescents themselves. However, the association between parental SOC and their adolescents' healthy dietary habits and practices was found not significant in another study (Freire and Hardy R 2003). These results may suggest that neither adolescents' SOC nor their parents' SOC influence dietary habits in adolescents. The inconsistency in questions used to measure dietary habits or varying methods/scales and cut-off points by which sugar consumption frequency was measured across the studies could explain the conflicting results. For instance, daily sugar-intake frequency was measured with answers "Less often than daily" and "On a daily basis" (Bernabé et al. 2009); however, this question was answered through two different items including "None to once" and "Twice or more" in another study (Freire et al. 2001).

SOC has received significant empirical research support as a determinant of tooth brushing behaviour in adults (Bernabé et al. 2009; Lindmark et al. 2011; Peker et al. 2012). In adolescents,

there is inconsistency in the results of different studies. While a significant association was reported between stronger SOC and more frequent tooth brushing among Iranian adolescents (Dorri et al. 2010), such an association was not found among 15-year old Brazilian adolescents (Freire et al. 2001). One reason for this inconsistency maybe because in adolescents tooth brushing behaviour is to some extent influenced by parents and personal sense of coherence is relatively unstable and under development (Freire and Hardy 2003; Freire et al. 2001). The second reason may relate to the cut-off point for dichotomizing tooth brushing frequency. In the Brazilian study (Freire et al. 2001), this cut off point was three times a day while in the study carried out with Iranian adolescents (Dorri, Sheiham, and Watt 2010), the cut off was twice a day. The third possible reason for the inconsistency is that this association may be influenced by cultural differences (Dorri, Sheiham, and Watt 2010).

The association between SOC and pattern of dental attendance was investigated on two different levels:

2.5.1 Adults' SOC and dental attendance pattern:

A positive significant association between SOC and adherence to regular dental visits in adults was observed in two studies (Bernabé et al. 2009; Freire et al. 2001). Whereas this association was reported insignificant in another study in which participants' SOC could not predict their dental attendance pattern (Lindmark et al. 2011). This inconsistency maybe related to the type of questions applied and differences in dental health systems and policies in the various countries, such as the use of a recall system *vs.* dental attendance being based on individual's initiative (Lindmark et al. 2011). These results support the idea that in adults, those with a high SOC were more likely to visit their dentists regularly for check-ups (Bernabé et al. 2009). According to the SOC concept proposed by Antonovsky (Antonovsky 1987), individuals with

higher SOC face their daily life challenges in a manner that they are more manageable and predictable. Therefore, attending routine checkups maybe more feasible for these people compared to those with a lower SOC.

2.5.2 Mothers' SOC and their children/adolescents' dental attendance pattern:

Increased attention has been given to the impact of psychological aspect of the family environment on children's oral health (Grøholt et al. 2003). Parental SOC has already been shown to be associated with their children's oral health status (Eriksson and Lindström 2007; García et al. 2012; Grøholt et al. 2003; Mandall et al. 2008; Togari et al. 2012). For instance, mothers have a significant role in the utilization of dental services for children (Mouradian et al. 2007). Parents' difficulties in dealing with daily problems were also reported to be the main reason for no-shows for their children's dental check-ups, even when the dental service was available, affordable, or free of charge for them (Hallberg et al. 2008). These findings verify the results from our review that mothers' SOC was found significantly associated with their children's dental attendance pattern (Freire and Hardy 2003; Da Silva et al. 2011) even after adjusting for socioeconomic (Da Silva et al. 2011) and social class (Freire and Hardy 2003) variables. In other words, mothers with a strong SOC are more capable of maintaining their children's oral health including visiting the dentist for check-ups even if they are from a lower socioeconomic class (Da Silva et al. 2011).

SOC was negatively associated with smoking habit in three Brazilian studies (Bernabé et al. 2009; Peker et al. 2012) and shown to have a protective role against smoking. (Peker et al. 2012) This result supports the previous reports that people with a poor SOC are more likely to smoke while they are involved in a stressful situation and feel that they are unable to cope with them (Igna et al. 2008; Kuuppelomäki and Utriainen 2003). However, a study carried out in Switzerland

(Lindmark et al. 2011) failed to find a similar association between SOC and smoking. One possible reason could be attributed to cultural differences between Brazilian and Switzerland populations.

2.5.3 Limitations

Some methodological limitations are identified in this systematic review. The first limitation is that almost all selected studies were cross-sectional. The cross-sectional design did not explain causation and changes over time in SOC, specifically regarding the influence of demographic and socio-economic factors on it (Peker et al. 2012). The second limitation was the lack of a validated risk of bias assessment tool to measure the quality of the included studies. Although we used the Newcastle-Ottawa Scale methodological assessment tool, to our knowledge, no validated checklist have been developed to assess bias risk within observational studies.

2.5.4 Recommendations for future research

There is a need for further longitudinal research to shed light on this association through a life course approach. In addition, improving SOC in the early stages of life while it is under development may have significant impact on an individual's life course and well-being. Consequently, it could be considered as a proactive way to improve the effectiveness of oral health promotion and intervention programs (Nammontri et al. 2013). For instance, an intervention has been developed to enhance individual's SOC by improving its components. The intervention was based on literature searches, guidelines from educators and previous work about SOC. It involved the approach of children and their mothers through classroom activities and healthy school programs with brainstorming, planning, implementation and evaluation (Nammontri et al. 2013). The improved SOC following such an

intervention may promote oral health since individuals with a strengthened SOC select more favorable oral behaviours (Bernabé et al. 2009) and cope better with stress. This can also lead to lower biological effects, such as oral diseases (Lindmark et al. 2011) and a better oral health-related quality of life (Wennström et al. 2013).

Further research is also required to see if it is possible to introduce SOC as a psychological construct that could be considered in oral health models. Regarding the impact of mothers' SOC on their children's oral health practices, it would be worthy to find strategies to structure and develop mothers' SOC with the aim to improve their children's oral health behaviours in particular taking their children for preventive dental checkups.

2.6 Conclusions

- A cross-sectional association was found between SOC and oral health-related behaviours. A stronger SOC was associated with more favorable behaviours of tooth brushing frequency, daily smoking, and dental attendance.
- Mothers' SOC can influence children's oral health practices in particular their pattern of preventive dental attendance.

3. Chapter Three: Parent's Sense of Coherence and Children's Oral Health-Related Behaviours: Is There an Association?

3.1 Abstract

Parental capacity to face day-to-day stressors has a relevant role in recognizing and mobilizing resources to control children's oral health behaviours. This capacity has been explored by means of the sense of coherence. The purpose of this study was to explore the association between mothers' sense of coherence (SOC) and their preschool children's oral health-related behaviours. Mothers and their preschool children were recruited during immunization programs at community health centers in Edmonton, Canada. Participants answered eight questions on socio-demographics (covariates), parents' SOC (main independent variable), and children's oral health-related practices (outcome variables). Statistical analyses comprised a two-sample t test, chi-square test, and logistic regression. A total of 378 pairs of mothers/children participated in this study. Children's mean age was 3.92±(1.33) years. Mothers' SOC was statistically associated with children's frequency of sugar consumption and frequency and pattern of dental visits. The children of mothers who had higher levels of SOC presented a lower frequency intake of food or drink containing sugar and were more likely to visit the dentist for preventive purposes. Conclusions. Mothers' sense of coherence had a significant association with children's oral health-related behaviours; a higher SOC of mothers was associated with more positive behaviours among their children.

3.2 Introduction

Dental caries is one of the most common and costly chronic disease among preschool children (Werneck et al. n.d.). Though preventable, dental caries persists as a serious health matter for communities across the world, with a global increase over the past decade (Bagramian, Garcia-Godoy, and Volpe 2009). In some countries, nearly 50 % of preschool children have already experienced tooth decay (Mothupi, Nqcobo, and Yengopal 2016). The potential consequences of early childhood caries (ECC) are acute and chronic pain; tooth loss; interference with child's daily performances and proper growth; increased expenses for dental care throughout life; and compromised general health (Bagramian et al. 2009; Firmino et al. 2016). Dental caries in preschoolers is influenced by three important behavioural factors: (1) frequent consumption of sugary snacks and drinks; (2) inadequate oral hygiene practices; and (3) lack of preventive dental visits (Ashkenazi et al. 2012).

The American Academy of Pediatric Dentistry (AAPD) advocates that preschoolers have dental check-ups every six months. This routine practice should be started no later than one year of age (American Academy of Pediatric Dentists 2015). Dental attendance may also have an influence on other preventive measures related to oral hygiene and diet through children's and parents' education (Badri et al. 2014). The uncooperative behaviour of some children is one of the reasons for general anesthesia to become a common procedure for the management of ECC at a significant number of pediatric dental services in Canada (Bonanato et al. 2009).

In the past few decades, public health research has aimed attention at the psychosocial predictors of health and illness (Bonanato et al. 2009). This has resulted in the emergence of theory-based approaches emphasizing the social circumstances and their interaction with

biological and psychological factors (Newton and Bower 2005). Salutogenesis is a well-established theory (Antonovsky 1993), which tries to explain that determinants of health differ from those influencing the possibility of a particular disease (Antonovsky 1987). This is based on the notion that, for an individual to be in good health, the non-existence of disease is neither necessary nor sufficient (Antonovsky 1987). Even when subjected to risk determinants of illnesses, individuals are able to maintain themselves as healthy, given that they are in control of their lives (Antonovsky 1987). The central core of the Salutogenic theory is the sense of coherence (SOC) concept, which aims to demonstrate why some individuals keep their health, even following the experience of permanent stressful circumstances, while their counterparts experience sickness (Antonovsky 1987). Individuals' SOC shows how much they view life as comprehensive, manageable, and meaningful. Comprehensibility is the ability to interpret life events as clear. Manageability is the ability of using resources to deal with stressors. Meaningfulness is the confidence of being worthy of investment (Antonovsky 1993). The SOC has been extensively used across different cultures. This theory is not only related to a particular coping scheme but to the determinants on which the strategy of handling a stressor is based (Antonovsky 1993).

Research findings have supported SOC as a psychosocial indicator of people's health behaviours (Antonovsky 1993; Bernabé et al. 2009). The literature has demonstrated that individuals with a higher SOC were more inclined to a healthier lifestyle and adherence to health-related recommendations versus their peers with a more fragile SOC, regardless of their socio-demographic status (Wainwright et al. 2007). The concept of SOC has been also deeply studied in dentistry and found to be a predictor of oral health-related behaviours in adults and adolescents (Elyasi et al. 2015). Individuals with a higher SOC were more predisposed to tooth

brushing at least twice a day, have a more adequate dietary scheme (particularly less sugar consumption), and visit their dentist regularly for checkups (Elyasi et al. 2015). However, information regarding preschoolers and the effect of their mothers' SOC on their oral health outcomes and related behaviours has been rarely explored thus far (Freire and Hardy 2003; Perazzo et al. 2017; Qiu et al. 2013; Da Silva et al. 2011). For young children, there is growing evidence supporting the important role of family psychosocial environment, particularly mothers' characteristics, in children's oral health and related practices (Wainwright et al. 2007).

Therefore, the purposes of the present study were to: (1) assess the association between mothers' sense of coherence and the oral health-related behaviours of Canadian preschoolers; and (2) evaluate the effects of mothers' SOC and socio-demographic characteristics on the likelihood of those preschoolers exhibiting promising oral health behaviours.

3.3 Methods

A cross-sectional study was carried out from June 2014 to October 2015 in Edmonton, Alberta, Canada. There were 12 community health centers in Edmonton offering immunization services for preschoolers. A random sampling technique was adopted to consider one community center from each area of Edmonton. This strategy guaranteed that the selection possibility of all community centers was equal.

This study was approved by the Research Ethics Board, University of Alberta, Edmonton. Participation was voluntary. Mothers and children who declined to participate were offered the same services at the community health centers as the study participants. Once they agreed to participate, mothers signed a statement of informed consent. This article followed the

Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (Vandenbroucke et al. 2014).

3.3.1 Participants/study population

According to the 2011 census, the overall population of preschoolers in Edmonton was approximately 85,000 and the overall vaccination rate for preschoolers in Edmonton in 2014 was 91.33 % (Government of Canada 2011). The sample size was calculated using Epi Info 7 software (Epi Info 7 for Windows, Atlanta, Ga., USA). The prevalence of adherence to oral health-related behaviours among children in Canada is 72 % (Locker, Clarke, and Murray 1998); based on a total of 85,000 children, a marginal error of five %, and a 95 percent confidence interval (CI), the estimated sample size for the present study was 309. Considering the possible losses, 20 % was added to the calculated sample size. Therefore, the total sample size was 378 pairs of mothers and their preschoolers in Edmonton.

3.3.2 Data collection

There were 12 community health centers in the city of Edmonton offering immunization services for preschoolers. Edmonton has four main geographical areas. Data collection took place in four community health centers, located in these four main geographical areas of Edmonton. A random sampling technique was adopted to consider one community center from each area of Edmonton. This strategy guaranteed that the selection possibility of all community centers was equal. A trained research assistant (RA) recruited participants where an immunization campaign for preschoolers was ongoing. Mothers and preschoolers were equally recruited from each community health center until the number of participants of the sample size

calculation was achieved. The RA introduced the study to the mothers of preschoolers while they were waiting for the child to be immunized in the waiting area. Mothers received an information letter, and those who agreed to participate in the survey completed the informed consent form. Once the consent form was obtained, mothers were asked to complete a questionnaire that included three sections.

3.3.3 Outcome variables

In this cross-sectional study, four oral health-related behaviours of the preschool children were allocated as outcome variables: (1) frequency of sugary food or sugary drink intake (never or less than once a day, equal to or greater than once a day); (2) how many times the child has his/her teeth cleaned (less than twice a day, equal to or greater than twice a day); (3) when the child had his/her last dental visit (within the last 12 months, over one year, or never had one); and (4) pattern of dental visit (regular check-up, non-urgent, or urgent dental problems). Data regarding the oral health-related behaviours were obtained using a form answered by mothers.

3.3.4 Independent variable

The short form of the validated adaptation of the SOC scale (SOC-13) assessed mothers' SOC. This version is comprised of 13 items distributed across three domains (comprehensibility, manageability, and meaningfulness). The response options for each item followed a Likert scale from one to seven (one equals very often and seven equals very seldom or never). The scores of the inverse worded questions were reversed for the analysis so that a higher score denoted a more robust SOC (Antonovsky 1993; Bernabé et al. 2009). This means that mothers with higher scores had a stronger SOC compared to mothers with lower SOC scores.

3.3.5 Covariates

The covariates included: children's gender (male or female) and age (between two and six years); mothers' age (mean age); if the child was born in Canada (yes or no); mothers' level of education (high school/under, college/trade or university); monthly household income (equal to or less than [Canadian dollars] $2,000, $2,000 to $2,999, $3,000 to $3,999, $4,000 to $4,999, or equal to or greater than $5,000); dental insurance (yes or no); and type of dental insurance (public or private). These covariates were chosen based on the previous studies (Qiu et al. 2013; Da Silva et al. 2011), and a theoretical framework was adopted for the study of children's utilization of dental care (Da Silva et al. 2011).

3.3.6 Statistical analysis

Data analysis was performed using SPSS 22.0 software (IBM Corp., Armonk, N.Y., USA). The total SOC was analyzed as a continuous (ordinal) variable. The association between SOC and oral health-related behaviours was measured in two steps using bivariate and multivariate tests.

After testing the normality of data and equality of variances, associations between the main independent variable and the outcome variables were assessed using two-sample *t* tests. The associations between the outcome variables and the covariates were assessed using a chi-squared test or Spearman's ranked correlation coefficient (**Error! Reference source not found.**). The c ovariates with *P*-values of 0.20 or lower were incorporated in the logistic regression analysis, for which the significance threshold was set at $P<0.05$. The assumptions for logistic regression analysis were also tested. Nagelkerke's R-squared was used to estimate the proportion of

variation in each model. Log transformation of data and non-parametric tests were applied in cases where the data were not normally distributed.

Table 3.1. Results of correlation* between covariates and children oral health behaviours.

Oral health behaviours	Child age	Mother age	No. of children
Brushing	0.19†	0.05	0.06
Sugar intake	-0.11‡	-0.08	-0.11‡
Utilization of dental care for children	0.27†	0.11‡	0.15‡
Regular dental check-up	0.27†	0.09	0.15‡
*Spearman's ranked order correlation for continuous controlling variables †Spearman's ranked order correlation is significant at the 0.01 level (two-tailed). ‡Spearman's ranked order correlation is significant at the 0.05 level (two-tailed).			

3.4 Results

The response rate for this cross-sectional study was 95 %. The participants were 378 mothers with a mean age of 34.4±4.9 years. Among children whose mothers completed the questionnaire, 191 (50.6 %) were girls and 187 (49.4 %) were boys. Children's mean age was 3.92±1.33 years. The demographic and socioeconomic characteristics of the sample are presented in **Error! Reference source not found.**. Mothers' SOC scores ranged from 24 to 91, w ith the mean of 68.12±11.9. For the statistical analysis, items were averaged to measure the SOC score of each participant, ranging between one and seven points (mean±SD equals 5.24±0.91).

Table 3.2. Socio-demographic characteristics of parents and their children in Edmonton (N=378)*

Characteristics	N (%)
Family structure	
Single parent	54 (14.2)
Both parents	324 (85.8)
No. of children/family	
1	106 (28)
2	173 (45.7)
≥3	99 (26.1)
Mother's level of education	
High school or under	83 (21.9)
College or trade	149 (39.4)
University degree	146 (38.6)
Monthly income level	
<$3,000	82 (21.6)
$3,000-$5000	146 (38.6)
>$5,000	150 (39.6)
Mother's age (year)	
Mean±(SD)	34.15±4.9
Range	22-48
Mother's SOC score (range 1-7)†	
Mean±(SD)	5.24±0.91
Range	1.85-7
Child's gender	
Male	187 (49.4)
Female	191 (50.6)
Child's age (years)	
2	63 (16.6)
3	54 (14.2)
4	122 (32.2)
5	115 (30.4)
6	24 (6.3)
Child's birth place	
Canada	325 (86)
Outside of Canada	53 (14)
Living with both parents	
Both parents	324 (85.7)
Single parents	54 (14.3)
Child's dental insurance	
No insurance	95 (25.1)
Has insurance	283 (74.8)
Type of insurance‡	
Private	247 (87.3)
Public	36 (12.7)

*Data were collected between June 2014 and October 2015.
†To ease the interpretation of the results, items were averaged to calculate the SOC score of each subject, which ranged between one and seven points.
‡Considering the 283 individuals who had dental insurance

The results of the bivariate analysis showed that mothers' SOC was significantly associated with their preschool children's oral health-related behaviours. Preschoolers whose mothers scored higher on the SOC scale were more likely to brush their teeth twice daily (P=0.037), consume sugar-added snacks never or less than once a day (P=0.001), visit a dentist during the last year (P<0.001), and have a regular dental checkup (P<0.001; **Error! Reference source not found.**). Parents of Canadian-born children reported higher frequency of daily tooth brushing and regular dental checkup behaviours for their children compared with parents whose children were born outside Canada (**Error! Reference source not found.**). The results of bivariate analyses showed that all three components of SOC were significantly associated with preschoolers' oral health-related behaviours, except for tooth brushing frequency in which the component "meaningfulness" showed a significant association (Table 3.5**Error! Reference source not found.**).

Table 3.3. Results of bivariate analysis (t test) between the child's oral health-related behaviours and his/her mothers' Sense of Coherence (SOC) in Edmonton (N=378)*.

Outcome variables	N (%)	SOC Mean†±(SD)	*P*-value
Tooth brushing frequency‡			
<2x/day	167 (42.6)	5.13±0.97	0.037
≥2x/day	211 (57.4)	5.32±0.86	
Sugar-intake frequency			
≥1x/day	225 (59.5)	5.12±0.94	0.001
<1x/day	153 (40.5)	5.42±0.69	
Utilization of dental services (last year)			
No	185 (48.9)	5.04±0.91	<0.001
Yes	193 (51.1)	5.43±0.64	
Pattern of dental attendance†			
Dental problem	31 (16.1)	5.06±0.92	<0.001
Regular check-up	162 (83.9)	5.49±0.86	

*Data were collected between June 2014 and October 2015.
†SOC was assessed by 13 items distributed across three domains (comprehensibility, manageability, and meaningfulness). The response options for each item followed a Likert scale from one to seven (one equals very often and seven equals very seldom or never). The scores of the inverse worded questions were reversed for the analysis so that a higher score denoted a more robust SOC. For the statistical analysis, the SOC mean was calculated and analysed for each oral health-related behaviour. ‡Considering a total of 193 children who used dental services within the previous year.

Table 3.4. Results of univariate analysis between the covariates and children oral health behaviours*.

Covariates	Tooth brushing	Sugary snack intake	Utilization of dental care for children	Pattern of dental attendance
Children's gender Male Female	0.94	0.57	0.55	0.55
Children born in Canada? No Yes	0.19	0.29	0.57	0.09
Mother level of education High school or under College or trade University	0.370	<0.001	0.010	0.61
Family structure Single parent Both parents	0.337	0.966	0.007	0.50
Family monthly income (Canadian dollars) ≤$2,000 $2,00-$2,999 $3,00-$3,999 $4,000-$4,999 ≥$5,000	0.024	0.009	<0.001	<0.001
Dental insurance (coverage) No Yes	0.004	0.119	<0.001	<0.001
*Chi-square test for categorical confounding variables (in bold, confounding variables with P<0.20)				

Table 3.5. Results of bivariate analysis (t-test) between the child's oral health-related behaviours and the subcomponents of their mothers' SOC (SD=standard deviation)

	Comprehensibility		**Manageability**		**Meaningfulness**	
	Mean (SD)	***P* value**	**Mean (SD)**	***P* value**	**Mean (SD)**	***P* value**
Tooth-brushing frequency						
<twice/day	25.16 (5.36)	=0.062	19.92 (4.31)	=0.032	21.44 (4.25)	=0.068
≥twice/day	26.19 (5.25)		20.86 (4.12)		22.26 (4.34)	
Sugar-intake frequency						
≥once/day	25.17 (5.25)	=0.011	20.06 (4.40)	=0.026	21.43 (4.30)	=0.009
<once/day	26.58 (5.31)		21.04 (3.89)		22.60 (4.26)	
Utilization of dental services (last year)						
No	24.84 (5.31)	=0.001	19.61 (4.26)	<0.001	21.04 (4.31)	<0.001
Yes	26.62 (5.18)		21.28 (4.03)		22.75 (4.16)	
Pattern of dental attendance						
Dental problem	24.81 (4.97)	=0.011	19.17 (4.26)	=0.002	20.98 (3.99)	=0.003
Regular checkup	26.69 (4.95)		21.07 (4.08)		22.73 (3.98)	

The logistic regression analyses were carried out to ascertain the effects of SOC and covariates on the likelihood of exhibiting promising oral health behaviours. For daily sugar intake, the logistic regression model was statistically significant (chi-square [nine] equals 39.80; *P*<.001). The model explained 13.5 % of the variation in daily sugar intake frequency and correctly classified 66.9 % of cases. After adjustment for covariates, the association between children's sugary snack intake and mothers' SOC remained significant, even though the strength of the relationship was attenuated (odds ratio [OR] equals 1.29; *P*=0.046; 95 % confidence interval [CI]). Preschool children whose mothers had a higher score SOC presented lower frequency of sugary food or drink intake.

For the tooth brushing behaviour, the model was significant (chi-square (six) equals 27.10, *P*<.001). It explained 9.3 % of the variation in tooth brushing frequency and correctly classified 60.3 % of cases. The association between preschool children's tooth brushing and mothers' SOC was not significant after controlling for other covariates (*P*=0.054) in the regression equation.

The logistic regression models for predicting the utilization of dental services and regular dental checkup were significant (chi-square (13) equals 106.79, *P*<.001; and chi-square (14) equals 108.32, *P*<.001, respectively. In addition, the models accounted for 32.8 % and 33.5 % of variation, respectively, and correctly classified 73.3 % and 72.5 % of cases. After adjusting for identified covariates in equation models, the association between mothers' SOC and their preschool children's utilization of dental services and seeking regular dental checkup remained strongly significant, (OR equals 1.46; *P*=0.008; 95 % CI) and (OR equals 1.57; *P*<0.002; 95 % CI), respectively. For every unit increase in mothers' SOC score, which ranged from one to seven, they were 1.46 times more likely to take their preschool children to the dentist during the last year and were 1.57 times more likely to seek regular dental check-up for their preschool children (**Error! Reference source not found.**).

Table 3.6. Results of logistic regression analysis for the association between mothers' sense of coherence* and children's oral behaviours in Edmonton (N=378) †.

CHILDREN'S ORAL BEHAVIOURS	Adjusted odds ratio	95% CI‡	*P*- value	R^2
Tooth brushing[§**] <2x/day ≥2x/day	1.27	0.99-1.62	0.054	0.09
Sugary snack intake[§**] ≥1x/day <1x/day	1.29	1.01-1.66	0.046	0.13
Utilization of dental care for children[¦**] No Yes	1.46	1.11-1.92	0.008	0.33
Pattern of dental attendance[#††] Treatment Regular check-up	1.58	1.19-2.10	0.002	0.34

*SOC equals sense of coherence
†Data collection from June 2014 to October 2015
‡CI equals confidence interval
§Adjusted for children's age and family monthly income
¦Adjusted for children's age, family monthly income, mothers' schooling, and number of children
Adjusted for children and mothers' age, family monthly income, mothers' schooling, number of children, family structure, and dental insurance
#Adjusted for children and mothers' age, family monthly income, mothers' schooling, number of children, family structure, dental insurance, and whether the child was born in Canada or not
**Considering the 378 children who participated in the study
††Considering the 193 children who used dental services within the previous year

3.5 Discussion

In our study, mothers' SOC was associated with children's consumption of sugar-added food and drink as well as the frequency and pattern of dental attendance; however, it was not a predictor of children's tooth brushing frequency after adjustment for covariates.

Our finding of parents' SOC not relating to children's tooth brushing behaviours corroborates with previous study findings (Freire and Hardy 2003; Qiu et al. 2013). However, the literature has recognized SOC as an important predictor of tooth brushing behaviour in adults

(Elyasi et al. 2015). The cause of this discrepancy may lie in the fact that children's oral hygiene practices demand more technical skills from the mothers in addition to their SOC, which makes the association between adults' SOC and their own tooth brushing habits more complex (Huebner and Riedy 2010). Moreover, the data were collected through self-report questionnaires; this might have caused an over-reporting of mothers, regarding their children's tooth brushing frequency, to provide more desirable answers. One of the covariates associated with the frequency of tooth brushing among children was the child's place of birth. Canadian-born children were more predisposed to perform tooth brushing twice a day or more in comparison with children born outside Canada. The availability of public oral health educational programs for mothers during pregnancy and early childhood in Canada may have promoted proper oral hygiene practices for preschool children (Lin, Harrison, and Aleksejuniene 2011).

In the present study, mother's SOC was a weak predictor of the consumption of sugary snacks or drinks, even though the association was attenuated after adjustment for socio-demographic characteristics. Unlike our results, sugary snack intake of young children was not associated with their mothers or fathers' SOC after adjustment for covariates. In a Chinese study (Qiu et al. 2013), however, this behaviour was correlated with the grandparents' SOC. This inconsistency might be a result of the differences in parental awareness of proper nutrition and healthy food choices for their children in different countries. The authors also suggested that the regularity of sugary food consumption among children may be impacted more by their guardians' sugary food consumption behaviour rather than their SOC, as has been reported in other studies (Poutanen et al. 2006). Among the sociodemographic variables collected in our study, mothers' level of education was observed to have a significant relationship with children's daily sugar-added snacks or drinks. A similar correlation was also observed in another study, in

which children of mothers with post-secondary schooling were more likely to be caries-free (Freire and Hardy 2003). These results indicate that mothers' SOC and their level of education can be independently related to their children's oral health status and related behaviours.

In our study, mothers' SOC strongly influenced their children's use of dental services, confirming the results of a previous study (Da Silva et al. 2011). Da Silva et al. reported that children whose mothers had a higher SOC were two times more likely to use dental care services (Da Silva et al. 2011). Our findings also revealed that mothers with a stronger SOC were more likely to seek regular dental checkups for their children, suggesting that mothers' SOC influenced both frequency and pattern of dental attendance for their children. However, such an association was not found in the study conducted in China (Qiu et al. 2013). This discrepancy may stem from the differences in dental care systems in these countries. For instance, in China, the availability of dental services to young children and their accessibility is still limited.[16] In Canada, apart from promising dental coverage for children, some provinces have free preventive dental services for children from low-income and disadvantaged families to promote regular dental checkups for the entire population(Amin, Perez, and Nyachhyon 2014). Nonetheless, despite the availability of dental insurance and some free preventive dental services for children, only half of children had utilized dental care services during the last year. Parents' difficulties in controlling their routine were found as the primary motive of children's dental appointment absenteeism, even when the service is appropriate and when dental care has no costs for children (Hallberg et al. 2008).

In our regression model, mothers' SOC association with the frequency and pattern of dental visits for their children remained stable after adjusting for their level of education and family income. This finding confirmed the conclusion, made previously by Da Silva et al., that

the capacity of mothers to handle disadvantageous social and economic conditions and their ability to employ applicable resources based on their SOC score were associated with their children's usage of dental services in low-income families(Da Silva et al. 2011). In our study, dental insurance coverage was not associated with the frequency and pattern of dental attendance; this supports the fact that dental services are under-used, even among individuals with insurance(Amin et al. 2014). While 83 % of families had dental coverage for their children, only 51.1 % utilized dental services during the last year.

This study had a few limitations. First, our findings relied on mothers' self-reporting of their children's oral health-related behaviours, which may have been biased. However, in most cases, mothers' reports of their children's oral health-related behaviours have been considered to be trustworthy and verified by clinical examination (Hallberg et al. 2008; Da Silva et al. 2011). Second, the cross-sectional design of this study makes inferences about causal relationships between mothers' SOC and their child's oral health behaviours impossible (Levin 2006). A future study with a longitudinal approach is recommended to cross-validate this study's results. A limitation on the number of questions adapted to measure the behaviours, particularly sugar intake frequency, may have affected the results. Therefore, a more comprehensive assessment is recommended to identify perhaps a stronger relationship among SOC and oral health behaviours in children. Finally, this study's participants were mothers who presented their children for immunization. Based on the available data, the vaccination rate in Edmonton in 2015 was approximately 90 %.

Nonetheless, it is recommended to include mothers who refuse immunizations for their children, as they may have different views about taking their children to receive preventive care services, such as regular dental check-ups. Further research is also warranted to list the social,

economic, and cultural characteristics that determine mothers' SOC and, in turn, facilitate dental care seeking for their children. Strengthening mothers' SOC to control the intake of sugar-added products by their children will not only decrease the risk of dental caries but also reduce the risk of childhood obesity. Finally, our results recommend further research to present SOC as a psychosocial construct that may be used in future oral health intervention strategies (Nammontri et al. 2013).

3.6 Conclusions

Based on this study's results, the following conclusions can be made:

1) Canadian mothers' sense of coherence plays an important role on their children's oral health behaviours, particularly their intake of sugary food or drink and frequency and pattern of their dental attendance.
2) Children whose mothers had a stronger SOC presented a lower frequency of sugary food or drink intake.
3) Mothers with stronger SOC were more likely to take their children to visit the dentist, mainly for regular dental check-ups.

4. Chapter Four: Modeling the Theory of Planned Behaviour to predict adherence to preventive dental visits in preschool children

4.1 Abstract

Background: Dental caries is the most common chronic childhood disease that occurs in a continuum and can be prevented by children and their parents' adherence to recommended oral health behaviours. Theory-driven tools help practitioners to identify the causes for poor adherence and develop effective interventions. This study examined the Expanded Theory of Planned Behaviour (TPB) Model by adding the concept of Sense of Coherence (SOC) to predict parental adherence to preschooler's preventive dental visits.

Methods: Data regarding socio-economic demographics were collected from parents of children aged 2-6 years. Constructs of TPB including parental attitudes, subjective norms (SN), Perceived Behavioural Control (PBC), and intention to attend preventive dental visits for their preschoolers were collected by questionnaire, alongside parents' sense of coherence (SOC). Dental attendance was measured by asking if the child had a regular dental visit during the last year. Structural Equation Modeling Analysis (SEMA) was carried out to identify significant direct and indirect (mediated) pathways in the extended TPB model.

Results: Three hundred and seventy-eight mothers (mean age = 34.41 years, range 22-48) participated in the study. The mean age of children was 3.92 years (range: 2-6) and 75.9% had dental insurance. Results of the final model showed that predisposing factors (child's birthplace

and mother's birthplace) significantly predicted enabling resources (family monthly income and child's dental insurance status); both predicted the TPB components (PBC, SN, and attitude). TPB components, in turn, predicted behavioural intention. However, contrary to expectation, intention did not significantly predict dental attendance in the past 12 months. Parent's SOC significantly predicted TPB components and dental attendance. Overall, the expanded TPB model explained 56% of the variance in dental attendance.

Conclusion: The expanded TPB model explained a great deal of variance in preschooler's dental attendance. These findings suggest that the expanded model could be used as the framework for designing interventions or strategies to enhance dental attendance among preschoolers; in particular, such strategies should focus specifically on enhancing parental SOC including empowerment.

4.2 Introduction

The most common chronic disease in children, dental caries, is almost entirely preventable with adequate adherence to recommended oral health behaviours including good oral hygiene, dietary habits, and regular dental visits (Kirschstein and Slavkin 2000). However, more than 40% of children have tooth decay by the time they reach preschool (Pierce et al. 2002). Canadian Dental Association reported an estimated 2.26 million school-days missed annually in Canada due to dental diseases that account for about one-third of day surgeries for preschoolers aged 1-5 nationwide (Canadian Institute of Health Information 2013). Therefore, the prevention of dental caries at younger ages, similar to any other chronic health conditions, could reduce many serious dental problems that would compromise children's general health and well-being and their quality of life over the lifespan (Kirschstein and Slavkin 2000).

Adherence to a healthy diet (consuming unsweetened foods and beverages) and good oral hygiene practices (tooth brushing twice a day with fluoride) are examples of professional recommendations for preventing dental caries in children (American Academy of Pediatric Dentists 2015; Harris et al. 2004). These daily home preventive measures are complemented by attending regular dental visits, which not only allow for early detection and management of oral diseases but also enhance parental awareness of the cause and prevention of the disease (Ashkenazi et al. 2012). The American Academy of Pediatric Dentistry (AAPD) recommends that children have dental examinations every six months, starting six months after the eruption of the first tooth but no later than their first birthday (American Academy of Pediatric Dentists 2015).

Although most studies seldom differentiate children's dental attendance between preventive and restorative visits, adherence to either type of visits have been found to be unsatisfactory (Yu et al. 2002). Nearly half of US children do not receive preventive dental visits (as recommended by the AAPD/Bright Futures report), and those younger than six years are the least likely to receive it (Yu et al. 2002). With the importance of preventive dental visits for children established, more attention has been paid to adherence to their preventive measures concerning oral hygiene and dietary habits than dental attendance (Badri et al. 2014). Few studies have examined parental adherence to these recommendations, and when they did they show inconsistent and conflicting results (Badri et al. 2014).

Adherence to professional recommendations in chronic health conditions has been recognized as a challenge among health care providers (Sabaté 2003). Parents, especially mothers, have a prominent influence on children's oral health behaviours as professional recommendations include regular dental visits; actions that children cannot independently adhere (Van den Branden et al. 2013; Weatherwax et al. 2015). Health behaviour theories, therefore, have been used to better understand the determinants of adherence behaviours. Specifically, the Theory of Planned Behaviour (TPB) is a popular explanatory model for preventive health behaviours (Ajzen 1991). According to this theory, behaviour is a function of their intention moderated by Perceived Behavioural Control (PBC). Their intention, in turn, is influenced by their attitudes toward their behaviour, subjective norms, and PBC (Ajzen 1991). Like attitudes and subjective norms, PBC has an impact on intention. In addition, PBC can also affect their behaviour directly, to the extent that the perception of control accurately reflects actual control (Ajzen 1991). In sum, PBC and intention can be used together to predict behaviour.

TPB has been applied in many oral health studies (Scheerman et al. 2016) and reported as the most frequently used theoretical framework to design theory-based studies in oral health domain (Scheerman et al. 2016). However, its application in children's oral health research is relatively new (Van den Branden et al. 2013). In the study by Van den Branden et al. in 2013, the predictive validity of the TPB was examined in relation to oral health behaviours of parents regarding their preschooler's; it was found that the TPB components accounted for 41% to 46% of the variance in predicting annual dental visits and tooth brushing twice a day among 5-year-old children in Belgium (Van den Branden et al. 2013). One advantage of the TPB is that it can accommodate the inclusion of additional constructs contributing to the elicitation of a particular behaviour and its predictive properties could, therefore, be enhanced by other variables known to be important in adherence (Ajzen 1991; Rich et al. 2015).

It is well-known that parental adherence to preventive measures for their children is determined by their ability to cope with daily stressors and to identifying and mobilizing resources to adhere to healthy practices (Da Silva et al. 2011). Although the TPB has elucidated how patients conceptualize health-threatening conditions and evaluate possible facilitators and barriers towards adherence, it does not address behavioural coping skills very well (Sabaté 2003). The ability to deal with life stressors has been examined previously in relation to health through the concept of Sense of Coherence (SOC) (Antonovsky 1987). Studies have shown the influence of parents' SOC on children's oral health behaviours (Freire and Hardy 2003; Da Silva et al. 2011) and oral-health-related quality of life (OHRQoL) (Perazzo et al. 2017b). Mothers with higher SOC were more likely to have positive attitudes and behaviours towards their children's oral health than those with lower SOC (Freire and Hardy 2003). Mothers' SOC has also been found to be significantly associated with their children's dental attendance pattern even

after adjusting for socioeconomic variables (Elyasi et al. 2015; Da Silva et al. 2011). Although studies showed that the TPB model accounts for predicting parental intention well, the effects of daily stressors on their intention and its transition to behaviour are not clear; therefore, SOC is used as a proxy for life stressors in this study to see how this construct can contribute to our TPB model.

Following this path of research, this study aimed to investigate the inclusion of SOC as an expanded TPB model to predict parental adherence to preventive dental visits for their children. We hypothesized that the development of an expanded TPB model would enhance the predictive power of the TPB model in predicting dental attendance behaviour in preschoolers.

4.3 Materials and Methods

4.3.1 Study setting and participants

This multi-center cross-sectional study was granted ethics approval from the University of Alberta Research Ethics Board (Protocol No. 00047287) and Alberta Health Services. A representative sample of English-speaking mothers of children aged 2-6 years living in Edmonton, Alberta, was recruited through vaccination programs in randomly selected community health centers located in four geographical areas in Edmonton.

4.3.2 Sample size calculation

According to the 2013-14 Alberta Health Services Report, the overall vaccination rate for preschoolers in Edmonton was 91.7%. A representative sample of this population was estimated at 370 participants given the prevalence of adherence to oral health-related behaviours among

Canadian-born children is 72% (Locker et al. 1998), a marginal error of 5%, 95% Confidence Interval (CI), and 20% possible participant losses.

4.3.3 Data collection/Procedure

A trained research assistant (RA) collected data from four randomly selected community health centers in Edmonton during immunization events for preschoolers. The RA explained the study to mothers in the waiting room and gave them an information letter and consent form. Once a signed consent form was obtained, mothers were asked to complete a questionnaire that included four sections as following and took about 20 minutes to complete.

4.3.3.1 Socio-demographic characteristics

Predisposing characteristics collected in section one included: child's gender, age, birthplace (whether in Canada or no), mothers' age and birthplace (whether in Canada or not) as well as enabling resources including child's dental insurance status (yes or no) and type of insurance (public or private), mother's level of education (high school or under, college or university degree), and monthly household income (less than $3,000, $3000 to $5,000, and more than $5,000 CAD).

4.3.3.2 Theory of Planned Behaviour questionnaire

The second section was a 24-item validated questionnaire based on Azjen's Theory of Planned Behaviour (TPB) constructs adopted to examine parental attitudes (8 items), subjective norms (10 items), PBC (5 items), and intention (1 item) towards their preschoolers' dental attendance (Ajzen 2010). Participants rated each item on a 7-point Likert scale ranged from strongly agree to strongly disagree. The responses to the items measuring the TPB constructs

were summed to indicate their final scores; therefore, the higher total score for items measuring participants' attitude denoted a more positive attitude.

4.3.3.3 Sense of Coherence questionnaire

The third section was a 13-item validated questionnaire for measuring mothers' SOC (SOC-13) based on three concepts including comprehensibility (five items), manageability (four items), and meaningfulness (four items). The response options for each item followed a Likert scale from one to seven and the scores of the negatively worded items were reversed for the analysis so that a higher score for each concept denoted a stronger SOC (Antonovsky 1987).

4.3.3.4 Oral health behaviours

In the last section, mothers' self-reported oral health behaviours of their children were collected; the frequency of sugary food or sugary drink intake was measured in response to the question *'How often does your child consume foods, drinks or snacks high in sugar? (*with binary answers *'never or less than once a day, equal to or greater than once a day');* oral hygiene was assessed in response to the *question 'How many times a day are your child's teeth cleaned?*' (with binary answers '*less than twice a day, equal to or greater than twice a day');* the frequency and pattern of dental attendance were evaluated by two questions '*when the child had his/her last dental visit (*with binary answers *'within the last 12 months, over one year or never had one*'); and '*what was (were) the reason(s)?' (*with binary answers *'regular check-up, non-urgent or urgent dental problems'*.)

4.3.4 Statistical Analyses

The descriptive characteristics of the participants were explored using SPSS 24.0 software (IBM Corp., Armonk, N.Y., USA). Structural Equation Modelling (SEM) was used to analyze the data. Two-stage SEM is currently the best method for testing prior theoretical models (Kline 2011). In the first stage, the measurement model, confirmatory factor analysis (CFA) was used to examine whether the indicators (items) chosen to measure the four latent (underlying) constructs were acceptable. The indicators that have been used are the ones that allow for a best-fitting model. The four latent factors were: predisposing factors (indicators: child's birthplace, mother's birthplace), enabling factors (indicators: family monthly income, child's dental insurance status), SOC (indicators: comprehensibility, manageability, meaningfulness domains), and dental attendance (indicators: attendance frequency, attendance pattern).

CFA provides information on how indicator items (e.g. child's birthplace) measure underlying (latent) constructs (e.g. predisposing factors). The initial step of the analysis was to test a first-order CFA with predisposing factors, enabling factors, SOC, and dental attendance as the four latent constructs. Scale items (indicators) representing each of the four latent constructs are detailed in

Figure **4.1.** Bootstrapped ML standardised estimates for the confirmatory factor analysis. For all pathways $p < 0.01$ except *.

. Items were not allowed to load on more than one construct nor were error terms allowed to correlate.

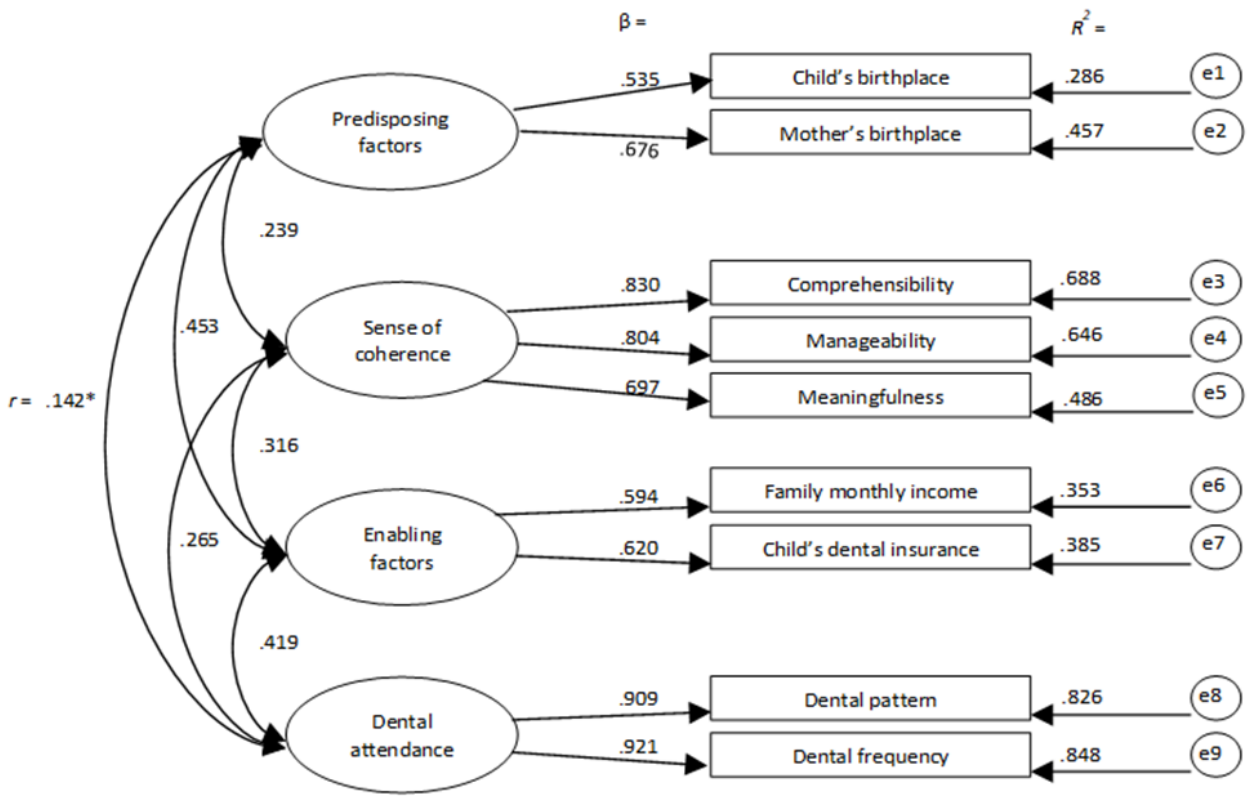


Figure 4.1. Bootstrapped ML standardised estimates for the confirmatory factor analysis. For all pathways $p < 0.01$ except *.

Following the specification of the measurement model, the second stage of the analysis was to test a structural model, which examined the direct and indirect relationships between the constructs as hypothesized within the amended TPB model. In accordance with the TPB and with SOC as an additional factor, 27 direct pathways were hypothesized; predisposing factors would predict enabling factors, and both of these would predict the three TPB components (perceived attitude, behavioural control, and subjective norms). The three TPB components would predict perceived behavioural intention, and all would, in turn, predict dental attendance. Predisposing and enabling factors would also predict dental attendance, tooth brushing and sugar intake frequency. Concerning SOC, we hypothesized that it would predict the TPB components, behavioural intention, dental attendance, tooth brushing and sugar intake frequency.

AMOS estimates the total effects, which are made up of both direct effects (a path directly from one variable to another, e.g. predisposing to enabling factors) and indirect effects (a path mediated through other variables, e.g. predisposing → dental attendance via enabling resources). The model was estimated using bootstrapping wherein multiple samples (n = 900+) are randomly drawn from the original sample. The CFA model is then estimated in each dataset, and the results averaged. The ML bootstrap estimates and standard errors [together with bias-corrected 95% confidence intervals (CIs)] are then compared with the results from the original sample to examine the stability of parameters and test statistics (Brown 2014). The full model illustrating direct & indirect effects can be seen in

Figure **4.2.** Bootstrapped standardized direct effect estimates for the amended TPB for dental attendance in preschool children illustrated with solid arrows. For ease of interpretation, only significant paths shown, and error and indicator variables omitted. * $p < 0.05$, ** $p < 0.01$, *** $p \leq 0.001$.

and

Figure **4.3.** Bootstrapped standardized indirect effect estimates for the amended TPB for dental attendance in preschool children illustrated with dotted arrows. For ease of interpretation, only significant paths shown, and error and indicator variables omitted. * $p <0 .05$, ** $p < 0.01$, *** $p \leq 0 .001$.

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As recommended, the model fit was evaluated using a range of indices (Brown 2014; Hu and Bentler 1999). A $\chi 2/df$ ratio of <3.0, RMSEA values <0.06, CFI and TLI ≥.9 and a SRMR <0.08 were taken to indicate an acceptable model fit (Hu and Bentler 1999).

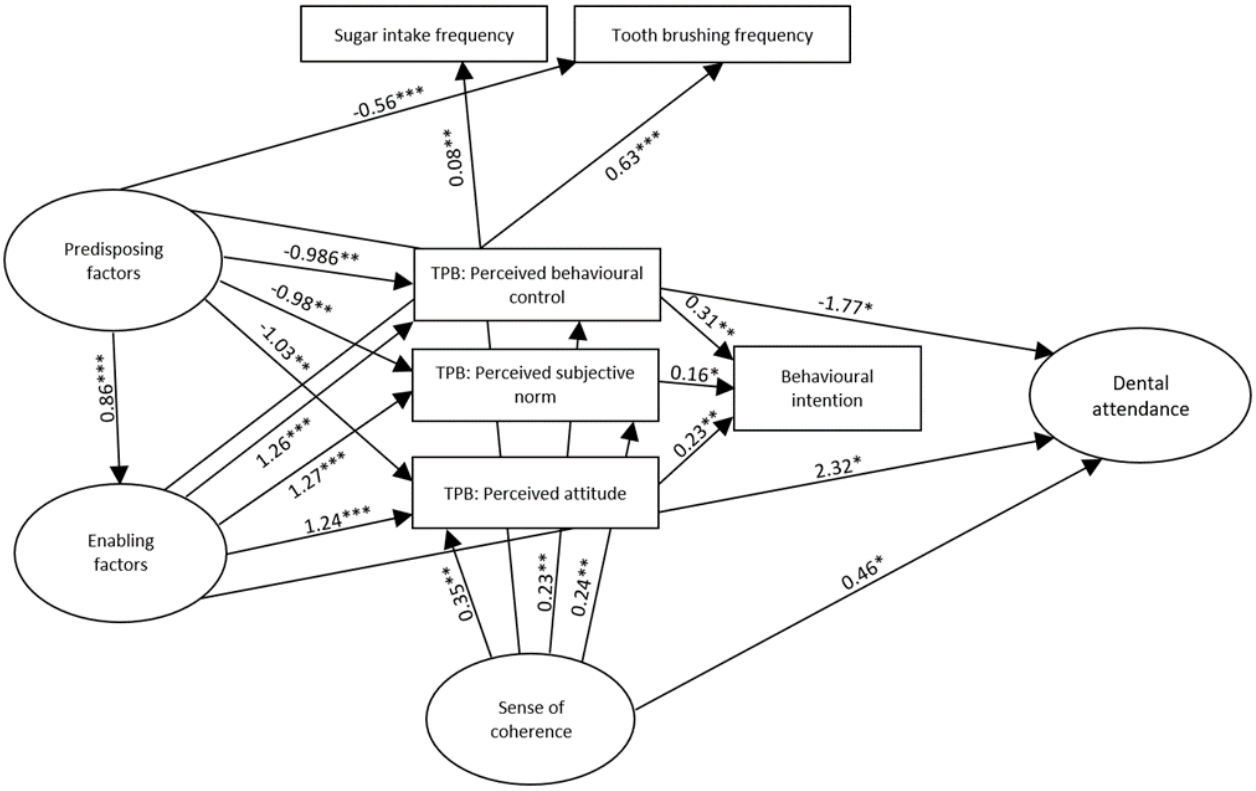

Figure 4.2. Bootstrapped standardized direct effect estimates for the amended TPB for dental attendance in preschool children illustrated with solid arrows. For ease of interpretation, only significant paths shown, and error and indicator variables omitted. * $p < 0.05$, ** $p < 0.01$, *** $p \leq 0.001$.

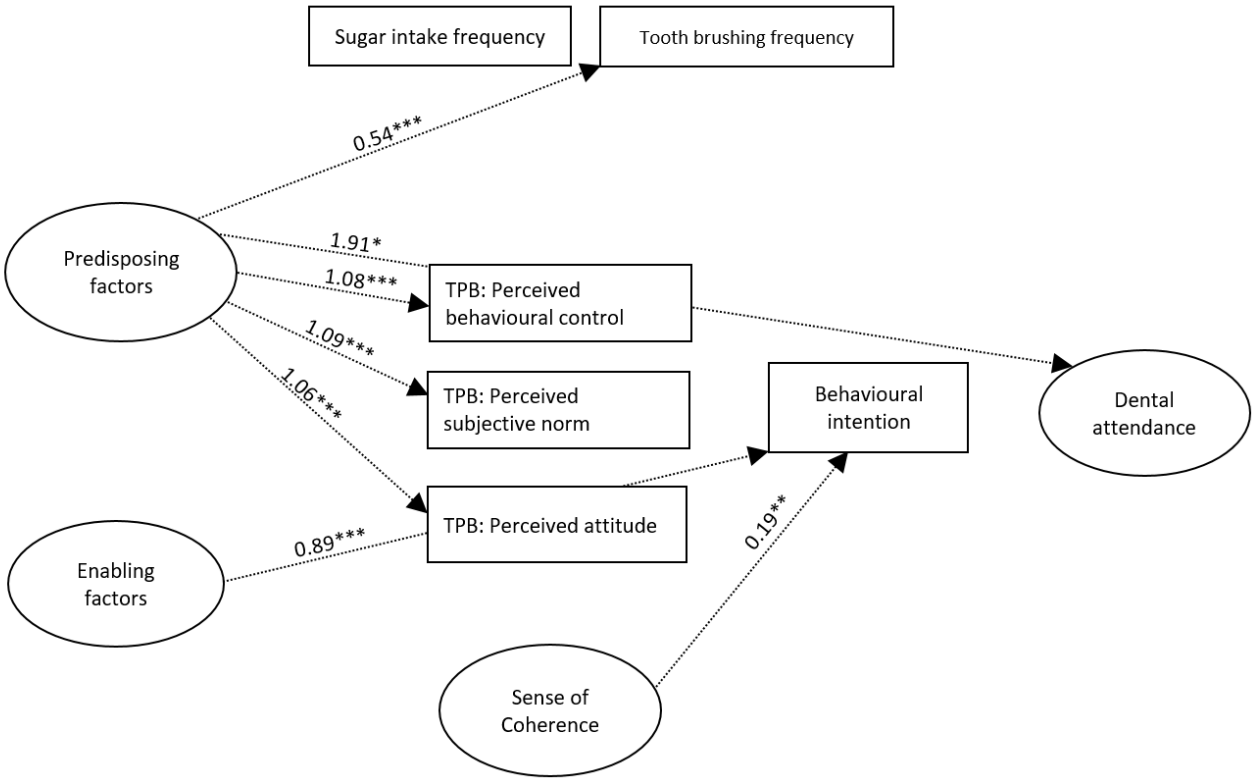

Figure 4.3. Bootstrapped standardized indirect effect estimates for the amended TPB for dental attendance in preschool children illustrated with dotted arrows. For ease of interpretation, only significant paths shown, and error and indicator variables omitted. * p <0 .05, ** p < 0.01, *** p ≤0 .001.

4.4 Results

The response rate was 95%. The mean age of 378 mothers who participated in this research was 34.4±4.9 years. All collected data were used in the analysis as there were no outlying results. Among the preschoolers with the mean age of 3.92±1.33 years, 191 (50.6 %) were girls. Participants' characteristics are presented in Table 4.1. The Cronbach's alpha for the subset of items applied to measure attitude, subjective norm, and PBC were 0.74, 0.83, and 0.76

respectively. The SOC-13 scale showed acceptable internal consistency (Cronbach alpha: 0.91) in this study.

Table 4.1. Participants' characteristics.

Characteristics	N (%)
Mother's level of education	
High school or under	83 (21.9%)
College or Trade	149 (39.4%)
University degree	146 (38.6%)
Monthly income level	
< $3,000	82 (21.6%)
$3,000 - $5000	146 (38.6%)
>$5,000	150 (39.6%)
Mother's age (year)	
Mean	34.15
SD	4.9
Range	22-48
Mother's birth place	
Canada	207 (54.8%)
Outside of Canada	171 (45.2%)
Child's gender	
Boy	187 (49.4%)
Girl	191 (50.6%)
Child's age (years)	
2	63 (16.6%)
3	54 (14.2%)
4	122 (32.2%)
5	115 (30.4%)
6	24 (6.3%)
Child's birth place	
Canada	325 (86%)
Outside of Canada	53 (14%)
Child's dental insurance	
No insurance	95 (25.1%)
Has insurance	283 (74.8%)
Type of Insurance*	
Private	247 (87.3%)
Public	36 (12.7%)
Tooth brushing frequency	
<2x/day	167 (42.6)
≥2x/day	211 (57.4)
Sugar-intake frequency	
≥1x/day	≥1x/day
<1x/day	<1x/day
Utilization of dental services (last year)	
No	185 (48.9)
Yes	193 (51.1)

Pattern of dental attendance** Dental problem Regular check-up	 31 (16.1) 162 (83.9)
*Considering the 283 individuals who had dental insurance. **Considering a total of 193 children who used dental services within the previous year.	

4.4.1 Confirmatory factor analysis

For the CFA, test of basic assumptions including univariate and multivariate normality, linearity and multi-collinearity were conducted. Logarithmic transformation of data was applied for non-normal data. Testing the specification, identification, and estimation of the model showed an acceptable fit on all a priori indices ($X^2 = 2.563$, SRMR=0.039, CFI=0.970, TLI=0.907, RMSEA=0.064, Cis = 0.043/0.086). The bootstrapped standardized estimates for this four-factor measurement model was presented in

Figure 4.1. Bootstrapped ML standardised estimates for the confirmatory factor analysis. For all pathways $p < 0.01$ except *.

. Factors (latent variables) are in ellipses, items (indicator variables) are in rectangles and residual error terms in circles. As seen in

Figure 4.1. Bootstrapped ML standardised estimates for the confirmatory factor analysis. For all pathways $p < 0.01$ except *.

, all factor loadings were significant and in the expected direction. Both the child and mother being born in Canada were associated with more of the 'predisposing' factor (with factor loadings of 0.54 and 0.68 respectively). Having a higher family income and dental insurance for

the child were associated with more of the 'enabling resources' factor. A preventive-orientated attendance and visiting the dentist regularly were associated with more of the 'dental attendance' factor (with factor loadings of 0.91, 0.92 respectively). Greater manageability, comprehensibility and meaningfulness were associated with more sense of coherence. The correlations among the four latent factors ranged between 0.14 and 0.45, indicating that they had acceptable discriminant validity (i.e. <0.85) (

Figure **4.1.** Bootstrapped ML standardised estimates for the confirmatory factor analysis. For all pathways $p < 0.01$ except *.

).

4.4.2 The extended TPB model

The model was an acceptable fit to the data meeting all apriori indices ($x^2 = 2.432$, SRMR=0.066, CFI=0.941, TLI=0.911, RMSEA=0.062, CIs = 0.050/0.074). Within this model, eight of the hypothesized bootstrapped paths were non-significant; predisposing and enabling factors to sugar intake frequency, SOC to behavioural intention, SOC to tooth brushing frequency, each of the three TPB components to dental attendance, and behavioural intention to dental attendance. All hypothesized paths within the model were presented in **Error! Reference s ource not found.**. The remaining paths were significant and can be seen in

Figure **4.2.** Bootstrapped standardized direct effect estimates for the amended TPB for dental attendance in preschool children illustrated with solid arrows. For ease of interpretation, only significant paths shown, and error and indicator variables omitted. * $p < 0.05$, ** $p < 0.01$, *** $p \leq 0.001$.

. The bootstrapped percentage of variance accounted for were enabling factors (73%), attitude (54%), subjective norm (50%), perceived behavioural control (49%), intention (34%) and dental attendance (56%).

Table 4.2. Bootstrapped direct and indirect effects for the adapted TPB model.

Effect	β	Bootstrap SE	Bias-corrected 95% CI	p
Direct effects				
Predisposing-enabling	0.856	0.161	0.547/0.986	0.001
Predisposing-attitude	-1.033	0.955	-3.237/-0.340	0.002
Predisposing-subjective norm	-0.981	1.102	-3.481/-0.263	0.004
Predisposing-PBC*	-0.986	1.011	-3.509/-0.302	0.009
Predisposing-dental attendance	-1.768	2.572	-10.020/-0.333	0.032
Predisposing-tooth brushing	-0.563	0.479	-1.660/-0.223	0.001
Predisposing-sugar intake	0.007	0.173	-0.257/0.220	0.312
Enabling-attitude	1.237	0.914	0.754/3.715	0.001
Enabling-subjective norm	1.271	1.039	0.763/4.013	0.001
Enabling- PBC*	1.260	0.964	0.785/4.098	0.001
Enabling-dental attendance	2.316	2.629	0.849/10.167	0.021
Enabling-tooth brushing	0.633	0.479	0.356/1.781	0.001

Enabling-sugar intake	0.084	0.161	-0.107/0.341	0.422
SOC-attitude	0.353	0.057	0.258/0.444	0.002
SOC-subjective norm	0.236	0.055	0.136/0.314	0.005
SOC-PBC	0.234	0.063	0.133/0.335	0.002
SOC-intention	-0.007	0.056	-0.107/0.083	0.880
SOC-dental attendance	0.464	0.227	0.182/0.958	0.014
SOC-tooth brushing	0.097	0.058	-0.004/0.189	0.114
SOC-sugar intake	0.084	0.055	0.072/0.255	0.008
Attitude-intention	0.239	0.059	0.143/0.335	0.002
Subjective norm-intention	0.162	0.059	0.050/0.247	0.012
Perceived control-intention	0.310	0.052	0.227/0.402	0.003
Attitude-dental attendance	-0.298	0.278	-0.861/0.076	0.166
Subjective norm-dental attendance	-0.276	0.259	-0.876/0.037	0.140
PBC-dental attendance	-0.348	0.254	-0.811/-0.010	0.084
Intention-dental attendance	-0.007	0.067	-0.113/0.110	0.929
Indirect effects				
Predisposing-Attitude	1.058	0.984	0.430/3.661	0.001
Predisposing-subjective norm	1.088	1.107	0.414/3.886	0.001
Predisposing- PBC	1.078	1.033	0.455/4.045	0.001
Predisposing-intention	0.052	0.058	-0.041/0.150	0.360
Predisposing-dental attendance	1.912	2.576	0.488/10.888	0.017
Predisposing-tooth brushing	0.542	0.510	0.207/1.857	0.001
Predisposing-sugar intake	0.072	0.152	-0.058/0.447	0.289
Enabling-intention	0.892	0.687	0.550/2.646	0.001
Enabling-dental attendance	-1.164	1.748	-5.993/-0.049	0.086
SOC-intention	0.195	0.043	0.124/0.262	0.003
SOC-dental attendance	-0.253	0.221	-0.752/0.007	0.111
Attitude-dental attendance	-0.002	0.017	-0.024/0.030	0.924
Subjective norm-dental attendance	-0.001	0.012	-0.019/0.020	0.939
PBC-dental attendance	-0.002	0.022	-0.036/0.034	0.933
β = bootstrapped standardised estimate; SE = standard error; CI = confidence interval. * Perceived Behavioural Control.				

4.4.3 Direct effects

All of the significant direct paths were in the expected direction (**Error! Reference source not found.**); more of the predisposing factor was linked to more enabling resources; greater predisposing and enabling resources were linked to higher perceived attitude, subjective norms and PBC scores, to greater dental attendance, and a higher frequency of tooth brushing; A greater

SOC was linked to higher perceived attitude, subjective norms and PBC scores, greater dental attendance and less frequent sugar intake (

Figure **4.2.** Bootstrapped standardized direct effect estimates for the amended TPB for dental attendance in preschool children illustrated with solid arrows. For ease of interpretation, only significant paths shown, and error and indicator variables omitted. * $p < 0.05$, ** $p < 0.01$, *** $p \leq 0.001$.

). The three TPB components were all linked to a greater behavioural intention but were not, as hypothesized, linked to dental attendance. In addition, surprisingly, the behavioural intention was not associated with greater dental attendance.

4.4.4 Indirect effects

There were a number of significant indirect effects between latent and observed variables within the model (**Error! Reference source not found.**). Predisposing factors were linked i ndirectly to the TPB components, dental attendance and tooth brushing via enabling factors (

Figure **4.3.** Bootstrapped standardized indirect effect estimates for the amended TPB for dental attendance in preschool children illustrated with dotted arrows. For ease of interpretation, only significant paths shown, and error and indicator variables omitted. * $p <0 .05$, ** $p < 0.01$, *** $p \leq 0 .001$.

). It seems that the relationship between the predisposing factor (i.e. child and mother born in Canada) and higher scores on perceived attitude, subjective norms, and perceived control, more frequent tooth brushing as well as a greater dental attendance, may be mediated by

a higher family income and having dental insurance. In addition, both enabling factors and SOC were linked indirectly to behavioural intention via the three TPB components (

Figure **4.3.** Bootstrapped standardized indirect effect estimates for the amended TPB for dental attendance in preschool children illustrated with dotted arrows. For ease of interpretation, only significant paths shown, and error and indicator variables omitted. * p <0 .05, ** p < 0.01, *** p ≤0 .001.

). It would seem that the effect of the enabling factor (greater family income and dental insurance) on parent's behavioural intention is, as would be hypothesized by the TPB model, indirectly associated with parent's perceived attitude, subjective norms and PBC towards dental attendance. Similarly, parents' behavioural intention is indirectly affected by their SOC via their perceived attitude, subjective norms and behavioural control towards dental attendance.

4.5 Discussion

In this study, we extended the TPB model to account for parent's SOC. Using an advanced statistical technique - SEM - revealed that predisposing factors (mother and child's birthplace) significantly predicted enabling resources (family income and child's dental insurance); both factors predicted the TPB components (PBC, SN, and attitude). TPB components predicted behavioural intention; however, contrary to expectation, intention did not significantly predict dental attendance. SOC significantly predicted TPB components and dental attendance. Overall, this model explained a great deal - 56% - of the variance in dental attendance in preschoolers.

Although both predisposing and enabling factors were linked to the frequency of tooth brushing, they were not significantly associated with sugar intake frequency. Mothers' SOC was the only component linked to sugary intake frequency, but it was not associated with tooth brushing behaviour. This inconsistency may imply the existence of specific contributing factors for each behaviour of interest while studying the predictors or developing interventions. Another reason for this discrepancy might be the fact that preschoolers' oral hygiene practices require additional technical support and skills from parents in addition to their SOC comparing with sugary intake frequency.

As for dental attendance, both predisposing and enabling factors were linked to the behaviour directly and indirectly. The significant direct link showed the independent/direct contribution of these two factors to the extended TPB model in predicting dental attendance among children. Although 74.8% of children had dental insurance and some free preventive dental services are available for children in Canada (Amin et al. 2014), less than half of the children (42%) had a preventive dental visit during the last year. This indicated the underutilization of available dental services that might be partly attributable to low parental awareness or some other barriers such as parents' time constraints or some psychosocial factors such as SOC (Elyasi et al. 2015).

SOC, an important psychosocial determinant in the oral health domain, has been applied to study the use of oral health services in a few studies (Elyasi et al. 2015; Holde, Baker, and Jönsson 2018; Da Silva et al. 2011). Holde et al., for example, tested modified Andersen's behavioural model, by adding SOC construct, and found that a stronger SOC was related to more use of dental services in Norwegian adults when the association was mediated through enabling resources (Holde et al. 2018). Among children, those whose mothers had stronger SOC scores

were more likely to use dental services (Da Silva et al. 2011) even in families with low socioeconomic status (Da Silva et al. 2011). In our study, a greater SOC was directly linked to higher TPB components (perceived attitude, subjective norms and PBC) scores, and greater dental attendance; SOC was also indirectly related to behavioural intention through the TPB components. Therefore, it could be concluded that incorporating the concept of SOC into the TPB model has improved the predictability of the model by linking to the TPB components and directly to the behaviour.

All TPB components in this study are linked to behavioural intention; however, the behavioural intention failed to translate into dental attendance behaviour. Therefore, the TPB model itself was able to predict parents' intention to take their children for preventive dental visits and not the actual performance of the behaviour. These findings are in line with previous studies outside of oral health domain (Armitage and Conner 2001; Conner, Mark and Norman 2005). There are three concerns regarding this observation in our study. First, measurement of intention was limited to only one question/indicator measured parental intention; therefore, low variation in the items measuring intention might result in the lack of association (Ajzen 2010). Second, we measured mothers' self-reported past behaviours in this study, not the consecutive behaviours (Van de Mortel 2008); and third, intentions and behaviours were both measured simultaneously and no time frame existed between both measurements (Armitage and Conner 2001). Therefore, longitudinal observation of performing the succeeding behaviour is required to assess the causality relationships between TPB constructs and draw more accurate conclusions (Armitage and Conner 2001; Conner, Mark and Norman 2005).

In this model, 34% and 56% of the variance was accounted for behavioural intention and dental attendance variables respectively. Among the predictors of intention within TPB model in

our study, PBC was the strongest predictor accounted for 31% of variance to predict it followed by attitude and subjective norms with values of 24% and 16% respectively. Generally, TPB explains 20% - 40% of the variance of numerous behaviours in the health domain (Armitage and Conner 2001; Sheeran 2002). In the oral health domain, a few previous studies have applied the TPB and its extended modifications to predict Oral Health Behaviours (OHB). In the study done by Buunk et al., the components of the TPB model and oral health knowledge explained 32.3% of the variance of oral hygiene behaviours including tooth brushing, flossing, and tongue cleaning among Dutch adults (Buunk et al. 2011); PBC was also the best predictor of OHB, which was in accordance with the results of a meta-analysis reporting PBC as the strongest predictor of health behaviour in the TPB model (Armitage and Conner 2001).

Among adolescents, Pakpour et al. tested the extended TPB model by adding action and coping planning suggesting that these two factors may help to overcome the barriers towards implementation of behavioural intention; they concluded that the expanded model accounted for 51% of the variance for tooth brushing behaviour. Similar to our study, they reported that perceived behavioural control was the strongest predictor of TPB in their model (Pakpour et al. 2012). Dumitrescu et al. tested another extension of the TPB model, by adding oral health knowledge, among young adults and concluded that participants' attitude, PBC, and oral health knowledge predicted 51.5% of the variance to predict behavioural intention to improve tooth brushing, flossing, and dental attendance behaviours (Dumitrescu et al. 2011); however they reported that knowledge was linked to attitude in such a way that increased knowledge led to stronger attitude, which was more stable and resistant to change (Dumitrescu et al. 2011).

In a longitudinal study using an extended version of TPB model, adult participants' attitudes, subjective norms, PBC were significant predictors of intention while participant's

intention, self-efficacy and past dental attendance were significant predictors of actual dental attendance (Luzzi and Spencer 2008). In this prospective cohort study, authors proposed "past dental attendance" as a potential predictor of individual's intention and future behaviour and hypothesized that the inclusion of past experience significantly contributed to the prediction of behavioural intention; they concluded that past behaviour predicted intention beyond TPB components. Their proposed model was able to explain 12.0% of the variance to predict intention. All four components were identified as independent predictors of individual's intention in the model. The TPB model explained 15.5% of the variance in dental attendance while adding the "past behaviour" component increased it by 7.0% (Luzzi and Spencer 2008). In our study, we measured participants' past behaviour as their actual behaviour that might cause the absence of a link between intention and behaviour in the TPB model. Therefore, it could be recommended to design longitudinal studies to evaluate our extended TPB model to predict dental attendance behaviour prospectively.

In 2013, Van den Branden et al. in Belgium developed and validated a TPB-based questionnaire to predict parents' determinants of oral health behaviours, including dietary habits, oral hygiene, and dental attendance for children using CFA and multiple regression analysis. For dietary habits, tooth brushing, and dental attendance, TPB model accounted for 44%, 49%, and 55% of the total variance in the regression model to predict the behaviours respectively. Participants' dental attendance was predicted by both their parents' intention and PBC (Van den Branden et al. 2013). Among TPB components, PBC was the strongest predictor of intention, which was in line with our results; however, neither intention nor PBC was significantly linked to the behaviour in our study. This inconsistency could be explained by adopting SEM analysis in our study to identify the significant pathways between TPB components while measuring

model's goodness of fit and eliminating the effects of confounding variables comparing with regression analysis. SEM enabled us to control the measurement errors and achieve more accurate estimates for studied regression-coefficients.

In this study, we examined the predictability of the extended TPB model and the direct and indirect effects among the factors; however, the study was of a cross-sectional design, which means no causality can be assumed. For example, the components of the TPB may lead to greater SOC or vice versa as tested in our model. Only by collecting longitudinal data in which SOC is measured at baseline, alongside, parent and child demographics, TPB components are collected at a second-time point, and finally outcomes at a third-time point can we explore cause and effect relationships. In this research, only one item adopted to measure intention; therefore, having more items to assess the construct in the future studies will enhance the internal validity of the questionnaire and reduce measurement errors. A further limitation was the use of a convenience sampling method and self-reported outcome variables. For example, dental attendance frequency may have been over-estimated, as parents may have answered the question according to how often they should be taking their child to their dentist. Based on the available data, the vaccination rate in Edmonton in 2013-14 was approximately 91%. Nonetheless, it is recommended to include mothers who refuse immunizations for their children, as they may have different views about taking their children to receive preventive care services, such as regular dental check-ups. Finally, the external validity of the extended TPB model needs to be investigated in other population groups such as adolescents, young adults, and adults in the future studies.

4.6 Conclusions

- Predisposing factors significantly predicted enabling resources; both predicted the TPB components (attitude, subjective norms, and PBC).
- TPB components predicted behavioural intention; however, nor intention neither PBC significantly predicted dental attendance.
- SOC was directly linked to TPB components and dental attendance while indirectly related to behavioural intention through the TPB components.
- Overall, the expanded TPB model explained 56% of the variance in dental attendance.

5. Chapter Five: Developing and Testing a Theoretical Model to Predict Adherence to Orthodontic Treatments

5.1 Background and significance

In children and adolescents, non-adherence to professional health care advice is a significant health concern and a complicated issue given that it involves both children and their parents (Taddeo et al. 2008). No matter how effective preventive or therapeutic regimens are, if children and parents do not adhere to instructions, the healthcare will be compromised (Chappell 2015). Orthodontic treatments for child patients are ideal therapeutic measures for studying the adherence to oral health treatments because of the prolonged nature of the treatment (2–3 years) (Trenouth 2003). Orthodontic treatment proceeds mostly in outpatient settings, which requires patients' self-care behaviours and parents' involvement. Better self-care behaviours are associated with shorter treatment duration and enhanced orthodontic treatment outcome (Ashkenazi et al. 2007). Further, the child patients under orthodontic treatment, are considered as moderate to high risk to caries development due to the difficulties and restrictions they have to clean their teeth properly (Ashkenazi et al. 2007). Patients with inadequate adherence during active treatment are likely to remain in treatment longer. Therefore, they have the potential to experience more detrimental side effects such as the development of white spot lesions (Lindauer et al. 2009).

Theory of Planned Behaviour has been found to be a successful theoretical model for application in oral health studies. TPB components have explained a significant proportion of the variance in predicting oral health related behaviours in adults. Nevertheless, despite what appears

to be an increase in the application of the TPB in oral health research, the use of TPB for predicting adherence to orthodontic treatments is relatively new. One study applied the former version of TPB namely the Theory of Reasoned Action (Mehra, Nanda, and Sinha 1998); however, based on our knowledge, no studies have investigated the application of TPB for orthodontic patients.

One of the advantages of the TPB is that it can accommodate the inclusion of additional constructs/predictors contributing to the elicitation of a particular behaviour and could be enhanced by other variables known to be important in adherence (Ajzen 1991). Other important psychosocial factors in adherence behaviours are patients' ability to cope with daily life stressors that play a substantial role in identifying and mobilizing resources to adhere to healthy practices (Antonovsky 1987). This perception can be evaluated through the concept of Sense of Coherence (SOC), which is the core concept of Salutogentic Model seeking to explain the relationship between coping with life stresses and maintaining health (Antonovsky 1987). As "people with a strong SOC view life as coherent, structured, manageable and meaningful", Antonovsky suggested that "people with a strong SOC are more likely to identify a range of available resources to deal with the demands" (Antonovsky 1987). It has been shown that SOC is associated with stronger intentions to comply with preventive or therapeutic health care measures (Eriksson and Lindström 2005; Ferry Brown and Moerenhout 2003).

Recently, adherence studies in orthodontics have also shed light on the critical role of coping skills among orthodontic patients and their parents (Ferry Brown and Moerenhout 2003). For the patients' part, the challenge of coping with pain and discomfort during the orthodontic treatment and adherence to oral health care practices were seen as the primary causes of discontinuation of treatment (Ferry Brown & Moerenhout, 2003; Mehra et al., 1998). From the

parents' part, their ability to support and encourage their children to adhere to their therapy and recommended oral health measures is critical to the treatment success (Albino et al. 1991; Prabakaran et al. 2012). For instance, children are generally more cooperative, if their parents encourage the treatment (Daniels, Seacat, and Inglehart 2009; Nanda and Kierl 1992).

Therefore, the overall goal of the second phase of this PhD research was to develop an expanded theoretical model, by adding the concept of SOC to the original TPB model, to predict adherence to orthodontic treatments among 12-18-year-old patients through a prospective approach.

5.2 Methods

5.2.1 Study design

A prospective longitudinal single-centre study of patient adherence to orthodontic treatment was conducted at the University of Alberta (UofA) Orthodontic Graduate Clinic. The research ethics approval was obtained from the UofA Research Ethics Board (Protocol No. 00047287).

5.2.2 Study setting and participants

This clinic-based cohort study was carried out from August 2017 to November 2019. A representative/consecutive sample of orthodontic child patients aged 12 to 18 and their parents were recruited from the orthodontic department using a convenient sampling method.

5.2.3 Inclusion criteria

The inclusion criteria were patients aged 12 to 18 years who were accepted for maxillary and mandibular fixed orthodontic treatment (patients scheduled to start an orthodontic multibracket treatment) in the Graduate Orthodontic Clinic.

5.2.4 Exclusion criteria

Exclusion criteria were 1) individuals with chronic systemic diseases or a significant medical history; 2) craniofacial developmental disorders, including cleft lip and palate; 3) hypodontia; 4) history of orthodontic treatment; 5) difficulties in reading or speaking English; and 6) individuals who declined to participate.

5.2.5 Sample size calculation

Based on a recent study on adherence behaviours among orthodontic patients, ‘‘The patient keeps appointments’’ was the highest-rated factor regarding the importance from orthodontists’ perspective (Al Shammary et al. 2015). Therefore, considering the 11.6% of appointment non-attendance, as one of the adherence behaviours for orthodontic treatments, at UofA orthodontic graduate program and based on 5% standard error, 95% confidence interval, the estimated sample size was 140 orthodontic patients and their parents. Additional 20% of the

calculated sample size was added to the minimum sample size to compensate for possible losses. Therefore, a total of 168 child orthodontic patients and their parents were recruited.

5.2.6 Data collection/Procedure

Recruitment was done after obtaining the records and at the beginning of the first treatment appointment. An orthodontic graduate student and a calibrated research assistant described the study to patients and their parents in the waiting room and gave them an information letter and consent form. Once signed consent forms were obtained, participants were asked to complete a questionnaire. Each questionnaire included four sections and took about 20 minutes to complete.

5.2.7 Collected data

5.2.7.1 Demographic and Socioeconomic (Socio-demographic) Characteristics

In the first section, participants' demographics were collected. Patients' demographics were age and gender. Parents' demographics included age, the relationship of the parent to the child, the level of education, and monthly household income.

5.2.7.2 TPB questionnaire for patients

The second section was a questionnaire developed by the graduate student and the content was validated based on Azjen's Theory of Planned Behaviour (TPB) constructs. The questionnaire included items to measure orthodontic patients' attitudes, subjective norms, and PBC; it was used to examine their intention to perform oral health care measures during the treatment phase. One item measured intention towards each of the adherence behaviours

including tooth brushing and appointment keeping. Patients were asked to rate each item on a 7-point Likert scale ranged from strongly agree to strongly disagree.

5.2.7.3 TPB questionnaire for parents

A separate TPB-based questionnaire was also developed to measure parents' attitude, subjective norms, and PBC as well as their intention to adhere to oral health care measures for their children undergoing orthodontic treatment including tooth brushing and appointment keeping.

5.2.7.4 SOC questionnaire

Orthodontic patients and their parents' SOC were measured using short version questionnaire (SOC-13) graded using a Likert point scale ranging from 1 to 7. The final SOC score is the sum of answers and can range from 13 to 91 with higher scores indicating stronger SOC.

5.2.7.5 Adherence Behaviours Measurements (Outcome variables)

5.2.7.5.1 Oral hygiene

Oral hygiene adherence was measured using a visual examination of labial/buccal White Spot Lesion (WSL) on each bonded tooth after 5 seconds of air drying and graded from 0 to 3 as described in **Error! Reference source not found.** (Zotti et al. 2016). Measurements were d one at the time of fitting the fixed appliance (T0), two months (T1), six months (T2) and 12 months after the baseline (T3). Self-reported brushing was also measured by asking participants about how often the patients brush their teeth per day (Aljabaa, Mcdonald, and Newton 2015).

Table 5.1. White Spot Lesion (WSL) Measurements.

Grade	Presentation
0	No visible WSL or surface disruption (no demineralization)
1	Visible WSL without enamel surface disruption (mild demineralization)
2	Visible WSL with roughened enamel surface (moderate demineralization)
3	Visible WSL requiring restoration (severe demineralization)

5.2.7.5.2 Appointment attendance

Patients' adherence to the scheduled appointment was recorded as appointment attendance during the one-year period. The appointment was considered as "failed/missed" if the patient did not show up, canceled the appointment on the same day, or came too late causing rescheduling (Aljabaa et al. 2015; AlSadhan 2013).

5.3 Preliminary/descriptive results

The response rate for this cross-sectional study was 98 %. No missing data were identified in the final dataset. No loss to follow-up occurred during the course of this study.

The participants were 168 pair of orthodontic patients with the mean age of 14.47±1.52 years and their parents with a mean age of 44.65±5.1 years. Among patients, 90 (53.6%) were girls and about 40% had other siblings in orthodontic treatment before or at the same time. Among parents whose children participated in this research, 135 (80.4 %) were mothers, 43% of families had a monthly income of $5000 or higher and 80 % of parents had post-secondary or college degree. The demographic and socioeconomic characteristics of the participants are presented in Table 5.2.

Table 5.2. Socio-demographic characteristics of 168 paired orthodontic child patients and their parents at UofA Orthodontic Graduate Clinic*.

Characteristics	N (%)
Parents' level of education	
High school or under	35 (20.8%)
College or Trade	73 (43.5%)
University degree	60 (35.7%)
Family monthly income	
< $3,000	9 (6.4%)
$3,000 - $5000	95 (50.6%)
>$5,000	74 (43%)
Parents' age (year)	
Mean	44.65
SD	5.1
Parents' relationship to child	
Mother	135 (80.4%)
Father	33 (19.6%)
Child's gender	
Boy	78 (46.4%)
Girl	90 (53.6%)
Child's age (years)	
12-14	73 (43.5%)
14-16	65 (38.7%)
16-18	30 (17.9%)
Another sibling(s) with orthodontic treatment	
Yes	63 (37.5%)
No	105 (62.5%)
[*]Data were collected between August 2017 and November 2019.	

Recording tooth brushing behaviour at the base time (T0) revealed that 76% of parents reported their children brushed their teeth twice a day or more which was very close to the percentage reported by their children of about 73%.

Oral hygiene was also measured indirectly at three time points during the treatment. At T0, 22% of patients had at least one tooth with labial/buccal White Spot Lesion (WSL) with minimal severity of Grade 1. At T1, 4-6 months later, 48% of patients had WSLs and the severity of about 21% of those was identified as Grade 2. At T2, one year into the treatment, about 60% of patients had WSLs and the severity of about 48% of lesions was recorded as grade 2 or higher.

Totally, 57% of patients had at least one missed appointment during the first year of their treatment and about 25% missed 3 or more appointments. Adherence-related characteristics of patients were demonstrated in **Error! Reference source not found.**.

Table 5.3. Adherence-related characteristics of orthodontic child patients at UofA Orthodontic Graduate Clinic (N=168) *.

Child's toothbrushing frequency (child's answers)			
<2x/day	**46 (27.2%)**		
≥2x/day	**122 (72.8%)**		
Child's toothbrushing frequency (parent's answers)			
<2x/day	44 (24.2%)		
≥2x/day	124 (75.8%)		
Patients with labial/buccal WSL** (s)			
T0	37 (22%)		
T1	81 (48.2%)		
T2	97 (58.7%)		
Severity of labial/buccal WSL(s)	**G_1*** **	**G_2**** **	**G_3***** **
T0	37 (100%)		
T1	65 (79.3%)	15 (20.7%)	
T2	57 (53.1%)	32 (38.9%)	8 (9%)
Missed appointments			
0	78(42.8%)		
1	55 (32%)		
2	17 (11.1%)		
3 or more	18 (14.1%)		

*Data were collected between Aug 2017 and Nov 2019.
** White Spot Lesion
*** $Grade_{1:}$ Visible WSL without enamel surface disruption (mild demineralization)
**** $Grade_{2:}$ Visible WSL with roughened enamel surface (moderate demineralization)
***** $Grade_{3:}$ Visible WSL requiring restoration (severe demineralization)

5.4 Anticipations and suggestions for future research

Since orthodontic treatment requires relatively extensive oral health resources, it is essential for the providers to be able to predict patient adherence and to enhance it, if needed. If we can identify patient characteristics associated with cooperative treatment behaviour, we may be able to remove some of the barriers to treatment or to defer treatment until treatment readiness has been achieved. To make this practice happens; practitioners must have access to specific measurement tools developed based on behaviour theories to understand the determinants of adherence behaviours fully and to develop effective interventions. Therefore, a comprehensive theoretical model of adherence has been suggested to clearly define which possible variables need to be analyzed, and which possible interactions between variables may be expected.

To achieve this goal and by using the extensive data collected in this research, an extended theoretical model which was initially developed and tested in phase I, will be applied to predict adolescents' adherence to orthodontic treatments through a prospective approach.

This goal will be achieved through addressing three objectives: *(i)* by examining the impact of parents and child patients' SOC on their adherence to orthodontic treatments, we will explore whether the SOC of child patients and their parents' affect their adherence to orthodontic treatments; *(ii)* by evaluating the development and validation of the measurement tools for measuring the psychosocial determinants of adherence for both parents and child patients undergoing the orthodontic treatment, we will address the question to what extent can a TPB-based questionnaire predict adherence to orthodontic treatments for both parents and child patients; *(iii)* by comparing the predictive power of both TPB and Extended TPB Model and to see whether the structural model of the Extended TPB remains stable for predicting adherence

behaviours in children undergoing orthodontic treatments, we will address the question, does the structural model of the Extended TPB remain stable for predicting adherence behaviours in children undergoing orthodontic treatments?

Regarding the statistical analysis to test the Extended TPB model, Confirmatory factor analysis will be performed using AMOS software. The fit of the model will be evaluated by several indices including chi-squared and p-value < 0.05; the ratio of chi-squared to the degree of freedom; goodness of fit index (GFI); adjusted goodness of fit index (AGFI); comparative fit index (CFI); and Root Mean Squared Error of Approximation (RMSEA). The aim is to confirm a particular pattern of relationships predicted by the first phase (model development) analytic results and to see whether the structural model of the Extended TPB remains stable for predicting adherence behaviours among orthodontic patients in a longitudinal setting.

6. Chapter Six: Discussion and Conclusions

In this PhD dissertation, I aimed to build and test a theoretical model to predict children's adherence to oral health behaviours. The focus was to develop and test this model in a community-based setting to predict children's adherence to preventive oral health care practices. This research was also implemented in a clinical-based setting with children undergoing orthodontic treatments for future cross-validation of our developed model.

6.1 Discussion

To predict patient adherence, practitioners must have access to specific measurement tools developed based on behaviour theories to identify the possible causes for non-adherence (Sabaté 2003). Theoretical models have prominent roles in developing health promotion interventions since the first stage in designing such interventions is to identify what predicts the behaviour using a theoretical approach (McEachan et al. 2011). However, based on the systematic review and meta-analysis aimed to study the psychosocial correlates of oral hygiene behaviour among 9- to 19-year olds, only 39% of the studies based their research on behavioural theory, the remaining 61% of the studies did not refer to a specific theoretical framework. The most dominant theoretical framework used for designing the included studies (25%) was the Theory of Planned Behaviour (TPB) (Scheerman et al. 2016).

Our developed model in this PhD research was based on the Theory of Planned Behaviour, a well-established social cognitive theory which has been successful in identifying the determinants of health-related behaviours in different contexts including adherence to preventive and therapeutic measures across different age groups (Conner, Mark and Norman

2005; Dorri, Sheiham, and Watt 2010). TPB is a useful model for studying individuals' decisions for others' health, such as parents' behaviours to supporting their children's health, named as parent-for-child health behaviours (Hamilton et al. 2019). Parents also act as facilitators of children's health behaviour by, for example, providing facilities or resources for children to exhibit those behaviours (Hamilton et al. 2019).

The TPB is a flexible model, which is open to the inclusion of additional constructs aiming to increase the proportion of the explained variance and allow for more applicability of this model to predict a wide range of behaviours (Ajzen 1991; Dumitrescu et al. 2011). The WHO global project of adherence to long-term therapies revealed that adopting social cognitive theories such as TPB has elucidated the ways in which patients conceptualize health-threatening conditions and evaluate possible facilitators and barriers towards adherence. However, these theories do not always address behavioural coping skills well (Sabaté 2003). These skills may be effectively evaluated using the concept of Sense of Coherence (SOC), which is the core concept of Salutogenic Model seeking to explain the relationship between coping with life stresses and maintaining health (Antonovsky 1993).

I achieved my research goal by addressing three objectives. I conducted a systematic review to critically analyze the empirical evidence on the association between SOC and oral health behaviours presented in Chapter 2. I examined parents' SOC and their adherence to preventive oral health behaviours for their children in Chapter 3. I then developed and tested the expanded TPB model, by adding SOC, to predict parents' adherence to preventive oral health behaviours in preschool children in Chapter 4. I also established the base for future extention of this research aiming to cross-validate the expanded TPB model to predict adolescents' adherence to orthodontic treatments through a prospective approach. The methods and preliminary results

for this study and the outline of the next steps presented in chapter 5. I expect that the final results of this study will strengthen the authenticity of this dissertation.

In the second chapter, given the importance of SOC in performing healthy behaviours, my systematic review looked to integrate the research findings with evidence on the impact of SOC on important components of oral health-related behaviours. This topic was particularly important because SOC was considered as a potential theoretical framework to study and better understand oral health behaviours. Studies were included if they evaluated the relationship between SOC and oral health behaviours including tooth cleaning, fluoride usage, dietary habits, dental attendance, and smoking. I excluded studies that only assessed the relationship between oral health status and SOC without evaluating oral health behaviours. Thirty-nine potential papers met the preliminary selection criteria and following a full-text review, nine papers were finally selected for this systematic review. Results provided by the included studies indicated different levels of association between SOC and oral health behaviours. The most frequent behaviours investigated were tooth brushing and dental attendance pattern. The impact of SOC on performing positive oral health behaviours, to some extent, was related to demographic and socio-economic factors. Besides, mothers' SOC influenced children's oral health practices. As a concluding remark on this review, I found more favourable oral health behaviours among individuals with a stronger SOC. This finding suggests SOC as a possible determinant of oral health-related behaviours including tooth brushing frequency, daily smoking, dental attendance, and the frequency of sugar intake (Elyasi et al. 2015).

In the third chapter, I explored the association between mothers' sense of coherence (SOC) and their preschool children's oral health-related behaviours. Mothers and their preschool children were recruited during immunization programs at community health centers in

Edmonton, Canada. Participants answered eight questions on socio-demographics (covariates), parents' SOC (main independent variable), and children's oral health-related practices (outcome variables). A total of 378 pairs of mothers/children participated in this study. Children's mean age was 3.92 ± 1.33 years. My results revealed that there was a strong association between mothers' SOC and children's frequency and pattern of dental attendance; however, mothers' SOC was not a predictor of children tooth brushing frequency after adjustment for other confounding factors. Mother's SOC was also a weak predictor of the consumption of sugary snacks or drinks, even though the association was attenuated after adjustment for socio-demographic characteristics. In my study, dental insurance coverage was not associated with frequency and pattern of dental attendance supporting the fact that the existence of available resources, even free of charge, does not necessarily lead to the exhibition of more promising oral health behaviours (Elyasi et al. 2018). The results obtained from the study prepared the grounds to conduct and design the next stage of this research.

In the fourth chapter, I examined the expanded TPB Model by adding the concept of Sense of Coherence (SOC) to predict parental adherence to preschooler's preventive dental visits. Constructs of TPB including parental attitudes, subjective norms (SN), Perceived Behavioural Control (PBC), and intention to attend preventive dental visits for their preschoolers were collected by questionnaire, alongside parents' sense of coherence (SOC). Dental attendance was measured by asking if the child had a regular dental visit during the last year. Structural Equation Modeling (SEM) analyses were carried out to identify significant direct and indirect (mediated) pathways in the extended TPB model. Results of the final model showed that predisposing factors (child's birthplace and mother's birthplace) significantly predicted enabling resources (family monthly income and child's dental insurance status); both predicted the TPB

components (PBC, SN, and attitude). TPB components, in turn, predicted behavioural intention. Parent's SOC significantly predicted TPB components and dental attendance. Overall, 56% of the variance in dental attendance was explained by the expanded TPB model (Elyasi et al. 2020). Contrary to our expectations, mothers' behavioural intention was not linked to their children's dental attendance during the past 12 months. There are some possible reasons for this observation: *(i)* assigning only one item to measure intention; *(ii)* memory bias that might affect the accuracy of mother's self-reported responses on their children's dental attendance; *(iii)* cross-sectional design of this research and lack of time frame between intention and the exhibition of the behaviour. In addition, while developing the TPB model, Azjen defined individual's intention as "motivational factors" that affect behaviour, "*they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, to perform the behaviour*" (Ajzen 1991). However, for some behaviours, the non- motivational determinants such as predisposing and enabling factors as well as their skills and potentials may play a more important role to perform the behaviour; they exemplify individual's actual control over the behaviour (Ajzen 1991). Sheeran et al. revealed a gap while studying the link between intention and behaviour using TPB, suggesting that people who have strong intention to perform a given behaviour may fail to perform the behaviour due to "inclined abstainers" (Sheeran 2002). In my study, it can be suggested that SOC and enabling factors may be considered as "inclined abstainers" that will have some mediating roles in the relationship between intention and the exhibition of actual behaviour that requires further investigation (Sheeran 2002). Besides, there is increased attention to behaviour change interventions that will ensure people's existing good intentions are effectively translated into relevant behaviour change by enhancing capabilities and opportunities (Armitage et al. 2020).

In the oral health domain, TPB and its proposed extended variations explained about 20% to 50% of the variance of oral health-related behaviours among different age groups (Elyasi et al. 2020; Simpriano et al. 2015). My expanded model successfully predicted a higher proportion of variance of 56%. The main contributing factors were enabling resources and SOC. Interestingly, the concept of SOC successfully predicted dental attendance while the TPB component failed to be linked to dental attendance either directly or via intention.

For enabling resources, initially, I collected data for four variables including child's dental insurance status and type of insurance (public or private), mother's level of education, and monthly household income. The results from first-order CFA revealed that only a child's dental insurance and monthly income were associated with more of the enabling resources. In Canada, apart from public and private dental coverage for children, some provinces, including Alberta, have free preventive dental services for children from low-income and disadvantaged families (Amin et al. 2014). Therefore, the lack of awareness about the existence of free preventive dental services for children might potentially affect the exhibition of dental attendance among my studied population. This assumption has been confirmed by the fact that only half of the 378 children participated in this study had utilized dental care services during the last year.

While monthly household income was considered as a significant enabling factor in our study, it has been showing that the capacity of mothers to handle disadvantageous social and economic conditions and their ability to employ applicable resources based on their SOC score were associated with their children's usage of dental services in low-income families (Da Silva et al. 2011). In the study that I have built as the next step to apply my extended TPB model to predict adherence among orthodontic patients, presented in chapter 5, the demographic showed higher socio-economic status of families with more insurance coverage. However, based on the

literature, more than 52% of orthodontic patients did not follow treatment recommendations from their orthodontist leading to compromised treatment outcomes, loss of chair time, patients and practitioners' frustration as well as unsatisfactory oral health status (Bos, Hoogstraten, and Prahl-Andersen 2005). Importantly, lack of adherence resulted in discontinuation of active treatments by 17.6%, which is a health care concern from the perspective of quality of life and health economics (Mobley et al. 2008; Trenouth 2003). Therefore, adopting my extended TPB model will allow/enable us to explore the relationships between variables and outline their contribution to predicting adherence behaviours among orthodontic patients. It is expected that this population have more resources available to exhibit the behaviour that will probably lessen the impact of enabling factors in this model. Therefore, I anticipate a more prominent role for other variables, mainly psychosocial variables.

In addition to enabling resources, the significant link between parents' SOC and their children dental attendance highlighted the important role of parental coping skills to overcome their daily life challenges and take their children for routine dental visits. It has been reported in the literature that parents' difficulties in controlling their routine were found as the primary reason for children's dental appointment absence, even when the service is appropriate and when dental care has no costs for them (Hallberg et al. 2008). In this research, SOC had a prominent influence on dental attendance behaviour while it was not linked to tooth brushing behaviour. This finding could be attributed to the fact that tooth brushing is considered as a personal health practice; however, dental attendance is about using health services that demand more enabling and psychological resources to perform the behaviour. For those behaviours that demand more coping skills, improving SOC in the early stages of life while it is under development may have a significant impact on an individual's life course and well-being (Hamilton et al. 2019). For

instance, an intervention has been developed in a cluster-randomized trial to enhance an individual's SOC through a school-based oral health promotion approach. Participants were engaged in classroom activities held by trained teachers. These activities included healthy school programs with brainstorming, planning, implementation and evaluation. Children received intervention displayed superior oral health beliefs, gingival health, and oral health-related quality of life (Nammontri et al. 2013). This intervention was also successfully implemented among socially vulnerable Brazilian children confirming the fact that improving SOC will enhance oral health related quality of life regardless of socio-economic barriers (Tomazoni et al. 2019).

In my expanded TPB model, 34% and 56% of the variance was accounted for behavioural intention and dental attendance variables, respectively. Among the predictors of intention, PBC was the strongest predictor accounted for 31% of variance to predict it. There are a few studies applied the extended modifications of the TPB model to predict a range of Oral Health Behaviours (OHB). In the study done by Buunk et al., the components of the TPB model and oral health knowledge explained 32.3% of the variance of oral hygiene behaviours including tooth brushing, flossing, and tongue cleaning among Dutch adults (Buunk-Werkhoven, Dijkstra, et al. 2011). PBC was also the best predictor of OHB, which was in accordance with the results of a meta-analysis reporting PBC as the strongest predictor of health behaviour in the TPB model (Armitage and Conner 2001). Among adolescents, Pakpour et al. tested the extended TPB model by adding action and coping planning suggesting that these two factors may help to overcome the barriers towards implementation of behavioural intention; they concluded that the expanded model accounted for 51% of the variance for tooth-brushing behaviour. Similar to our study, they reported that perceived behavioural control was the strongest predictor of TPB in their model (Pakpour et al. 2012). Dumitrescu et al. tested another extension of the TPB model, by adding

oral health knowledge, among young adults and concluded that participants' attitude, PBC, and oral health knowledge predicted 51.5% of the variance to predict behavioural intention to improve tooth brushing, flossing, and dental attendance behaviours (Dumitrescu et al. 2011). However, they reported that knowledge was linked to an attitude in such a way that increased knowledge led to stronger attitude, which was more stable and resistant to change (Dumitrescu et al. 2011). In a longitudinal study using an extended version of TPB model, adult participants' attitudes, subjective norms, PBC were significant predictors of intention. In contrast, participant's intention, self-efficacy and past dental attendance were significant predictors of actual dental attendance (Luzzi and Spencer 2008). In this prospective cohort study, authors proposed "past dental attendance" as a potential predictor of individual's intention and future behaviour and hypothesized that the inclusion of experience significantly contributed to the prediction of behavioural intention; they concluded that past behaviour predicted intention beyond TPB components. Their proposed model was able to explain 22.5% of the variance in dental attendance (Luzzi and Spencer 2008). Overall, comparing the results from this PhD dissertation with the findings of previous similar studies revealed the superior performance of my expanded TPB model in predicting behavioural intention and actual intention.

6.2 Limitations

My research had some limitations. First, my findings relied on mothers' self-reporting of their children's oral health-related behaviours, which could be a subject to social desirability and recall biases. However, in most cases, parents' reports of their children's oral health-related behaviours have been verified by clinical examination (Hallberg et al. 2008; Da Silva et al. 2011). Second, the inherent investigative limitations in the cross-sectional design of this study

and lack of time frame between collecting data and exhibition of the actual behaviour, make inferences about causal relationships between variables impossible (Levin 2006). Future studies with a longitudinal approach are required to cross-validate my proposed model. Third, this study's participants were mothers who presented their children for immunization. Based on the available data, the vaccination rate in Edmonton in 2015 was approximately 90 %. Nonetheless, it is recommended to include mothers who refuse immunizations for their children, as they may have different views about taking their children to receive preventive care services, such as regular dental check-ups. Fourth, I only had one item adopted to measure intention; therefore, having more items to assess this construct in the future studies may enhance the internal validity of the questionnaire and reduce measurement errors. Finally, the external validity of the extended TPB model needs to be investigated in other population groups and for other oral health-related behaviours in future studies.

6.3 Conclusions

The conclusions drawn from the results of the present dissertation were as follows:

1. Mothers' SOC plays an important role in parent-for-child oral health behaviours, particularly their frequency and pattern of their dental attendance; mothers with stronger SOC were more likely to take their children to visit the dentist, mainly for regular dental check-ups.
2. In my expanded TPB model, both predisposing factors and enabling resources predicted the TPB components including attitude, subjective norms, and PBC.
3. TPB components successfully predicted behavioural intention; however, nor intention neither PBC significantly predicted dental attendance.

4. Enabling resources such as income and dental insurance were directly associated with dental attendance among preschoolers.
5. SOC was directly linked to TPB components and dental attendance while indirectly related to behavioural intention through the TPB components.
6. Overall, 56% of the variance in dental attendance was explained by the expanded TPB model which was relatively superior to the other studies applied TPB in oral health domain.
7. PBC was identified as the strongest predictor of predicting behavioural intention in my extended TPB model.

6.4 Avenues for future research

The findings of this dissertation will provide insight into a theoretical approach to predict children's adherence to oral health behaviours by outlining the psychosocial determinants of those behaviours. Future research recommendations include:

- Performing SEM analysis to test and cross-validate my expanded version of TPB to predict adherence among orthodontic patients. This study is the first study adopting the TPB, SOC, and on top of that, an expanded version of this theory in the field of orthodontics;
- Construction and psychometric evaluation of a survey that will be used as a valid and reliable screening tool for non-adherence among pediatric and orthodontic patients;
- Adding moderators that can serve as an additional predictor of behaviour by mediating the intention-behaviour relationship;
- Including participants' oral health status (dmf/DMF, plaque and gingival indices, etc.) in my expanded TPB model as ultimate outcomes;

- The cross-validation of my results needs recruitment of participants from other countries since the utilization of services may be affected by system structure and dental health policies. My extended TPB model may also perform differently in other socio-cultural frameworks;
- My proposed theoretical model can be applied as a prior framework to guide policy makers and health promotion specialists to design effective behaviour change interventions aiming to reduce the incidence of adverse oral health outcomes among children; and
- Adopting this theory-based model to measure treatment adherence in the case of other pediatric chronic health conditions, such as diabetes and asthma.

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Appendix 1: Ethics Approval

Notification of Approval

Date:	April 28, 2014	
Study ID:	Pro00047287	
Principal Investigator:	Maryam Sharifzadeh-Amin	
Study Title:	**Relationship between preschool children's oral health-related behaviors and their parents' or caregivers' sense of coherence**	
Approval Expiry Date:	April 22, 2016	
Approved Consent Form:	Approval Date 24/04/2014	Approved Document Maternal Consent Form.doc

Thank you for submitting the above study to the Research Ethics Board 1. Your application has been reviewed and approved on behalf of the committee.

A renewal report must be submitted next year prior to the expiry of this approval if your study still requires ethics approval. If you do not renew on or before the renewal expiry date, you will have to re-submit an ethics application.

Approval by the Research Ethics Board does not encompass authorization to access the staff, students, facilities or resources of local institutions for the purposes of the research.

Sincerely,

William Dunn, PhD

Chair, Research Ethics Board 1

Note: This correspondence includes an electronic signature (validation and approval via an online system).

Appendix 2: Ethics Approval

Approval Form

Date:	August 2, 2017
Study ID:	Pro00074659
Principal Investigator:	Maryam Sharifzadeh-Amin
Study Title:	Developing and Testing a Theoretical Model to Determine Children's Adherence to Orthodontic treatments
Approval Expiry Date:	Wednesday, August 1, 2018
Approved Consent Form:	Approval Date: 8/2/2017 — Approved Document: Informed consent. Revised
Sponsor/Funding Agency:	American Association of Orthodontists Foundation

RSO-Managed Funding:

	Project ID	Project Title	Speed Code	Other Information
View	RES0034650	Developing and Testing a Model to Determine Adolescents' Adherence to Orthodontic treatments		

Thank you for submitting the above study to the Health Research Ethics Board - Health Panel. Your application, including the following, has been reviewed and approved on behalf of the committee;

- Letter of Information Revised ((8/2/2017)
- Assent Revised (7/19/2017)
- Research Proposal (7/19/2017)
- Questionnaire - Child (6/28/2017)
- Questionnaire - Parents (6/28/2017)
- Appendix I - Data Collection Sheet for Medical Records (7/19/2017)

The Health Research Ethics Board assessed all matters required by section 50(1)(a) of the Health Information Act. Subject consent for access to identifiable health information is required for the research described in the ethics application, and appropriate procedures for such consent have been approved by the HREB Health Panel. In order to comply with the Health Information Act, a copy of the approval form is being sent to the Office of the Information and Privacy Commissioner.

A renewal report must be submitted next year prior to the expiry of this approval if your study still requires ethics approval. If you do not renew on or before the renewal expiry date (Wednesday, August 1, 2018), you will have to re-submit an ethics application.

Approval by the Health Research Ethics Board does not encompass authorization to access the patients, staff or resources of Alberta Health Services or other local health care institutions for the purposes of the research. Enquiries

Appendix 3: Demographic Questionnaire-Parents of preschoolers

Participant ID: _____ Health center: _____

1. Child's date of birth:_____/_____/_____ mm / dd / yyyy

2. Gender: ☐ Boy ☐ Girl

3. Your date of birth:_____/_____/_____ mm / dd / yyyy

4. How many child(ren) is/are in your care? ☐ One ☐ Two ☐ Three ☐ Four or more

5. Was your child born in Canada? ☐No ☐Yes

6. What is your level of education?

☐ Grade 9 & under ☐ High school ☐ College or Trade ☐ University degree

7. Is your child living with? ☐ Both parents ☐ Single parent ☐ Other

8. What is your household income level per month?

☐ under $999 ☐ $1,000-$1,999 ☐ $2,000-$2,999 ☐ $3,000-$3,999 ☐ $4,000-$4,999 ☐ over $5,000

9. Does your child have a dental coverage? ☐No ☐Yes

If you answered "Yes", is it

☐ Private (employment benefit plan) ☐ Private (self-employed plan) ☐ Public

Appendix 4: Oral Health Behaviours Questionnaire

Participant ID: _____ Health center: _____

1. How many times a day are your child‘s teeth cleaned?

☐ Less than once a day ☐ Once ☐ Twice ☐ More than twice

2. How often does your child consume foods, drinks or snacks high in sugar?

☐ never ☐ less often than everyday ☐ once a day ☐ twice day

☐ three times a day or more often

3. When was your child’s last dental visit?

☐ within the last 12 months ☐ over one year ☐ never had one

4. If your child has visited a dentist, what was (were) the reason(s)? (check all that apply)

☐ Regular check-up ☐ Non-urgent dental problems ☐ Urgent dental problems
☐ Others (please specify) _____

Appendix 5: Sense of Coherence Questionnaire

Participant ID: _____ Health center: _____

Here is a series of questions relating to various aspects of our lives. Each question has 7 possible answers. Please, mark the number which expresses your answer, with numbers 1 and 7 being the extreme answers. If the words close to "1" are right for you, circle "1". If the words close to "7" are right for you, circle "7". If you feel different, circle the number which best expresses your feeling. Please, give only one answer to each question

1. Do you have the feeling that you don't really care about what goes on around you?	Very seldom or never	1	2	3	4	5	6	7	Very often
2. Has it happened in the past that you were surprised by the behaviour of people whom you thought you knew well?	Never happened	1	2	3	4	5	6	7	Always happened
3. Has it happened that people whom you counted on disappointed you?	Never happened	1	2	3	4	5	6	7	Always happened
4. Until now, your life has had:	No clear goals or purpose at all	1	2	3	4	5	6	7	Very clear goals and purpose
5. Do you have the feeling that you're being treated unfairly?	Very often	1	2	3	4	5	6	7	Very seldom or never
6. Do you have the feeling that you are in an unfamiliar situation and don't know what to do?	Very often	1	2	3	4	5	6	7	Very seldom or never
7. Doing the things you do every day is:	A source of deep pleasure and satisfaction	1	2	3	4	5	6	7	A source of pain and boredom
8. Do you have very mixed-up feelings and ideas?	Very often	1	2	3	4	5	6	7	Very seldom or never
9. Does it happen that you have feelings inside you would rather not feel?	Very often	1	2	3	4	5	6	7	Very seldom or never
10. Many people - even those with a stronger character – sometimes feel like sad sacks (losers) in certain situations. How often have you felt this way in the past?	Never	1	2	3	4	5	6	7	Very often
11. When something happened, have you generally found that:	You overestimated or underestimated its importance	1	2	3	4	5	6	7	You saw things in the right proportion

12. How often do you have the feeling that there's little meaning in the things you do in your daily life?	Very often	1	2	3	4	5	6	7	Very seldom or never
13. How often do you have feelings that you're not sure you can keep under control?	Very often	1	2	3	4	5	6	7	Very seldom or never

Appendix 6: Theory of Planned Behaviour Questionnaire-

Preschoolers Dental attendance

Participant ID: _____ Health center: _____

How much do you agree or disagree with the following ideas?									
1. I don't see myself taking my child to the dentist.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
2. We manage to take our child to the dentist twice a year.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
3. I think of making an appointment with the dentist in time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
4. We don't have time to take our child to the dentist.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
5. I think I am able to positively prepare my child for a visit to the dentist.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
6. When it comes to visiting the dentist, my family doctor or pediatrician or health care provider's opinion is important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
7. My spouse finds it important that we take our child at an early age to the dentist for a checkup.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
8. In our family it's normal to take our child already at an early age to the dentist.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
9. Most of my friends take their children at an early age to the dentist for a checkup.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
10. It's important for our family doctor or pediatrician or health care provider that we take our child at an early age to the dentist.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
11. When it comes to visiting the dentist, my parent's opinion is important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
12. In infant class they already pay attention to visiting the dentist at an early age.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
13. It's important for my parents that we take our child at an early age to the dentist for a checkup.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
14. When it comes to visiting the dentist, my partner's opinion is important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
15. The risk of dental decay decreases when you regularly take your child to the dentist for a checkup.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
16. Going for a checkup at the dentist is a traumatic experience for a child.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
17. Taking my child to the dentist is unpleasant.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
18. Taking my child regularly to the dentist for a check-up is reassuring.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
19. Visiting the dentist for my child is expensive.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

20. Regularly visits to the dentist help my child's teeth to stay sound and healthy for a longer time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
21. For a child, a visit to the dentist is not terrible at all.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
22. Regularly taking your child to the dentist for a checkup makes your child not afraid of the dentist.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
23. We intent to take our child twice a year to the dentist for a checkup	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
24. Sugary food is damaging for the teeth	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

Appendix 7: Demographic Questionnaire - Orthodontic patients

Participant ID: _____ Health center: _____

1. Your date of birth:_____/_____/_____ mm / dd / yyyy
2. Gender: ☐ Boy ☐ Girl
3. 2. Do you have any sibling who had orthodontic treatment before? ☐**No** ☐**Yes**
4. How many times a day do you clean your teeth?

☐ Less than once ☐ Once ☐ Twice or more

Appendix 8: Demographic Questionnaire – Parents of orthodontic patients

Participant ID: _____ Health center: _____

1. Your date of birth:_____/_____/_____ mm / dd / yyyy

2. Your relationship to your child:

☐ Mother ☐ Father ☐ Other (please specify) .....

3. Your child's date of birth:____/_____/_____ mm / dd / yyyy Your child's gender: ☐ Boy ☐ Girl

4. Do you have any child who had orthodontic treatment before? ☐No ☐Yes

5. What is your household income level per month? (without tax deduction)

☐ under $999 ☐ $1,000-$1,999 ☐ $2,000-$2,999 ☐ $3,000-$3,999 ☐ $4,000-$4,999

☐ over $5,000

6. What is your level of education?

☐Secondary school or less graduation ☐ Some postsecondary or college degree ☐ Post-secondary degree

Appendix 9: Theory of Planned Behaviour Questionnaire - Orthodontic patients

How much do you agree or disagree with the following ideas?									
Tooth Brushing									
Brushing my teeth at least twice per day during orthodontic treatment is important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Brushing my teeth at least twice per day during orthodontic treatment will prevent my teeth from developing cavities.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Brushing my teeth at least twice per day during orthodontic treatment will prevent gum infection.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Brushing at least twice per day is needed during orthodontic treatment	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It is beneficial for me to brush my teeth twice daily while having braces on	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
People who are important to me would be disappointed if I do not brush my teeth at least twice a day during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Most people who are important to me believe that I should brush my teeth twice daily during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to brush my teeth at least twice daily during orthodontic treatment, the opinion of significant others in my life* is very important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to brush my teeth at least twice daily during orthodontic treatment, my dentist's opinion is very important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to brush my teeth at least twice daily during orthodontic treatment, my orthodontist's opinion is very important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I am confident that I can brush my teeth at least twice daily.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It is difficult for me to brush my teeth at least twice a day during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I can manage my time to brush my teeth twice a day during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I think I am able to brush my teeth at least twice a day during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I don't have time to brush my teeth twice a day during the orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I intend to brush my teeth at least twice per day during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Appointment Attendance									
It is important to attend all required orthodontic appointments on time to have									

successful treatment outcomes such as beautiful smile and straight teeth.									
Attending all required orthodontic appointments on time will result in completion of my orthodontic treatment at the expected time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It is important to attend all required orthodontic appointments on time to prevent dental cavities caused by having braces for a long period.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It causes a lot of worry and concern for me to attend all required orthodontist appointments on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Attending all required orthodontic appointments is annoying for me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Most people who are important to me think that I should attend all required orthodontic appointments on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
People who are important to me may feel disappointed if I fail to attend all required orthodontic appointments on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to attending all required orthodontic appointments on time, the opinion of significant others in my life* is important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to attending all required orthodontic appointments on time, my dentist's opinion is important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to attending all required orthodontic appointments on time, my orthodontist's opinion is important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I am confident that I can attend all required orthodontist appointments on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It is difficult for me to make all required appointments with my orthodontist on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I can manage my time to attend all required appointments with my orthodontist on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
My schedule does not allow me to make all required appointments with my orthodontist on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Making sure that I will attend all required appointments to orthodontist on time is beyond my abilities.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I intend to attend all required orthodontist appointments on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Appliance Maintenance									
It is important for me to follow all the recommendations** made by my orthodontist to prevent the breakage of my braces.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
If I follow all the recommendations made by my orthodontist, the results of my orthodontic treatment will be successful.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Following all the recommendations made by my orthodontist helps to finish my treatment on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

Following all the recommendations made by my orthodontist prevents having emergency appointments.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
If I follow all the recommendations made by my orthodontist, I will not be in pain caused by damaged braces	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Most people who are important to me think that I should follow all the recommendations made by my orthodontist to prevent the breakage of the braces	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
People who are important to me may feel disappointed if I do not follow all the recommendations made by my orthodontist to prevent the breakage of the braces.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to follow all the recommendations made by my orthodontist, the opinion of significant others in my life* is very important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to follow all the recommendations made by my orthodontist, my dentist opinion is very important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to follow all the recommendations made by my orthodontist, my orthodontist's opinion is very important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I am confident that I can protect my braces from breakage during orthodontic treatment	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It is difficult for me to protect my braces from breakage during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I can control my diet and oral habits to prevent damaged braces during the orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I cannot see myself protecting my braces from the breakage during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It causes a lot of worry and concern to protect my braces from breakage during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I intend to protect my braces from breakage during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
*significant others include your parents, grand parents, friends, or anyone that has a significant role in your life. **instructions include controlling your diet and oral habits, and avoiding any trauma to the jaws and teeth as explained by your orthodontist during consultation appointment.									

Appendix 10: Theory of Planned Behaviour Questionnaire – Parents of orthodontic patients

How much do you agree or disagree with the following ideas?									
Tooth Brushing									
Making sure that my child brushes her/his teeth at least twice per day during orthodontic treatment is important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Making sure that my child brushes her/his teeth at least twice per day during orthodontic treatment will prevent him/her from developing cavities.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Making sure that my child brushes her/his teeth at least twice per day during orthodontic treatment will prevent him/her from gum infection.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Brushing at least twice per day is needed during orthodontic treatment for my child.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
The risk of dental cavities during the orthodontic treatment declines when my child brushes his/her teeth at least twice daily.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
People who are important to me would be disappointed if I fail to support my child in brushing his/her teeth at least twice a day during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Most people who are important to me believe that I should make sure that my child brushes her/his teeth twice daily during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to manage my child brushing his/her teeth at least twice daily during orthodontic treatment, the opinion of significant others in my life is very important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to manage my child brushing his/her teeth at least twice daily during orthodontic treatment, our dentist/dental hygienist's opinion is very important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to manage my child brushes his/her teeth at least twice daily during orthodontic treatment, our orthodontist's opinion is very important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

I am confident that I can make sure my child brushes his/her teeth at least twice daily.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It is difficult for me to make sure my child brushes her/his teeth at least twice a day during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I think I am able to help my child brushes his/her teeth at least twice a day during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I do not have time to make sure that my child brushes his/her teeth twice a day during the orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Making sure that my child brushes her/his teeth twice a day during orthodontic treatment is beyond my abilities/control.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I intend to make sure that my child's teeth are brushed at least twice per day during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Appointment Attendance									
It is important to attend all required orthodontic appointments on time to have successful treatment outcomes such as beautiful smile and straight teeth.									
Attending all required orthodontic appointments on time will result in completion of my child's treatment at the expected time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It is important to attend all required orthodontic appointments on time to prevent dental cavities caused by having braces for a long period.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Attending all required orthodontic appointments on time is beneficial for my child.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It causes a lot of worry and concern for me to take my child to all required orthodontist appointments on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Most people who are important to me think that my child should attend all required orthodontic appointments on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
People who are important to me may feel disappointed if my child fail to attend all required orthodontic appointments on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to attending all required orthodontic appointments for my child on time, the opinion of significant others in my life is important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to attend all required orthodontic appointments for my child on time, our dentist/dental hygienist's opinion is important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

When it comes to attend all required orthodontic appointments for my child on time, our orthodontist's opinion is important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I am confident that I can take my child to all required orthodontist appointments on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I will manage my time to make sure that my child attend all required orthodontic appointments on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It is difficult for me to make all required appointments with my child's orthodontist on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I can manage my work/duties to make all required appointment for my child's orthodontist on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
My schedule does not allow me to make all required appointments with my child's orthodontist on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I intend to take my child to all required orthodontist appointments on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Appliance Maintenance									
It is important for me to make sure my child follows all the recommendations* made by her/his orthodontist to prevent the breakage of the braces.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
If I support my child, follow all the recommendations made by the orthodontist, the results of his/her orthodontic treatment will be successful.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Making sure my child follows all the recommendations made by her/his orthodontist helps to finish the treatment on time.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Following all the recommendations made by the orthodontist prevents having emergency appointments for my child.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
If I support my child follow all the recommendations made by her/his orthodontist, she/he will not be in pain caused by damaged braces.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Most people who are important to me think that I should support my child in preventing the breakage of her/his braces during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
People who are important to me may feel disappointed if I do not support my child in preventing the breakage of her/his braces during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to support my child in preventing the breakage of her/his braces, the opinion of significant others in my life is very important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
When it comes to support my child in preventing the breakage of her/his braces, our	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

dentist/dental hygienist's opinion is very important to me.									
When it comes to support my child in preventing the breakage of her/his braces, our orthodontist's opinion is very important to me.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I am confident that I can support my child to protect her/his braces from breakage during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
It is difficult for me to support my child to protect her/his braces from breakage during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I can control my child's diet and oral habits to prevent damaged braces during the orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I cannot see myself supporting my child to protect her/his braces from the breakage during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I do not have enough time to control my child's diet and oral habits during the orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
I intend to support my child in preventing the breakage of her/his braces during orthodontic treatment.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
*****_instructions include controlling your child's diet and oral habits, and avoiding any trauma to the jaws and teeth as explained by your orthodontist during consultation appointment._									