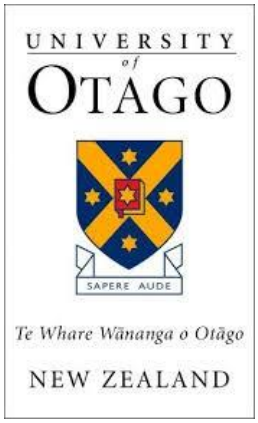

Factors affecting children's oral care practices during the first 2 years of life

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Abstract

1. Background

The main purpose of oral care practices for young children is to prevent dental caries. Oral care practices have 2 components: home care and professional dental care. Home oral care practice involves toothbrushing, which mechanically removes dental plaque and, more importantly, acts as a vehicle to bring the fluoride in the toothpaste to come into contact with the surfaces of the teeth. Fluoride promotes remineralisation of the tooth surface and acts as a key protective factor in the dynamic process of dental caries. Professional dental care involves visiting an oral health professional to seek preventive advice and care. A person who visits an oral health professional regularly tends to have better oral health in the longer term than an irregular (problem-oriented) dental visitor. Hence, by removing dental plaque (the causal agent) and introducing fluoride (the protective agent), children's oral care practices play a direct role (as a biomedical factor) in the prevention of dental caries. However, oral care practices are influenced by factors that are socioeconomic, environmental, cultural or political. Although these factors can be associated with the experience of dental caries, they are not direct causal agents and need to be mediated by direct factors (such as biomedical factors) to have an impact. The mechanism of these associations remains largely unknown and pathway models have been developed trying to explain the interplay of these factors.

2. Aim of study

This study examines some of the factors that affect the oral care practices in the first 2 years of an Australian child's life. The factors are the mothers' sociodemographic characteristics; oral care practices, oral health status, and psychosocial influences.

3. Methods

A secondary analysis of the data from the Study of Mother's and Infant's Life Events Affecting Oral Health (SMILE) project was carried out to examine the effects of those factors on children's oral care practices. Descriptive statistics and bivariate analysis were performed, and a multivariate modelling was undertaken with Poisson regression to control for possible confounders and mediators.

4. Findings

Mothers' oral care toothbrushing pattern and oral health fatalism were found to be associated with children's toothbrushing frequency. For the children's visiting to an oral health professional for check-ups, family size was the only predictor. Mothers born in India appeared to have the most unfavorable oral care practices and oral health. Fewer than half of the mothers considered drinking fluoridated water important. The longitudinal design of this study also showed that mothers' oral care practices and oral health deteriorated towards the end of the 24-month study.

5. Conclusion

The strong association between favourable mothers' oral care toothbrushing pattern and favourable children toothbrushing frequency implies that the provision of oral health interventions during the critical period of pregnancy needs to focus on both maternal and child oral care practices instead of solely on the latter. The deterioration of mothers' oral care practices and oral health during the period between childbirth and 24 months could suggest that the post-partum period could be stressful for the mothers. Further studies are needed to explore the association between favourable mothers' oral care toothbrushing pattern and favourable children toothbrushing frequency, and if this association is well established, it could determine the most effective approach for oral health education with the mothers of young children.

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List of Abbreviations

ARCPOH	Australian Research Centre for Population Oral Health
ADA	American Dental Association
BMI	Body Mass Index
COHQOL	Child Oral Health-related Quality of Life Questionnaire
DMFT	Delayed, missing, filled teeth
DMHDS	Dunedin Multidisciplinary Health and Development Study
ECC	Early Childhood Caries
GA	General anaesthesia
KCOH	Knowledge of Children's Oral Hygiene
OHF	Oral health fatalism
OHRQoL	Oral health related quality of life
OHSE	Oral health related self-efficacy
S-ECC	Severe early childhood caries
SMILE	Study of Mother's and Infant's Life Events Affecting Oral Health
WHO	World Health Organization

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1. Introduction

The maintenance of oral hygiene has been an objective of man since the dawn of civilisation. Oral care practices have evolved from self-care using only oral care devices to seeking dental care provided by specially trained oral health care workers when a country developed, resulting in a higher demand for oral health. Twice-daily brushing with fluoride toothpaste is now a widely recommended daily hygiene procedure (Van der Weijden and Hioe, 2005). In addition, numerous national oral health authorities recommend regular preventive visits to a oral health professional (Riley et al. 2013). According to data collected by the Australian Research Centre for Population Oral Health (ARCPOH) in 2012 to 2014, about 50% of children age 2 to 3 years in Australia brushed their teeth twice daily with fluoride toothpaste (Do and Spencer, 2016). For those who visited a dental health professional for the first visit, 86.7% of them went for a check-up. These oral care practices, especially the widespread usage of fluoride toothpaste, have contributed to a marked reduction in dental caries experience over the last 50 years (O'Mullane et al, 2016).

Even though the prevalence of dental caries has reduced, it remains the most common chronic oral disease in young children. Dental caries is a theoretically preventable disease because the disease process at the individual level is well understood (Featherstone, 2008). The caries process consists of a dynamic continuum of numerous demineralisation and remineralisation cycles occurring on the tooth surface that is determined by the physiological balance of pathological and protective factors. Protective factors (such as the use of fluoride and having clean teeth surfaces achieved by effective toothbrushing) can be promoted by good oral care practices. The brushing of teeth itself cleans the teeth surfaces, and when fluoride toothpaste is used, the remineralisation process is accelerated.

Despite numerous programs to increase awareness of the benefits of toothbrushing with fluoride toothpaste and regular preventive dental visits to control dental caries in young children, there are still many who do not adopt favourable oral care practices. Furthermore, some considered fluoride harmful and advocate against any fluoride usage, resulting in a resurgence of toothbrushing with non-fluoride toothpaste (Connett, 2004). Hence, dental caries cannot be totally preventable at the individual level and

much less at a population level. Caries remains a problem and continues to affect the individual and community and places a burden on health care systems (Bagramian et al, 2009).

Toothbrushing and preventive dental visits are factors at the individual level affecting the development of oral diseases (Fisher-Owens et al, 2007). These factors at the individual level can be influenced by factors operating at the family and community levels; these factors can be psychosocial, socioeconomic, environmental, cultural and political. Using an individual-level intervention without addressing the factors at the family or community levels is insufficient to eradicate an oral health problem.

Most studies reporting on oral care practices and the multi-level factors affecting the development of oral diseases of young children below the age of 5 have been cross-sectional in design (Leong et al, 2013). Analysis of the data collected from the Study of Mother's and Infant's Life Events Affecting Oral Health (SMILE) project, a longitudinal birth cohort study conducted in Adelaide, South Australia will allow examination of the changes in the pattern of oral care practices of young children in the first 2 years of life, and the factors that influence them.

2. Literature Review

For young children, the main purpose of oral care practices is to prevent dental caries. The 2 components of oral care practices at the individual level, home care and professional dental care, will be discussed in this study. The public health aspect of oral care practices, (such as oral care education and oral health screening at the population level), are beyond the scope of the current investigation and so not considered here. In this study, home oral care practice involves the mechanical cleaning of teeth to remove dental plaque by toothbrushing with fluoride toothpaste (correct amount according to age). Professional dental care discussed in this study involves visiting an oral health professional to seek preventive care. It consists of regular visits to an oral health professional for preventive procedures such as oral hygiene instructions, prophylaxis and if appropriate, the application of fluoride dental materials to prevent dental caries. Visiting an oral health professional due to a dental problem or pain is not considered as preventive care, and hence, it is not considered to be the professional dental care described in this study.

In this section, the significance and influence of oral care practices in the prevention of dental caries are discussed. Oral care practices can be influenced by non-biomedical factors, and these factors are examined.

2.1 Oral care practices

The 2 components of oral care practices and the oral care practices of Australian children are discussed.

2.1.1 Oral care devices

Natural physiological forces cannot adequately remove dental plaque and clean the oral cavity (Van der Weijden and Slot, 2011). The contact of the tongue on tooth surfaces, the cheek covering the buccal aspects of posterior maxillary teeth and the saliva flow may help to control plaque build-up but is inefficient and provides no cleaning of the dentition. The deficiency of natural physiological forces in maintaining oral health has long been recognised, and this awareness has led to the usage of oral care devices such as toothbrushes.

Oral care was practised for a very long time with devices for teeth cleansing manufactured from both plant and animal sources (Sammons, 2003). Chew sticks, made from twigs, were used in ancient Mesopotamia, Egypt, and China. An example of a chew stick currently in use is the Miswak. Miswak is used mainly in the Islamic world and is known to have antiseptic and antibacterial properties (Niazi et al, 2016). Even in non-Islamic countries such as New Zealand, the Muslim immigrants use them (Alayan et al, 2017).

Not only oral care devices were made from plant products, animal bristles were also used. The Chinese probably first invented the bristle toothbrush that resembles the current modern one (Hyson, 2003). During the Tang dynasty, about 1500 years ago, toothbrushes were devices consisting of hog bristles attached to handles made from bamboo or bone. Chinese hog bristle brushes were brought to Europe and adopted as teeth cleansing devices in the 17th century. French dentists, who were the most advanced during that time, advocated their usage. These hog bristle brushes were imported into Europe until the mid-20th century.

The nylon bristles in the modern toothbrush were introduced in 1938. The modern nylon bristle toothbrushes are considerably less expensive and easier to manufacture than the animal bristle ones, and they are being mass-produced (Baruah et al, 2017). Their affordability has resulted in toothbrushing being widely practised in the industrialised part of the world. Thus, cleaning the teeth with a toothbrush is commonly undertaken at home and has become an essential oral care practice. For example, the 2009 New Zealand Oral Health Survey reported that 93.0% of children between 2 to 17 of age brushed their teeth daily, with 63.5% doing it at least twice a day (Ministry of Health, 2010).

2.1.2 Toothbrushing as a home oral care practice

Toothbrushing is one of the most commonly described oral self-care practices. The main aim of toothbrushing is to clean the tooth surfaces and remove dental plaque. Dental plaque is a biofilm made up of a diverse community of microorganisms found on a tooth surface embedded in a matrix of polymers (Socransky and Haffajee, 2002; Cugini et al, 2019). It is the aetiological agent responsible for the 2 most common dental diseases, dental caries and periodontal disease (Marsh, 2006).

There is substantial evidence to show that toothbrushing and other mechanical cleansing procedures when they are performed effectively and at appropriate intervals, can control dental plaque (Van der Weijden and Slot, 2015; Figuero et al, 2017). Toothbrushing was established as an effective method in the control of plaque more than 50 years ago. Löe et al demonstrated in a clinical trial that the withdrawal of toothbrushing in 12 persons with healthy gingiva and good oral care practices resulted in plaque build-up, causing marginal gingivitis within 10 to 21 days (Löe et al, 1965). Subsequently, when toothbrushing restarted, gingival health was re-established within one week.

The effect of toothbrushing frequency on plaque removal and gingiva health is clear. Numerous studies have consistently reported the positive impact of frequent toothbrushing on gingival condition (Cancro and Fischman, 1995; Van der Weijden and Slot, 2015). For example, Lang et al, who conducted a study on the frequency of toothbrushing and dental plaque growth in dental students, reported that those who brushed once or twice daily managed to maintain the baseline plaque scores throughout the 6 weeks duration of the study while those who brushed only once in 3 or 4 days developed generalised gingivitis in 3 to 4 weeks (Lang et al, 1973).

Although the frequency of toothbrushing is a major influence on gingival health and the control of dental caries, other factors (such as brushing technique, brushing duration, type of toothbrushes, toothbrushing skill and individual motivation) could affect the efficacy of toothbrushing. In a systematic review, Attin and Hornecker determined that meticulous toothbrushing once daily was sufficient to maintain oral health even though brushing twice daily was the generally recommended frequency (Attin and Hornecker, 2005). The findings of that review implied that someone's technique, motivation and skill all could affect the efficacy of toothbrushing.

The duration of toothbrushing could also affect the amount of dental plaque removed. Gallagher et al conducted a cross-over randomised controlled study in Cincinnati (USA) and found that plaque removal increased with brushing time and that the widely recommended 2 minutes of brushing time removed 26% more plaque than 45 seconds of brushing time (Gallagher et al, 2009). In a literature review, Cancro and Fischman reported that, generally, adults spent a longer time brushing their teeth than children and that there was hardly any improvement when children brushed their teeth beyond

one minute (Cancro and Fischman, 1995). The possibility of the children's shortened brushing time could result in insufficient plaque removal and this is one of the reasons for the recommendation of supervised toothbrushing (Dos Santos et al, 2018).

Although toothbrushing frequency is strongly associated with plaque removal and periodontal health, the evidence for toothbrushing *per se* (without fluoride toothpaste) controlling dental caries is not as convincing (Tinanoff, 2017). Kumar et al, in their systematic review and meta-analysis of case-control, cohort and randomised control trial studies, reported that infrequent toothbrushers of all ages had a greater risk of developing dental caries than those who brushed frequently, and that the difference was greater for the deciduous dentition than the permanent one (Kumar et al, 2016a). However, almost all of the studies that were reviewed did not state whether toothbrushing was carried out with or without fluoride toothpaste. Therefore, it was not possible to ascertain whether the positive effect on caries prevention was due to toothbrushing or the effect of fluoride. In a systemic review of the development of dental caries in children aged 6 years and below, Hooley et al also documented that not all studies were able to show the association between toothbrushing and caries experience, albeit with many of the studies were cross-sectional in design (Hooley et al, 2012). Nonetheless, assuming that toothbrushing is often carried out with fluoride toothpaste, it can be concluded that toothbrushing with fluoride toothpaste is likely to be associated with lower dental caries rates.

2.1.3 Usage of fluoride in the prevention of dental caries

The frequency of toothbrushing with fluoride toothpaste is crucial in dental caries prevention because the toothbrush acts as a vehicle to bring the fluoride in the toothpaste to come into contact with the surfaces of the teeth. The fluoride could be effective even where unsatisfactory brushing technique was employed (Chestnutt et al, 1998).

The benefits of fluoride in preventing tooth decay are well established (Marinho et al, 2003; Walsh et al, 2019). Since fluoride was introduced more than 50 years ago, the widespread use of fluoride toothpaste had resulted in a marked reduction of dental caries incidence. Water fluoridation, regular toothbrushing with fluoride toothpaste, and the use of fluoride mouth rinses could significantly reduce dental caries experience

in children and adults. Fluoride promotes remineralisation and acts as a key protective factor in the dynamic process of dental caries (Featherstone, 2008). The brushing of teeth itself cleans the teeth surfaces, removes plaque and, when fluoride toothpaste is used, the remineralisation process is accelerated.

On the other hand, free sugars in the form of sucrose are major pathological factors in the caries process (Sheiham and James, 2015). Free sugars act as substrates for oral bacteria, and the organic acids produced by the metabolism of the sugars cause demineralisation of the tooth structure. Other causal factors (such as oral microorganisms, acids, salivary flow, differential properties of the teeth, and frequency of sugar consumption) simply alter the speed of the cariogenic properties of free sugars (Featherstone, 2008).

The use of fluoride toothpaste for children is even more crucial because deciduous teeth are more vulnerable to caries than permanent teeth (Sønju Clasen et al, 1997; Lynch, 2013). Deciduous teeth have greater enamel porosity and lower mineralisation than permanent teeth; this allows caries lesions to develop more easily in deciduous teeth than permanent teeth. Sønju Clasen et al conducted a study comparing exposed permanent and deciduous tooth structures to plaque accumulation in the presence and absence of fluoride (Sønju Clasen et al, 1997). Each participant wore a removable orthodontic appliance with 2 enamel slabs secured to it for 4 weeks. The enamel slabs were prepared from freshly extracted permanent premolars and deciduous molars and one of each was attached to one removable orthodontic appliance worn by the participants. One group of participants was exposed to fluoride while the other group was not. At the end of the study period, the enamel slabs were examined. Larger carious lesions were found in the deciduous enamel slabs than in the permanent enamel ones who did not use any fluoride products. Enamel slabs that were exposed to fluoride mouthrinses hardly developed any carious lesions. This study implied that deciduous teeth are more vulnerable to caries than permanent teeth. Fluoride is effective in inhibiting the development of caries, and exerts a higher impact on the primary dentition.

In their systematic review and meta-analysis on the effect of toothbrushing on caries development, Kumar et al found very few studies that separated toothbrushing with and without fluoride toothpaste into 2 variables (Kumar et al, 2016a). The studies that did

so reported a weak association between frequency of toothbrushing *per se* and dental caries (Leroy et al, 2005; Wong et al, 2012). With this evidence, it is possible that the mechanical cleansing of toothbrushing performed by an individual in a normal setting is not effective in the control of dental caries without the action of fluoride on the tooth surface to promote tooth remineralisation.

2.1.4 Guidelines for oral care practices for children at home

Guidelines for toothbrushing and the usage of fluoride toothpaste for children vary from country to country. A higher degree of variation appears to be in respect to the amount of fluoride to be used and when to start using it.

Both the American Dental Association (ADA) and the British National Health Service recommend toothbrushing twice daily and commence as soon as the primary teeth erupt[1,1](Table 1).

Table 1. Guidelines for children's oral care practices in different countries

	American Dental Association	British National Health Service	Australian Government
Frequency of toothbrushing (daily)	Twice	Twice	Twice
Commence of toothbrushing	As soon as tooth erupts	As soon as tooth erupts	As soon as tooth erupts
Amount of fluoride toothpaste			
Below 3 years of age	Smear	Smear	No toothpaste till 18 months
3 to 6 years of age	Pea size	Pea size	Pea size
Brushing time	Not mentioned	2 minutes	2 minutes
Flossing	Not mentioned	Not mentioned	As soon as 2 teeth in contact
First visit to dental health professional	As soon as 1st tooth appears and below one year of age	As soon as 1st tooth appears	As soon as 1st tooth appears and below one year of age

[1] https://www.ada.org.au/Your-Dental-Health/Children-0-11/Kids

[2] https://www.nhs.uk/live-well/healthy-body/taking-care-of-childrens-teeth/#toothbrushing-tip

The usage of fluoride toothpaste is encouraged. For children younger than 3 years, the amount of toothpaste is a smear or the size of a grain of rice on the toothbrush. For children 3 to 6 years of age, the amount is a pea size. The Australian government's recommendation is closely similar, albeit with a slight difference[2]. Although toothbrushing starts when the children's teeth erupt, no toothpaste is used until 18 months of age. Thereafter, the fluoride used is a pea-sized amount and flossing is also encouraged as soon as there are 2 teeth in contact. Both the British National Health Service and the Australian Government recommend a 2-minute brushing time.

2.1.5 Professional dental care for children

All of the above 3 oral health bodies advocate regular visits to an oral health professional, with a first visit to be made as soon as possible after the eruption of the primary teeth. Both the ADA and the Australian government advise the first visit to be made before one year of age. Regular dental visiting facilitates preventive care and allow the diagnosis of dental problems at an early stage before the disease progresses (Riley et al. 2013). The first dental visit is important because it represents the first contact with the oral health system.

In a systematic review of studies of more than 6 months in duration, Van der Weijden and Hioe found that an average person aged 18 years and above performing mechanical plaque removal such as toothbrushing was not sufficiently effective to maintain a plaque-free dentition; furthermore, sustained effective brushing was uncommon (Van der Weijden and Hioe, 2005). However, when professional prophylaxis and oral hygiene instruction was given at baseline, there was a small but significant improvement in participants' gingival health by the end of the studies. Therefore, professional dental care can be helpful in addition to self-performed oral care in maintaining good oral health.

At the individual level, it is possible to maintain good oral health with favourable self-care at home supported by professional care. Axelsson et al illustrated this possibility

[3] https://www.healthdirect.gov.au/dental-care-for-children

with a 30-year study whereby the participants enjoyed favourable oral care sustained throughout the study (Axelsson et al, 2004). However, this study is not feasible to be implemented at the population level and is unlikely to be repeated elsewhere. The study involved providing an oral hygiene program to a group of participants for 30 years. The program consisted of regular dental appointments 3-monthly to 12-monthly. During the dental visit, each participant received comprehensive oral hygiene instructions focused on plaque control measures and prophylactic treatment by an oral hygienist. The participants used fluoride throughout the duration of the study. A high standard of oral care was provided and the participants themselves were also motivated to carry out good oral care practices. By the end of the study, a very low incidence of dental caries, periodontal disease, and tooth mortality was reported.

Similarly, at the population level, those who visited an oral health professional regularly tend to have better oral health in the longer term than irregular (problem-oriented) dental visitors (Thomson et al, 2010). In that study, participants in the Dunedin Multidisciplinary Health and Development Study (DMHDS) who consistently went for regular professional dental visits reported better oral health than those who visited a dentist whenever they encountered dental problems. The DMHDS is a prospective birth cohort study with a very low dropout rate. When these regular dental attenders were examined at age 32, they presented with fewer dental caries lesions and tooth loss. They were also likely to be more health-conscious and adopt favourable general and oral health practices. The combination of both favourable oral care practices at home (such as toothbrushing with fluoride toothpaste, and regular preventive dental visits) tended to lead to better oral health. Since dental caries is a chronic oral disease with the effects of its risk factors accumulating over the life course of an individual, the key to control dental caries is adopting a lifetime of consistent favourable oral care practice (Nicolau et al, 2007).

Since regular dental attenders tend to have better oral health than those problem-related attenders, regular visits to a dental health professional are recommended. A variety of time intervals for a recall check-up visit are suggested, but there is little scientific justification for recommending the ‘one-size-fits-all’ recall interval for all (Tomar, 2011). Caries experience for children is never uniform in a population and a recall interval adopting a risk-based recall approach with shorter recall intervals for someone

with poorer oral health appears reasonable (Riley et al, 2013). However, the selection of a recall interval is a multifaceted and complex decision involving the judgment of both clinician and patient (Clarkson et al, 2009). With a paucity of reliable evidence of ideal recall intervals for different clinical situations, there are disparities in recommendations of the optimal recall intervals relying solely on experts' opinions. Hence, further research is needed to study the impact of recall intervals in the control of oral diseases.

2.1.6 Oral care practices of Australian children

The information provided by the National Child Oral Health Study 2012-2014 on Australian children's oral care practices is discussed below (Do and Spencer, 2016).

About half of Australian children aged 2 to 3 years brushed their teeth twice daily with fluoride toothpaste. Children from lower-income households, those having parents with only school-level education or indigenous status, were less likely to brush twice daily. A greater number of older children (71.3% of 13- to 14-year-old) brushed twice daily than the younger ones (66.4% of 5- to 6-year-old). One-third of the children started toothbrushing for the first time with toothpaste before 18 months of age and 40.1% did so between 18 and 30 months. These children were from lower-income households, with parents with only school-level education, who were non-Australian born, or with indigenous status were less likely to do so. No differences were observed by sex of the child, residential location or reason for last dental visit.

When children at 2 to 3 years of age brush their with fluoride toothpaste, too much fluoride increases the risk of dental fluorosis and too little may not be effective for caries prevention. The recommended amount of a pea-sized toothpaste to be used during childhood toothbrushing is based on the assumption of twice-daily toothbrushing (Australian Research Centre for Population Oral Health (ARCPOH), 2012). About 4 out of 10 children used a pea-sized amount of toothpaste at age 2 to 3. Except indigenous children, who were less likely to use a pea-sized amount, there were no associations between toothpaste quantity and parental education, household income, residential location and reason for last dental visit.

Due to the potential risk of dental fluorosis, Australia currently recommends that children up to 6 years of age use low-fluoride toothpaste rather than the standard fluoride toothpaste (ARCPOH, 2012). Even though the low-fluoride children's toothpaste is readily available, 8.6% of children were using the standard fluoride toothpaste at 2 to 3 years of age. These children, who ran the risk of developing fluorosis, were likely to be indigenous, have parents who were born in Australia, had only school-level education, were from a low-income household or visited a dental professional only because there was a dental problem.

The switch to standard fluoride toothpaste usage was rather gradual after age 6. Slightly fewer than half of the children age 7 to 8 years used the standard fluoride toothpaste. Unlike the younger children, almost all (94.2%) the older ones age 13 to 14 years brushed with standard fluoride toothpaste. There was only a slight difference in standard toothpaste usage by sociodemographic characteristics for those who had made the switch. Girls or those who visited a dental health professional regularly were more likely to do so. The gradual switch to the use of standard fluoride toothpaste resulted in some male children having a lower than recommended fluoride exposure, with an associated greater risk of developing ECC.

Most Australian children had adequate access to oral care. More than half of the children made their first visit to a dental health professional below the age of 5 and 86.7% of the first visits were for a check-up. These children were likely to be non-indigenous in status, from higher-income households, having tertiary-educated parents or having last visited for a check-up.

The most recent dental visit is considered important because it tends to reflect current health behaviour (Shahid and Freeman, 2019). Eight out of ten Australian children aged 5 to 10 years last visited a dental health professional in the previous 12 months and 80.2% had had a check-up. Once again, the sociodemographic characteristics of these children were similar to those who made their first visits below the age of 5.

In summary, twice-daily toothbrushing and the usage of fluoride toothpaste were more common in older Australian children. Those having favourable oral care practices of twice-daily toothbrushing with fluoride toothpaste (correct amount according to age), regular visit to an oral health professional and started brushing at the appropriate age

were likely to have non-indigenous status, Australian-born and tertiary-educated parents, or from higher-income households. This sociodemographic gradient in oral care practices is likely to contribute to inequalities in oral health among Australian children. This inequality in oral health is likely to widen later in life (Thomson, 2012).

2.2 Dental plaque induced chronic oral diseases in young children

The most common chronic oral diseases for children below 5 years of age are early childhood caries (ECC) and to a lesser extent, chronic gingivitis. These 2 diseases are caused by the accumulation of dental plaque. Oral care practices need to be effective in controlling the chronic oral diseases because these diseases, mainly ECC, can impact the individual, family and the community. ECC and its impact are discussed below.

2.2.1 Occurrence of ECC

ECC has been defined as the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in the primary dentition of children 71 months old or younger (Drury et al, 1999). Severe early childhood caries (S-ECC) is diagnosed when there is any sign of smooth-surface caries (non-cavitated or cavitated) in children younger than 3 years of age.

Although countries with higher economic and social development had experienced a steep decline from a relatively high pre-1980s level of caries experience towards the low level experienced in developing countries, the World Health Organisation (WHO) reported that dental caries was still endemic, with a 60 to 90% caries prevalence among school-age children in most countries in 2003 (Petersen, 2003). In fact, at the beginning of this century, caries experience in developing countries, rather than declining, had been increasing (Petersen et al, 2005). Thus, dental caries in children had changed from a disease of affluence to a disease of deprivation and it appeared that this was a global phenomenon (Do, 2012).

The distribution of ECC between and within countries reflects the differences in economic circumstances, distribution of wealth, technological advances, and accessibility to education and health care. As for disparities within a country, there is well-established evidence that dental caries, including ECC, is associated with

socioeconomic status (SES) (Schwendicke et al, 2015). Lower SES is strongly associated with higher caries experience, and the disadvantaged groups tend to suffer more. This strong association has allowed ECC to be recognised as a marker of social inequality, with the association even greater in countries with high-income inequality (Bernabé et al, 2009).

2.2.2 ECC in Australia

Mirroring the global trend in caries experience in school-age children in most industrialised countries, Australia enjoyed a substantial decline in caries experience for children aged 6 until 2000 and since then, has suffered a gradual increase (Mejia et al, 2012). Data from the Australian Institute of Health and Welfare in 2015 showed that caries experience, using mean dmft (decayed, missing, filled primary teeth) as a measure, decreased from 3.2 in 1978 to 1.5 in 1996 and then increased to 2.6 in 2010 for 6-year-old children attending the School Dental Services for all States except New South Wales (Chrisopoulos et al, 2016). The caries prevalence rate for deciduous teeth peaked at age 6, affecting 55.1% of children in 2010.

In another survey, data from the National Child Oral Health Study 2012-2014 showed that 41.7% of children aged 5 to 10 years had caries experience (Do and Spencer, 2016). Children who visited a dental health professional only when there was a problem, from lower-income households, living in remote areas, having parents with only school-level education or indigenous status were more likely to have ECC. Therefore, ECC is still a problem and has a widespread impact in Australia.

2.2.3 Impact of ECC

In spite of the advancement in technology and economic development in many parts of the world, the 2015 Global Burden of Disease study reported that 573 million children (or 7.8%) globally were still affected with untreated caries in deciduous teeth and the prevalence peaked at age 6 (Kassebaum et al, 2017). In Australia, 27.1% of children aged 5 to 10 had at least one untreated carious tooth in 2012 to 2014 (Do and Spencer, 2016). Furthermore, the caries experience is likely to be underestimated because the reporting of untreated dental caries for deciduous teeth has the possibility of ignoring

teeth extracted or filled due to caries. Untreated caries reflects the population's access to dental care and indicates the severity of the disease. The presence of untreated caries implies that there is a long way to go for health organisations to tackle this chronic oral disease. Meanwhile, ECC continues to burden children, families, society and the health care system.

Dental pain resulting from untreated dental caries is the most common dental pain experienced in childhood (Tickle et al, 2008; Boeira et al, 2012). A population-based cohort study of 1129 participants in Brazil reported a dental pain prevalence of 16.5% at age 5 (Boeira et al, 2012). Even restoring carious deciduous teeth might not prevent the occurrence of dental pain. Tickle et al observed in a cohort study in North West of England that the majority of children who experienced dental pain had had their molar teeth restored (Tickle et al, 2008). They concluded that, once dental caries had started, adverse outcomes were likely.

To relieve the pain from acute pulpitis caused by ECC, the options are endodontic treatment or tooth removal. Premature tooth loss in the primary dentition could cause the drifting of the remaining teeth and the permanent teeth to erupt into incorrect positions; tooth loss could have negative effects on eating, speech, school performance and self-esteem (Fayle et al, 2001). Logically, dental pain and tooth loss could affect eating and hence compromise weight gain in children. However, the results of the findings from studies were equivocal. Acs et al found that children with ECC undergoing dental treatment with sedation or general anesthesia weighed less than those in a comparison group but Davidson et al reported that Canadian children with severe ECC had a significantly higher chance of being overweight than children with no caries (Acs et al, 1992; Davidson et al, 2016). Others reported (through study or systematic review) that no association was found between body mass index (BMI), obesity and ECC experience and the authors further cautioned against possible confounders such as age and SES (Macek and Mitola, 2006; Sheller et al, 2009; Hayden et al, 2013).

However, there is overwhelming evidence that pain suffering or the effects of tooth loss caused by ECC negatively impacts oral-health-related quality of life (OHRQoL) (Do and Spencer, 2007; Martins-Júnior et al, 2013, Li et al, 2015). OHRQoL was defined by Locker as "a standard of the oral tissues which contributes to overall physical,

psychological and social wellbeing by enabling individuals to eat, communicate and socialise without discomfort, embarrassment or distress and which enables them to fully participate in chosen social roles" (Locker, 2001). The negative impact of ECC on OHRQoL has been reported consistently worldwide using various child measures of OHRQoL. For example, in Australia, Do and Spencer demonstrated an association between poor OHRQoL and caries with the Child Oral Health-related Quality of Life Questionnaire (COHQOL) as an OHRQoL measure (Jokovic et al, 2002; Do and Spencer, 2007). ECC in childhood could also lead to poorer OHRQoL later in life (Kragt et al, 2016).

ECC not only affects the child and family but also creates a burden for the community and health care system in terms of its economic cost (Casamassimo et al, 2009). On top of the well-established evidence of poorer OHRQoL for the child and family, dental care for children with ECC could consume a disproportionate share of dental expenditure in the community and health care system. For paediatric dental patients, treatment under general anesthesia (GA) is often indicated because very young children can be uncooperative and traumatised by conventional treatment; however, the cost of dental treatment under GA is substantially higher than conventional care (Thomson, 2016). Especially in industralised countries where the practice of patient-centred dentistry was more widespread, the demand for dental treatment under GA has been increasing (Jamieson and Roberts-Thomson, 2006; Klingberg et al, 2006; Moles and Ashley, 2009). Economic data from 66 countries provided an estimate that the global economic burden of oral diseases was US$442 billion, comprising US$298 billion for direct treatment costs and US$144 billion for indirect costs such as loss of productivity (Listl et al, 2015). It is possible that a substantial amount of the cost was related to treatment under GA.

2.2.4 Chronic gingivitis in young children

Chronic gingivitis is the inflammation of the gum tissue surrounding the teeth without any loss of bone. It is mainly caused by the accumulation of dental plaque and can be reversed by oral care practices that effectively remove the plaque. This plaque-induced gingivitis is the most common form of periodontal disease found in young children (Oh et al, 2002).

Older children are more likely to suffer from plaque-induced gingivitis than the younger ones (Matsson, 1993; Agarwal et al, 2009). Matron and Goldberg, using an experimental model similar to Löe et al in 1965, demonstrated that the susceptibility of gingival tissue to the same amount of plaque accumulation was greater for the older children than the younger ones (Löe et al, 1965; Matron and Goldberg, 1985). The age-related differences in the response of the gingival tissue to plaque accumulation could be due to bacteriological, immunological or morphological (Matsson, 1993; Agarwal et al, 2009). Furthermore, the amount of plaque accumulation in children tended to increase with age (Agarwal et al, 2009).

For younger children below the age of 3, very few develop chronic gingivitis and the impact of this disease is considerably lesser than ECC. However, favourable oral care practices are still essential as plaque accumulation could encourage early colonisation of periodontal pathogens with the potential to promote the development of periodontal diseases later in life (Takahashi et al, 2017).

In summary, for young children below 3 years of age, the major consequence of unfavourable oral care practices is ECC.

2.3 Factors affecting oral care practices

The direct causal role of oral care practices in the development of dental caries, and factors that could influence them are discussed below.

2.3.1 Oral care practices as a direct cause of ECC

Dental plaque is a well-established individual risk factor for dental caries. Under the list of criteria for causal inference proposed by Susser, dental plaque qualifies as a causal agent or direct risk factor of dental caries (Susser, 1991). There are 3 essential attributes for a factor to be a cause. They are association, time order, and direction. The first attribute is that a factor and its putative effect have to occur together for an association to be considered; this association is determined by the probability of its occurrence concerning the preset expectation of normal variation. Second, time order means that when there is an association, the causal factor has to precede the effect.

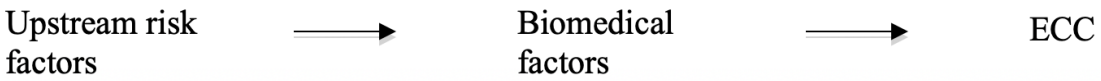
Direction implies that any changes in the causal factor will lead to changes in its effect that cause a change in the outcome.

Thus, the removal of dental plaque, which is a causal agent of dental caries, has proven to be effective in controlling the disease. Since toothbrushing is the most common method of plaque removal carried out at home, unfavourable home oral care practice (referred to in this study) becomes a direct risk factor for ECC. Other methods of plaque removal (such as prophylaxis by oral health professionals or even the usage of miswak) would also have a direct impact on the development of caries, and so those are potential direct risk factors.

Similarly, under the above-mentioned criteria for causal inference, insufficient fluoride also acts as a causal agent in the development of caries. By promoting remineralisation, fluoride alters the chemical composition of the tooth surfaces and protects the surfaces against cariogenic agents. According to the multi-level conceptual model by Fisher-Owens et al, the chemical composition of the tooth, along with the inherited predisposing genetic endowment, oral microflora, morphology of the teeth, and the physical attributes of the child, are all biomedical factors operating at the individual level; these biomedical factors are direct determinants of an oral disease (Fisher-Owens et al, 2007). Together with toothbrushing (home care) and prophylaxis by oral health professionals (professional care), the oral care practices referred to in this study collectively act as a biomedical factor, playing the role of a causal agent for ECC.

According to the Fisher-Owens model, the factors that are not biomedical tend to operate at the family or community levels. These 'non-biomedical' factors can be socioeconomic, environmental, cultural and political and are considered to be upstream determinants of an oral disease (Crall et al, 1990; Watt, 2007). These upstream determinants are not direct risk factors because they are unable to act on their own to cause the disease. Their influences on ECC in young children need to be mediated by biomedical factors to have an impact (Figure 1).

Figure 1. Action of upstream risk factors on ECC



Consistent global observation of a social gradient in oral health led to the belief that upstream risk factors operating in the social environment of the individual living in can influence the biomedical factors and affect the occurrence of oral disease (Sheiham and Watt, 2000). Earlier in the 1970s and 1980s, most oral health policies were based on the notion that an individual's oral health behaviour could be changed with the acquisition of knowledge through oral health education. Since then, there has been a realisation that education, though necessary, was not sufficient to bring about a favourable long-term oral health behavioural outcome without also tackling the underlying upstream risk factors. This led to greater interest in studying further and understanding the effect of the upstream risk factors on oral diseases. By the inclusion of these upstream factors, dental caries is often described as a multi-factorial and complex chronic disease (Borutta et al, 2010). Factors that can influence the development of the disease outcome act in a complex interplay to influence one another.

2.3.2 The influence of socioeconomic factors on oral care practices

SES is frequently used as a practical indicator for the social status of a person (Foley and Akers, 2019). It is difficult to define and quantify and usually needs measurable variables such as income, employment status, occupation, residential location, education level, and ethnic status as proxies.

The socioeconomic gradient associated with ECC has been well documented, with people of lower SES and minority groups having greater caries experience (Schwendicke et al, 2015; Watt et al, 2018). SES was often reported to have similar or even stronger associations with ECC than biomedical factors after a multivariate analysis was performed. For example, using parents' education level as a proxy for SES, Wong et al reported a higher incidence ratio rate for parents' education level than the biomedical factors such as toothbrushing frequency and consumption of snacks when a binomial regression was performed with caries increment acting as the

dependent variable in a 2-year longitudinal study of young pre-school children in Hong Kong (Wong et al, 2012).

Besides the education level, other measures of SES also showed a strong association with dental caries. Ferreira et al found that the prevalence of dental caries was higher among children from families with low household income in a population-based study conducted in southern Brazil (Ferreira et al, 2019). The association between mothers' occupation and ECC is also commonly reported. Children of mothers holding white-collar jobs were likely to have lower caries experience in an industralised country such as Finland (Mattila et al, 2000). Similarly, in a developing country such as India, Kumar et al observed that children whose mothers were housewives or unskilled, experienced higher caries rates (Kumar et al, 2016b). The remaining SES proxies, such as parents' marital status or residential location, though not commonly used, are observed to be associated with ECC as well. Children from single-parent or reconstituted households tend to have poorer oral health than those from 2-parent households. In South Australia, Slade et al found that 5-year-old children from single-parent households had a higher chance of having ECC than children from 2-parent households (Slade et al, 2006). Similarly, Mattila et al reported higher caries experience for 5-year-old Finnish children whose parents were cohabiting but unmarried (or whose parents' marital status had changed during the first 5 years of the child's life) than children whose parents had stayed married (Mattila et al, 2000).

However, while correlation, repeated observation, and strength of association are not sufficient evidence of causation, the repeatedly observed association between the various SES proxies and ECC are unlikely to be due to bias or the result of chance (Foley and Akers, 2019). Although many studies have focused on documenting the association between SES and ECC, it is important to assess why the association exists. The effect of SES on the development of ECC is likely to be mediated by the biomedical factors operating at the individual level. Since oral care practice is one of the biomedical factors, a similar socioeconomic gradient associated with ECC can be expected.

The commonly used proxies for SES were reported to be associated with children's toothbrushing frequency. For example, from a cross-sectional study of school children 6-to 12-years-old in Mexico, Vallejos-Sánchez et al, using mothers' education level as a SES proxy, reported that children in higher SES families (whose mothers with higher

education level) were likely to brush their teeth more frequently than the lower SES children (Vallejos-Sánchez et al, 2008). Similarly, Casanova-Rosado et al also reported that children in higher SES families (smaller sized family) were likely to brush their teeth more frequently than the lower SES children by using family size as a SES proxy (Casanova-Rosado et al, 2014). A similar observation was reported by Kumar et al, whereby children in India who brushed their teeth regularly belonged to families of higher SES; these were families with higher household income, parents with higher education level, or families of a smaller size (Kumar et al, 2011). However, Lima et al showed in a cross-sectional study that, although there was hardly any difference in toothbrushing frequency among 3- to 4-year-old children in Brazil, children of mothers with lower education levels had greater caries experience (Lima et al, 2016). By contrast, in a prospective longitudinal study in Iowa, whereby a cohort of participants was followed from birth to 9 years of age, the difference in the overall mean toothbrushing frequency (mean frequencies taken at various ages and then combined) among the high and low SES groups was almost negligible (Hamasha et al, 2006). Although at a younger age, the children of the low SES group had a slightly greater toothbrushing frequency but vice versa when they were older (above 84 months).

While children with lower SES are consistently more likely to suffer greater caries experience, they do not necessarily have unfavourable toothbrushing habits, as the above studies have shown. Furthermore, the toothbrushing frequency of a child appears to change over time during childhood. Due to the variation of toothbrushing frequency at different point of a child's life, longitudinal studies appear to be more suitable to study toothbrushing patterns during childhood. The inconsistencies in the observed association between SES and toothbrushing also imply that there are possible confounding factors affecting this oral care practice.

When fluoride toothpaste is used, the exposure to fluoride is very much dependent on the frequency of toothbrushing. The same longitudinal Iowa study discussed above reported that there was not much difference in the percentage of children brushing with fluoride toothpaste among the high and low SES groups (Hamasha et al, 2006). Moreover, in the National Health and Nutrition Examination Survey, USA, Thornton-Evans et al found that children whose parents with an education level below high school were more likely to start brushing their teeth with fluoride toothpaste later than the

recommended commencement time for young children (Thornton-Evans, 2019). In Brazil, Lima et al documented that, although there was hardly any difference in toothbrushing frequency among the 3- to 4-year-old children, those whose mothers had a lower education level tended to use fluoride at higher than the recommended amount or concentration (Lima et al, 2016). The pattern of fluoride usage described in these studies was similar to that reported in Australia's National Child Oral Health Study 2012-2014, whereby children of lower SES tended to have less favourable fluoride usage. Hence, children of lower SES are less likely to follow oral care guidelines for fluoride usage.

The utilisation of dental services is a complex phenomenon that involves affordability, accessibility, valuation of dental care by the parents, and the perceived need for oral care (Badri et al, 2014; Curi et al, 2018). Access to dental care can be influenced by public policies, the availability of oral health providers, and affordability. The practice of preventive and favourable oral health care involves regular dental visits and adhering to guidelines for the timing of the children's first dental visit (Twetman and Dhar, 2015). SES is known to be associated with utilisation of dental services for preventive oral care. For example, from a retrospective cohort study of children age 3 to 5 conducted in Belgium, Leroy et al found that high SES (mother's education level as a SES proxy) was associated with children starting a visit to an oral health professional at a younger age (Leroy et al, 2013). Similarly, Goettems et al reported the association between high SES and earlier start of regular dental attendance by 2- to 5-year-old in Brazil when household income was used as an SES proxy (Goettems et al, 2012). Higher household income was also associated with a higher likelihood of planned (rather than problem-related) dental visits for US children aged 4 to 8 (Telleen et al, 2012).

In summary, it appears that parents'/caregivers' education level and household income are the 2 most commonly used proxies for SES. They are essentially interconnected; academic achievement provides access to a particular occupation that could attain a certain level of income, and the level of income could influence access to oral care (Kawachi et al, 2010). With this link, household income could play a greater role in affecting the utilisation of dental services, and especially in countries where oral care is self-funded. This contributed to a strong association between high SES and regular

utilisation of dental services for preventive oral care. Low SES is associated with less favourable topical fluoride use at home, but the effect of SES on toothbrushing habits is not as consistent because there are possibly other confounding factors.

2.3.3 The association of ethnicity, immigration and indigenous status on oral care practices and oral diseases

Ethnic minority, immigrant and indigenous status are upstream risk factors for ECC (Fisher-Owens et al, 2013). According to Fisher-Owens et al, low SES, particularly low family income, is the most important factor associated with these groups of people. Low SES can be further exacerbated by racial discrimination and racism (Nazroo, 2003). Cultural differences arising from ethnicity, immigration, and indigenous status can also act as confounding factors to the socioeconomic factors and exposure factors for oral care practices.

Ethnic disparities in children's oral health happen in many parts of the world, but ethnic minority does not necessarily lead to poorer oral health. Each ethnic group has its values, customs, beliefs, and behaviours that can affect oral care practices, thus resulting in different disease outcome. Some ethnic groups may be less prone to oral diseases because they come from cultures with favourable oral hygiene habits and traditionally less cariogenic diets, such as diets high in fiber and low in refined carbohydrates (Cruz et al, 2009). For example, in New York City (USA), among all the ethnic minority groups, Hispanic subgroups and other Black Caribbeans exhibited greater caries experiences than the Asians and the Haitians. Similarly, ethnic disparities in the oral health status of 5-to 8-year-old children have been reported from the urban settings of Calgary and Edmonton, Canada. Although Filipino and Arab children had poorer oral health, Latin American children were not affected and had similar oral health to the European American children (Shi et al, 2018).

Most migration is from a developing country to a more developed one. The oral health of an immigrant depends on the length of living in the host country, age at migration, language proficiency, or country of origin, and these factors are the common proxies for acculturation (Dahlan et al, 2019). Acculturation is broadly defined as the process whereby a person adopts the attitudes, values, customs, beliefs, and behaviours of another culture. Host language proficiency, a commonly used acculturation proxy, is

one of the most influential behavioral acculturation indicators because a person who speaks the host country's local language is likely to gain more confidence to socialise and has access to oral health services. One of the reasons that length of residency in the host country is used as a proxy is because the length of stay in the host country affects the awareness of the health care system and the ways to overcome structural barriers to health care such as language, social, or cultural differences (Cruz et al, 2009). Age at migration is another acculturation influence; a younger immigrant has the advantage of early adaptation to the host country's oral health services. Some have considered country of origin as one of the most important acculturation measures because it acts as a baseline of immigrants' cultural, historical and geographical characteristics that can affect their acculturation rate and level (Cruz et al, 2009).

These proxies were quick and convenient measures and are uni-dimensional (Cruz et al, 2009). Both they and uni-dimensional acculturation measurement instruments can only describe changes in a linear continuum ranging from unacculturated to acculturated states (Thomson and Hoffman-Goetz, 2009). Thus, they are only able to provide a snapshot of immigrants' cultural changes rather than presenting acculturation as a process. To explain the extent to which immigrants retain their own culture or adapt to their host culture, bi-dimensional or multi-dimensional measurement instruments are needed because they have separate scales that measure these various aspects. However, most studies that have measured the acculturation process used either proxy measures or uni-dimensional scales. Hence, the influences of intermediary factors such as cultural values, beliefs, and attitudes are not measured. Nonetheless, most studies reported the association of an overall higher level of acculturation with immigrants' improved oral health knowledge, more favourable oral care practices, higher utilisation of oral health services, improved oral health status, and reduced orofacial pain when measured with the various proxies (Gao and McGrath, 2011; Dahlan et al, 2019).

Not only do the people who are newly arrived in a country tend to suffer poorer oral health, those who were originally in a country also have similar oral health status. The children of indigenous populations also suffer from higher rates of oral diseases. Parker et al found that indigenous children aged 5 and below in Australia, Canada, New Zealand, and the USA all had a higher prevalence of ECC (Parker et al, 2010). These

groups of people tended to be marginalised and experienced the inadequate provision of oral health services in their respective societies.

In summary, although ethnic minorities, immigrants and indigenous people are likely to suffer poorer oral health, it cannot be presumed to be the same in another part of the world. The cultural influences in oral care practices that are complex and unique to each ethnic group, and the specificity of the demographic characteristic of a population, need to be taken into consideration when trying to explain oral care practices and health status.

2.3.4 The influence of psychosocial factors on oral care practices

The interest in studying further and understanding the psychosocial risk factors is that these factors have the potential to be amendable, unlike the upstream factors described above which are not easily amendable. Bader et al reviewed articles published from 1966 to 2001 addressing the effectiveness of oral health professionals' interventions to prevent dental caries in young children (Bader et al, 2004). They found that interventions aimed at increasing dental knowledge were only effective in the short term and needed reinforcement over time. Moreover, the increase in dental knowledge did not translate to changes in oral health practices or a reduction in ECC. The failure in the translation from knowledge to favourable oral care practices could potentially lead to a greater oral diseases outcome. Dental knowledge can be obtained in many ways but the most effective method appeared to be personalised one-on-one attention with active involvement from both patients/caregivers and dental professionals (Bader et al, 2004; Gao et al, 2010). Psychological factors affect learning and if they are favourably amended, could lead to improved adherence to oral hygiene instructions given at the one-on-one session and result in a change in oral care practices. This led to the usage of psychological models to study the influence of psychosocial factors on a person's oral care behaviour/practices and possibly to apply interventions to bring about a change in them (Renz et al, 2007).

Theories of behavior change incorporate a variety of constructs, interventions, and methods to explain relationships or causal pathways that influence behavior (Michie et al, 2008). Psychological models are smaller formalised concepts that provide a theoretical framework to help in the understanding of factors causing a change in health

behaviour (Renz et al, 2007). These models usually include a social cognitive element. A social cognitive element is a thought, belief or attitude that relates to an individual's understanding of a particular behaviour. The theory of these 'social cognition' models is based on the assumption that a person would take responsibility of his/her health and the action/behaviour is best understood by examining the beliefs and attitudes (Sheeran and Abraham, 2013). There are 82 theories currently in use in the public health but only 4 theories are widely used. The 4 are the Transtheoretical Model of Behaviour Change, the Theory of Planned Behaviour, Social Cognitive Theory, and the Information-Motivation-Behavioural-Skills Model; they accounted for 63% of the 276 articles (published between 1977 and 2012) reviewed (Davis et al, 2015).

The Transtheoretical Model of Behaviour Change was the most commonly used (33% of the articles). It is a biopsychosocial model that integrates the principles and processes of change from leading theories of counselling and behaviour change (Prochaska and Velicer, 1997). This model focuses on the decision-making of the individual and assumes that behavioural change of a person occurs continuously through a cyclical process or stages. The Theory of Planned Behaviour (13%) is an extension of the Theory of Reasoned Action and both models are based on the premise that the individual can make logical, reasoned decisions by evaluating available information to engage in specific behaviours (Ajzen, 1991). Social Cognitive Theory (11%) started as the Social Learning Theory in the 1960s, but when the construct of self-efficacy was added to the existing 5 constructs, the theory became known as Social Cognitive Theory (Bandura, 2001). The unique feature of this theory is the emphasis on social influence and internal social reinforcement; it postulates that learning occurs in a social context with a dynamic and reciprocal interaction of the individual, environment, and behavior. The Information-Motivation-Behavioural-Skills Model (7%) presumes that, although information is a prerequisite for changing behaviour, it may be insufficient to achieve this change by itself. Also, motivation is needed; and both information and motivation can induce a change in behaviour through the mediation of behavioural skills (Fisher et al, 2003).

Psychological models are used to identify modifiable cognitions associated with the oral health-promoting behaviours so that psychological interventions can be designed to target the appropriate participants. One of the modifiable psychosocial factors is self-

efficacy. Bandura defined it as “people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives” (Bandura, 2001). Although self-efficacy is a construct of the Social Cognitive Theory proposed by Bandura, the concept can also be found in other health behavior change theories such as the Theory of Planned Behaviour as "perceived behavioral control" or "self-efficacy/temptation" in the Transtheoretical Model of Behaviour Change. Self-efficacy can be modified or gained by 3 methods. The most powerful method is through personal experiences, especially when the experiences are successful. Vicarious learning is another method. Learning can be carried out by observation or modelling. The third method of gaining self-efficacy is through verbal persuasion. Oral health professionals can use these 3 methods to increase the self-efficacy of participants in oral health programs.

Self-efficacy has been known to be an accurate predictor of oral health practices and status (Finlayson et al, 2007; Buglar et al, 2010; Lee at al, 2012; de Silva-Sanigorski et al, 2013). The association of low self-efficacy with poorer oral health practices and status was recorded with various self-efficacy measures that were based on different theoretical frameworks. Finlayson et al used a 9-items scale derived from the theoretical framework of the Social Cognitive Theory to measure the mothers/caregivers self-efficacy regarding their children toothbrushing habits (Finlayson et al, 2007). The association of self-efficacy with children’s toothbrushing frequency was discovered to be the strongest among other psychosocial factors such as knowledge of both bottle-feeding and oral hygiene practices, and oral health fatalism. Similarly, Buglar et al and Goodarzi et al, who assessed the association of self-efficacy with tooth brushing and flossing practices among Australian adults and Iranian school children respectively with another theoretical framework derived from the Health Belief Model, also found self-efficacy predicted both oral hygiene behaviours (Buglar et al, 2010; Goodarzi et al, 2019).

Better self-reported oral health status is also associated with higher self-efficacy (Lee at al, 2012; Jamieson et al, 2014). Jamieson et al found that there was an association between higher self-efficacy and better self-reported oral health status among pregnant Aboriginal women in Australia (Jamieson et al, 2014). Similarly, Lee et al, using a 10-items General Self-Efficacy Scale, reported that women above 17 years of age in the

USA who had higher self-efficacy felt that they had better oral health (Lee et al, 2012). In the same study, higher oral health literacy was also found to be associated with better self-reported oral health status.

Oral health literacy is commonly defined as "the degree to which individuals have the capacity to obtain, process, and understand basic oral health information and services needed to make appropriate oral health decisions".[3] Better self-reported oral health status was also associated with higher oral health literacy for women above 17 years of age in the USA (Lee et al, 2012). However, when the actual oral health status was concerned, it was found that the evidence was weak for the association between lower levels of oral health literacy and dental caries in the primary dentition and other oral diseases (Firmino et al, 2017). This is because the studies were conducted with either non-representative or non-probabilistic samples, and sample size calculation was absent. Furthermore, since all the studies were cross-sectional in design, oral health literacy can only act as a mediator and not a direct factor for oral conditions.

From the above study by Lee et al involving women above 17 years of age in the USA, poor oral health knowledge was found to be associated with low oral health literacy (Hom et al, 2012). Logically, low oral health literacy could be a barrier to information seeking. Oral health literacy is usually evaluated by the Rapid Estimate of Adult Literacy in Dentistry-30, a word-recognition instrument in which respondents are required to pronounce a list of 30 oral health related words arranged in increasing order of reading difficulty (Lee et al, 2007). The instrument only evaluates word recognition. However, a person's ability to read certain words may not translate into knowing the meanings of the words, and so, it is possible that better oral health literacy may not translate to better oral health knowledge (Firmino et al, 2017). In Australia, Jones et al reported that poor oral health knowledge was associated with lesser toothbrush ownership among a homeless population in Adelaide. However, also in Australia but in the state of Victoria, de Silva-Sanigorski et al found that oral health knowledge was

[3] https:// nysoralhealth.squarespace.com/s/Oral-Health-Literacy-Toolkit.pdf

not associated with toothbrushing frequency, visit to an oral health professionals, or self-reported oral health status of children aged 5 to 12 years (de Silva-Sanigorski et al, 2013; Jones et al, 2016). The contradictory findings of these 2 studies imply that better oral health knowledge did not necessarily lead to favourable oral care practices, and that there were possibly other upstream factors acting as confounders in a complex interaction of determinants.

Theoretical frameworks of psychological models are also used to design interventions with the objective in improving the oral health promoting behaviours. Most interventions are carried out with sessions whereby participants are provided with oral health knowledge and cognitive behavioural guidance to improve adherence to oral hygiene instructions (Renz et al, 2007). Improvement in oral health promoting behaviours can be measured through positive changes in observable oral health behaviour, self-reported oral health behaviour, and clinical markers of the disease.

From their reviews, Renz et al and Werner et al found that the overall quality of the studies conducted on adults or adolescents aged 13 years and above using psychological interventions to improve oral health promoting behaviours or disease outcome was low (Renz et al, 2007; Werner et al, 2016). Only a small number of studies managed to fit into the inclusion criteria in both reviews and only these were analysed. These studies had small sample sizes. Although all the psychological interventions used were stated to be theory-driven, the theories were often not clearly described. No study reported the use of a treatment manual that could help with the replication of the method used. Some designs of the intervention also left out key aspects of the theories and this could intervene with the original theoretical framework. According to a recent review by Sanaei et al, psychological interventions that used the theoretical framework of Health Belief Model and the Theory of Planned Behaviour were effective in improving oral health-promoting behaviours or disease outcome, but Social Cognitive Theory was not (Sanaei et al, 2019).

In summary, the association of the psychosocial factors with oral care practices is important because these factors are more likely to be amenable to change than the socioeconomic and cultural factors. Oral health programs tailored to improve these psychosocial factors, especially self-efficacy, may elicit a favourable outcome in the

oral care practices of the children. However, the evidence to date is cross-sectional, and so can be considered to be circumstantial.

2.3.5 The influence of mothers'/caregivers' oral care practices on children's oral care practices

Besides affecting children's oral care practices, psychosocial factors such as self-efficacy are also associated with mothers'/caregivers' oral care practices. De Silva-Sanigorski et al found that in Australia, higher self-efficacy was associated with more frequent toothbrushing and visits to an oral health professional for a checkup by mothers or caregivers (de Silva-Sanigorski et al; 2013).

Likewise, mothers'/caregivers' favourable oral care practices are associated with children's favourable oral health or oral care practices. Mohebbi et al, found that mother's toothbrushing frequency was the only independent variable in a multivariate analysis that had a significant impact on 1- to 3-year-old children's twice-daily teeth cleaning in Teheran, Iran; other factors that related to self-efficacy, oral health knowledge, and SES had no significant impact (Mohebbi et al, 2008). Wigen and Wang found that favourable parents' attitudes and behaviours towards toothbrushing were associated with lower caries prevalence in 5-year-old children in Norway (Wigen and Wang, 2010). In Finland, an association of favourable self-reported oral health behaviour of older children aged 11-to 12-years with favourable self-reported oral health behaviour of their parents was reported (Poutanen et al, 2006).

The positive impact of favourable mothers' oral care practices does not stop at the children's childhood and they continue to enjoy better oral health even when they turn adults. In Sweden, Isaksson et al found that favourable parents' oral health behaviours and attitudes when their children were 1 to 3 years old were associated with low prevalence of proximal caries when the children reached 20 years of age (Isaksson et al, 2019). The Dunedin Multidisciplinary Health and Development Study also showed that children of mothers with poor oral health were more likely to have poor oral health as adults 3 decades later (Shearer et al, 2011). These mothers were unlikely to have favourable oral care practices since favourable oral health practices were likely to translate to favourable oral health outcomes.

In summary, children appear to enjoy better oral care and health when their mothers have favourable oral care practices.

2.4 Aim of the study

The study aimed to examine the oral care practices in the first 2 years of an Australian child's life, together with the factors that can affect them.

Most epidemiological studies reporting on the oral care practices of young children or ECC below the age of 5 have been cross-sectional in design (Leong et al, 2013). There are significant changes in the oral cavity during the first 2 years of life and cross-sectional studies may not sufficiently document these changes. This prospective study is expected to provide a more detailed documentation of the changes in the child's oral care practice pattern, with recording done at 3 age points within the first 2 years of life.

By studying the association of sociodemographic characteristics of the mothers/caregivers with oral care practices, the vulnerable group of mothers/caregivers in the population can be identified. Likewise, the psychosocial factors of self-efficacy, oral health knowledge, and dental fatalism as well as mothers'/caregivers' toothbrushing habits are included because these factors have a higher potential to be modified to improve the children's oral care practice.

3. Methods

This study was a secondary analysis of the data collected from the SMILE project between July 2013 and August 2014.

3.1 Background

The SMILE project was developed to study the influences of socioeconomic factors on child oral health in Australia (Do et al, 2014). It adopted a common risk factor approach and the project had 4 objectives. First, the study was conducted to evaluate the child oral health status at age 2 and second, to identify and study the effects of the oral health determinants. The third and last objectives mainly concerned infant feeding and oral care practices. For the third objective, the study evaluated the influence of socioeconomic factors on the dietary pattern and oral care practices; fourth, it set out to identify the common risk factors for oral health and obesity. The Australian National Health and Medical Research Council funded the project.

3.2 Study design and setting

The project used an observational prospective birth cohort study design. To obtain a representative sample of the South Australian population, the calculated required sample size at baseline was 1677 children with an assumed minimum 2-year retention rate of 80%. Oversampling of mothers from the low socioeconomic areas was carried out because of the expected higher attrition rate of this group of participants.

Ethical approval was obtained from the Southern Adelaide Clinical Human Research Ethics Committee (HREC #50.13, approval date: 28 February 2013). Clinical governance clearance was given by the 3 largest metropolitan public hospitals in Adelaide.

3.3 Sample selection and recruitment

The targeted population was all children born in Adelaide and its surrounding regions from July 2013 to August 2014. Since about 60% of children in the region were born at the 3 largest metropolitan public hospitals in Adelaide, the recruitment process was carried out there to obtain a representative sample of the population.

The recruitment process took place within the first 48 hours after birth. Mothers were invited to participate in the project and were given a written and verbal description of the study by trained health professionals. While only mothers who were living in Adelaide for at least the first year of the project and able to understand the survey questions and instructions were invited to participate, there were no restrictions on the newborns. All survey questions and instructions were written in English.

Mothers were informed that their participation were voluntary and informed consent was obtained from all participants.

3.4 Data collection

At the time of recruitment, enrolment for the project was completed and baseline (wave 1) questionnaire data was collected through face-to-face interviews. The follow-up data were collected when the children were 3 (wave 2), 6 (wave 3), 12 (wave 4), and 24 months old (wave 5). The follow-up questionnaires were administered through a few means of communication to achieve a higher participation rate. Participants were able to answer the questionnaires online, by paper-based hard copy, or through a telephone interview.

The data collection stages are summarised in Table 1. The data on sociodemographic characteristics were collected at Wave 1, psychosocial measures at Wave 2 and 5, mothers' oral care practices at Wave 1, 4 and 5, child's oral care practices at Wave 3, 4 and 5, and mother's self-reported oral health needs and status at Wave 3 and 5.

3.5 Measure

The study explored factors affecting the oral care practices of the children. The independent and dependent variables are described below.

3.5.1 Sociodemographic characteristics

For uniformity in the reporting of results for studies related to the SMILE project, the sociodemographic variables were re-categorised in a similar fashion to studies that were already published (Ha et al, 2017, Ha and Do, 2018). For example, mothers' age at birth

of the child were categorised into 3 age groups. They were the age range of '16-24', '25-34', and '35 and above'.

The SES proxies analysed were mother's education level, annual household income before tax, ethnic status, and family size. For education level, the 2 categorical variables of 'some high school' and 'completed high school' were recoded to one categorical variable 'school level', 'some vocational training' and 'completed vocational training' to 'vocational', and 3 variables 'some university or college', 'completed university or college' and 'postgraduate' to 'some university or higher'. For household income, the 10 categories of household income were recoded to 4 categories. The 4 categories were '$40000 or below', '$40001-$80000', '$80001-$120000', and '$120000 and above'.

Mothers' country of birth was categorised into 4 groups; they are Australia/New Zealand/ United Kingdom, Asia other than India, India, and all other countries. The indigenous status of the child was classified into 2 groups, one group of non-indigenous status and the other having Aboriginal or Torres Strait Islanders status to be classified as indigenous status.

For family structure, the household status was classified into 2 groups; the single parent group represented mothers not living with a partner. The number of children in the family was categorised into 3 groups, single child, 2 children, and 3 or more children. The newly born child was included as one of the children.

3.5.2 Psychosocial behavioural change measures

Oral health-related self-efficacy (OHSE), knowledge about children's oral hygiene (KCOH), and oral health fatalism (OHF) were used before as psychosocial measures to assess an individual's oral health-related beliefs and behaviour (Finlayson et al, 2005; Jones et al, 2016). According to Finlayson et al, the 3 psychosocial measures operate under the theoretical framework of the Social Cognitive Theory because self-efficacy, knowledge, beliefs (dental fatalism) and observational learning are 4 key constructs of the Social Cognitive Theory (Bandura, 1989; Finlayson et al, 2007). Simlarly, in the SMILE project, these 3 psychosocial measures were used. The OHSE and KCOH measures were adapted from the measures originally developed by Finlayson et al (Finlayson et al, 2005). In that study by Finlayson et al, these measures were used to

analyse US African American mothers' knowledge of their children's oral health and the level of self-efficacy related to oral care practices.

OHSE was assessed with the questions listed in Table 2. Each item (question) has 5 response choices; the response of "very confident" scored 1, "somewhat confident" scored 2, "not very confident" scored 3, "not at all confident" scored 4, and "I never feel like this" scored 5. The total sum derived from the answers to the 7 questions constituted the OHSE score. A low OHSE score signified high efficacy. The scale developed by Finlayson et al to measure OHSE has 9 items instead of 7 items in the SMILE project (Finlayson et al, 2005). The 2 items left out were regarding tiredness and worry.

The KCOH scale is similar to that developed by Finlayson et al and no items was left out. The KCOH scale consists of 6 items (Table 2). Each item has responses in a 5-level Likert scale. The answer "Strongly agree" scores 1 and "Strongly disagree" scores 5. The KCOH score is the total sum derived from the answers to the 6 questions with a maximum score of 30 and a minimum 6. A high KCOH score is considered to be 27 and above and high scores represent good oral health knowledge.

OHF generally refers to an individual having the belief that he/she is unable to do anything positive in oral health-related matters. OHF can be measured by asking questions on oral health-related beliefs. Instead of using the single item OHF scale by Finlayson et al or the 2-item scale by Jones et al, the OHF scale in the SMILE project adopted the 5-question dental belief measures originally used in the Dunedin Multidisciplinary Health and Development Study to assess dental fatalism (Finlayson et al, 2005; Broadbent et al, 2006; Jones et al, 2016). These 5 questions about maternal oral health beliefs have a 5-level Likert scale responses with 'important' scoring 1 and 'not important at all' scoring 5 (Table 2). The OHF score is the total sum derived from the answers to the 5 questions with a maximum score of 25 and a minimum 5. Contrary to KCOH, a high total score represents high dental fatalism.

3.5.3 Mothers' oral care practices

The longitudinal design of the SMILE project allowed the examination of the mothers' changing pattern of oral care practices in the first 2 years of the children's life. The oral care practices of the mothers consisted of home oral self-care and professional oral care.

For home oral self-care, the frequency of toothbrushing was assessed. The frequency of daily toothbrushing was categorised into 3 groups, no brushing, brushing once or less than once daily, and twice or more daily. In accordance with the recommended toothbrushing regime by the Australian government, brushing twice daily is considered a favourable oral self-care practice. Therefore, mothers who ended up brushing their teeth twice or more daily at 24 months were considered to have a favourable toothbrushing practice (Table 3). There are 4 favourable combinations of toothbrushing practices across the 24 months. The first is mothers who brushed their teeth twice or more daily throughout the 24 months. The second is mothers who brushed once or less than once daily at baseline and 12 months and ended up brushing their teeth twice or more daily at 24 months; and the other 2 combinations are mothers who brushed once or less than once daily either at baseline or at 12 months and ended up brushing their teeth twice or more daily at 24 months.

For professional visit to an oral health practitioner, the favourable oral care practice is a regular visit to an oral health practitioner for preventive care. Therefore, mothers' seeking an oral health professional and the reason for the visit were examined; those who visited an oral health professional within the previous 12 months and the reason for that visit was for a check-up were deemed to practise favourable oral care.

3.5.4 Mothers' self-reported oral health status

Mothers' oral health status was assessed using the experience of toothache within the previous 12 months as a proxy. The toothache experience was re-categorised into 2 groups. One group is mothers having toothache very often, often or sometimes and the other group includes mothers who hardly ever or never had toothache.

3.5.5 Child's oral care practices

Similarly, the longitudinal design of the SMILE project allowed the examination of the children's oral care practices in the first 2 years of the children's life. The children's oral care practices is the dependent variable and consisted of home oral self-care and professional oral care.

For home oral self-care, the frequency of toothbrushing was assessed. The frequency of daily toothbrushing was categorised into 3 groups, brushing twice or more daily, brushing once or less than once daily, and other. 'Other' means no brushing or tooth cleaning may be done by other methods instead of brushing. Similar to adults, the Australian government also recommends twice-daily toothbrushing for children. Therefore, children who ended up having their teeth brushed twice or more at 24 months were considered to have a favourable toothbrushing practice (Table 4). There were 4 favourable combinations of toothbrushing practices across the 24 months. These 4 combinations are similar to the 4 favourable combinations of mothers' toothbrushing patterns described above. In addition, the usage of fluoride toothpaste was assessed.

For the variable professional visit to an oral health practitioner, the child's visit to an oral health practitioner was probably his/her first visit. The visit and the reason for the visit were assessed.

3.6 Statistical analysis

Analysis of the data was undertaken using SPSS version 24 (SPSS Inc., Chicago, IL, USA). Following the generation of descriptive statistics, cross-tabulations were used to compare frequencies for categorical variables, with Chi-square tests used to determine their statistical significance. Comparisons of differences in means were undertaken using analysis of variance. A p value of less than 0.05 was considered to be statistically significant.

Multivariate modelling was undertaken using the GLM command in Stata with a modified Poisson approach using robust error variances, in order to generate prevalence ratios and their 95% CI.

Table 2. Summary of data collection at the different stages of the SMILE project

Stages	Variables	
	Independent	Dependent
Wave 1 (At baseline)	Mothers' sociodemographic details Maternal age Maternal education Household income Country of birth Indigenous status Marital status Family structure Number of children Mothers' oral care practices Toothbrushing frequency Visit to oral health professional Last visit Reason for visit	
Wave 2 (At 3 months)	Psychosocial measures Knowledge of children's oral hygiene Oral health-related fatalism	
Wave 3 (At 6 months)	Mothers' self-reported oral health status Toothache in the last 12 months	Child's self-care practices at home Toothbrushing frequency Fluoride usage
Wave 4 (At 12 months)	Mothers' oral care practices Toothbrushing frequency Visit to oral health professional Last visit Reason for visit	Child's self-care practices at home Toothbrushing frequency Usage of fluoride toothpaste Professional care Visited oral health professional Reason for visit
Wave 5 (At 24 months)	Mothers' oral care practices Toothbrushing frequency Visit to oral health professional Last visit Reason for visit Psychosocial measures Self-efficacy Mothers' self-reported oral health status Toothache in the last 12 months	Child's self-care practices at home Toothbrushing frequency Usage of fluoride toothpaste Professional care Visited oral health professional Reason for visit

Table 3. Oral health-related self-efficacy (OHSE), knowledge of children's oral hygiene (KCOH) and dental fatalism (OHF) measures

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Oral health-related self-efficacy (OHSE)
Scale: 1 = Very confident, 5 = I never feel like this

How confident do you feel about your ability to brush your child's teeth at night when you _____?

1. are under a lot of stress
2. are depressed
3. are anxious
4. feel you do not have the time
5. are bothered by your crying child
6. are bothered because your child doesn't stay still when you want him or her to brush
7. are told by your child that he or she does not feel like brushing right now

Knowledge of children's oral hygiene (KCOH)
Scale: 1 = Strongly agree, 5 = Strongly disagree

1. Cavities in baby teeth don't matter since they will fall out anyway.
2. Keeping baby teeth clean is not very important; after all, they fall out.
3. There is not much I can do to stop my child from developing cavities.
4. There is not much I can do to help my child have healthy teeth.
5. Children don't need to brush every day until they get their permanent teeth.
6. Children don't really need their own toothbrush until all their teeth come in.

Dental fatalism (OHF)
Scale: 1 = Important, 5 = Not important at all

How important do you rate the following in relation to your dental health?

1. Not having a lot of sweet food
2. Using fluoride toothpaste
3. Visiting dentists
4. Brushing teeth
5. Drinking tap (fluoridated) water

Table 4. Overview of algorithm used for categorising changing patterns of mothers' toothbrushing practices

	Toothbrushing twice or more daily		
	At baseline	At 12 months	At 24 months
Not favourable	No	No	No
Not favourable	No	Yes	No
Not favourable	Yes	Yes	No
Not favourable	Yes	No	No
Favourable	No	No	Yes
Favourable	No	Yes	Yes
Favourable	Yes	No	Yes
Favourable	Yes	Yes	Yes

Table 5. Overview of algorithm used for categorising changing patterns of children's toothbrushing practices

	Toothbrushing twice or more daily		
	At 6 months	At 12 months	At 24 months
Not favourable	No	No	No
Not favourable	No	Yes	No
Not favourable	Yes	Yes	No
Not favourable	Yes	No	No
Favourable	No	No	Yes
Favourable	No	Yes	Yes
Favourable	Yes	No	Yes
Favourable	Yes	Yes	Yes

4. Results

Some 2181 mothers participated in the SMILE study. However, 71 (3.3%) participants with 5 or more missing sociodemographic variables were excluded from the analysis of the baseline study sample for this particular investigation, resulting in a total of 2110 participants. All subsequent analyses are confined to these 2110. In the section that follows, I will present first, the data on the sociodemographic characteristics and an overview of the retention of participants in the longitudinal study. Next, bivariate analysis of the independent variables (such as psychosocial characteristics, mothers' oral care practices, and oral health status) and dependent variables (children's oral care practices) are presented and their associations with sociodemographic characteristics described. Following that, the outcome of the multivariate analysis is presented.

4.1 Sociodemographic characteristics and attrition pattern of participants

The sociodemographic characteristics described were collected at baseline. The majority of mothers were between ages 25 and 34 (Table 6). Most were born in Australia, New Zealand or the United Kingdom. Only 1 in 25 had Aboriginal or Torres Strait ethnicity. Almost half of the mothers had university qualifications. The highest percentage of mothers was those with annual household incomes between $40,000 and $80,000.

4.1.1 Family structure

Fewer than 1 in 10 mothers were single parents (Table 7). The highest percentage of single parenthood came from the youngest age group (16 to 24 years old), from the lowest category of annual household income of less than $40,000 or had only school-level education. Most of these mothers were born in Australia, New Zealand or the United Kingdom. The proportion of Aboriginal or Torres Strait mothers who were single parents was almost 3 times that of other mothers.

Most mothers were having their first child. The highest percentage of mothers who had given birth to more than two children was from the lowest annual income category. They were mostly Aboriginal or Torres Strait mothers or those who had only school-level education.

4.1.2 Overview of retention in the longitudinal study

Some 535 (25.4%) of the 2110 mothers who participated had dropped out of the study by 3 months (Table 6). This followed a gradient whereby attrition was higher among younger mothers aged 16 to 24 years, had school level education, in the lowest income group, of Aboriginal or Torres Strait ethnicity, single or had 2 or more other children. In particular, mothers born in India had a higher attrition rate than mothers born elsewhere. Fewer than half of the Aboriginal or Torres Strait mothers remained in the study at the 3-months stage.

The attrition rate had decreased to 69.4% by 6 months with a further 104 mothers (4.9%) who had dropped out between 3 and 6 months. The attrition rate was still higher for mothers who had school-level education, in the lowest income group, were Aboriginal or Torres Strait Islanders, single or had 1 or more other children. By contrast, no mother born in India was lost at this stage but a relatively high percentage of others left the study. At this stage, 30% of participants had been lost.

From the 1471 participants at 6 months, a further 203 (9.3%) were lost. This resulted in 1268 (60.1%) remaining in the SMILE project by 12 months. Similar to the pattern at 6 months, attrition rates were higher among mothers who had school-level education, in the lowest income group, were Aboriginal or Torres Strait Islanders, or were singles.

At this final stage (and after 2 years of the SMILE project), 1178 (55.8%) of the participants remained. As was expected, more young (16-to 24-year-olds) or low SES mothers had been lost. Similarly, of the 86 Aboriginal or Torres Strait mothers who participated in the SMILE project, only 29 (33.7%) were left. In terms of the characteristics of the family structure, the attrition rates for single mothers or those with 3 or more children were slightly higher. Other than mothers born in India, the rates of dropout for mothers born elsewhere were similar.

In summary, the sociodemographic characteristics of the longitudinal sample changed as the study progressed. More mothers of lower SES or who were disadvantaged could not finish the study. The higher attrition of the disadvantaged group meant that the percentage of high SES or advantaged mothers was higher at 24 months than at baseline.

Table 6. Overview of sociodemographic characteristics at baseline and attrition pattern (brackets contain column percentages unless otherwise indicated)

	Baseline	3 months	6 months	12 months	24 months	Missing values
Maternal age						9
16-24	336 (16.0)	202 (12.9)[a]	188 (12.8)[a]	156 (12.3)[a]	127 (10.8)[a]	
25-34	1353 (64.4)	1043 (66.4)	977 (66.5)	848 (66.9)	797 (67.8)	
35+	412 (19.6)	326 (20.8)	304 (20.7)	264 (20.8)	251 (21.4)	
Maternal education						6
School only	564 (26.8)	352 (22.4)[a]	313 (21.3)[a]	260 (20.6)[a]	222 (18.9)[a]	
Vocational	572 (27.2)	419 (26.7)	384 (26.2)	326 (25.8)	301 (25.7)	
University	968 (46.0)	800 (50.9)	770 (52.5)	679 (53.7)	650 (55.4)	
Household income						119
<=$40,000	391 (19.6)	238 (15.8)[a]	212 (15.1)[a]	173 (14.2)[a]	151 (13.4)[a]	
$40,001-$80,000	683 (34.3)	488 (32.5)	470 (33.4)	398 (32.7)	365 (32.4)	
$80,001-$120,000	549 (27.6)	445 (29.6)	410 (29.1)	374 (30.7)	342 (30.4)	
>$120,000	368 (18.5)	332 (22.1)	316 (22.4)	272 (22.4)	268 (23.8)	
Country of birth						13
Australia/NZ/UK	1530 (73.0)	1173 (75.0)[a]	1097 (75.0)[a]	937 (74.6)[a]	875 (74.8)	
Asia (not India)	240 (11.4)	178 (11.4)	162 (11.1)	146 (11.6)	132 (11.3)	
India	186 (8.9)	114 (7.3)	114 (7.8)	98 (7.8)	90 (7.7)	
Other	141 (6.7)	100 (6.4)	89 (6.1)	74 (5.9)	73 (6.2)	
Aboriginal or Torres Strait						10
Yes	86 (4.1)	42 (2.7)[a]	37 (2.5)[a]	30 (2.4)[a]	29 (2.5)[a]	
No	2014 (95.9)	1525 (97.3)	1426 (97.5)	1231 (97.6)	1143 (97.5)	
Single-parent household						8
Yes	168 (8.0)	104 (6.6)[a]	95 (6.5)[a]	78 (6.2)[a]	72 (6.1)[a]	
No	1934 (92.0)	1466 (93.4)	1371 (93.5)	1187 (93.8)	1101 (93.9)	
Number of other children						58
None	927 (45.2)	723 (47.2)[a]	691 (48.3)[a]	606 (49.2)[a]	542 (47.2)[a]	
One	739 (36.0)	554 (36.1)	508 (35.5)	436 (35.4)	426 (37.1)	
Two or more	386 (18.8)	256 (16.7)	233 (16.3)	190 (15.4)	181 (15.8)	
Total[b]	2110 (100.0)	1575 (74.6)	1471 (69.7)	1268 (60.1)	1178 (55.8)	

[a] P<0.05

[b] Row %

Table 7. Family structure, by sociodemographic characteristics at baseline (brackets contain row percentages unless otherwise indicated)

	Single parent			Number of other children			
	No	Yes	MV	None	One	Two or more	MV
Maternal age			17				67
16-24	280 (83.8)	54 (16.2)[a]		220 (69.2)	76 (23.9)	22 (6.9)[a]	
25-34	1269 (94.1)	80 (5.9)		608 (46.1)	480 (36.4)	231 (17.5)	
35+	379 (92.4)	31 (7.6)		96 (23.6)	180 (44.3)	130 (32.0)	
Maternal education			14				64
School only	495 (88.2)	66 (11.8)[a]		206 (38.1)	179 (33.1)	155 (28.7)[a]	
Vocational	510 (81.5)	60 (10.5)		248 (44.1)	203 (36.1)	111 (19.8)	
University	926 (96.0)	39 (4.0)		471 (49.9)	354 (37.5)	119 (12.6)	
Household income			127				177
<=$40,000	275 (70.7)	114 (29.3)[a]		163 (42.8)	110 (28.9)	108 (28.3)[a]	
$40,001-$80,000	649 (95.7)	29 (4.3)		288 (43.3)	256 (38.5)	121 (18.2)	
$80,001-$120,000	543 (99.1)	5 (0.9)		227 (43.2)	213 (40.5)	86 (16.3)	
>$120,000	363 (98.6)	5 (1.4)		199 (55.1)	116 (32.1)	46 (12.7)	
Country of birth			21				69
Australia/NZ/UK	1385 (90.8)	141 (9.2)[a]		661 (44.4)	514 (34.5)	313 (21.0)[a]	
Asia (not India)	223 (94.5)	13 (5.5)		116 (50.4)	86 (37.4)	28 (12.2)	
India	183 (98.4)	3 (1.6)		88 (48.1)	89 (48.6)	6 (3.3)	
Other	132 (93.6)	9 (6.4)		58 (41.4)	45 (32.1)	37 (26.4)	
Aboriginal or Torres Strait			16				68
Yes	64 (79.0)	17 (21.0)[a]		26 (31.0)	31 (36.9)	27 (32.1)[a]	
No	1863 (92.5)	150 (7.5)		898 (45.9)	704 (36.0)	356 (18.2)	
Number of other children							
None	847 (91.6)	78 (8.4)[a]	65				
One	699 (94.8)	38 (5.2)					
Two or more	335 (87.5)	48 (12.5)					
All combined	1934 (92.0)	168 (8.0)	8	927 (45.2)	739 (36.0)	386 (18.8)	58

[a]P<0.05

MV = missing values

4.2 Psychosocial characteristics

The 3 psychosocial characteristics measured were oral health-related self-efficacy (OHSE), knowledge of children's oral hygiene (KCOH) and oral health fatalism (OHF). Each will be described.

The OHSE data were collected at Wave 5 at 24 months and so had fewer values than KCOH and OHF that were collected at Wave 2 (at 3 months). About 1 out of 5 mothers felt very confident that they could still brush the children's teeth during the 7 distressful situations described by the 7 items of the OHSE scale (Table 8). The most common response was 'somewhat confident' to all 7 OHSE questions. Among the 7 items, fewer mothers felt very confident in brushing the children's teeth when the children were crying or not staying still but not when they were stressful. Oddly, there were substantially more mothers (about 3 out of 10) answering 'I never feel like this' when they were asked whether they felt confident they were able to brush their children teeth while depressed or anxious.

The value of the Cronbach's alpha coefficient was 0.93 for the 7 items of the OHSE scale; depicting that the internal consistency of the 7 items of the OHSE scale was relatively high. Hence, the total OHSE score was used to categorise the participants' levels of oral health-related self-efficacy. A participant's total OHSE score of 7 to 12 was considered to have high OHSE. In the SMILE project, 1 out of 4 participants had high OHSE and close to 1 out of 10 answered 'very confident' to all 7 items of the scale (Table 9).

The KCOH data concern 2 aspects, one is knowledge of oral care practices and the other is knowledge of the child's oral health. For oral care practices knowledge, the participants appeared to possess good knowledge of oral care practices. About 9 out of 10 mothers strongly disagreed with the 4 questions representing poor home self-care practices (Table 10). For the knowledge of children's oral health condition, only slightly fewer (about 8 out of 10) mothers strongly disagreed that it did not matter that the children's teeth had cavities but once again, about 9 out of 10 strongly disagreed that clean teeth were not important. The Cronbach's alpha coefficient for the 6 items of the KCOH scale was 0.74, implying that the items had relatively high internal consistency since a reliability coefficient of 0.70 or higher is considered acceptable.

A participant's total KCOH score of 27 and above was categorised as good KCOH, and close to 90% of mothers were in that category (Table 11). Slightly more than 6 out of 10 had maximum scores. For a KCOH score to be 27 and above, the answers for at least half of the 6 questions had to be 'strongly disagree'. Thus, a participant who had good KCOH strongly disagreed with at least 3 out of the 6 statements representing KCOH and also somewhat disagreed with the remaining 3 statements.

For the OHF data, the 5 items of the OHF scale had a low Cronbach's alpha coefficient of 0.56 (Table 12). The lack of internal consistency could be observed by the answers to the questions. Although about 9 out of 10 mothers considered teeth brushing important for their oral health, about 6 out of 10 agreed on the importance of visiting a dentist and on the usage of fluoridated toothpaste. Furthermore, only about half of the mothers recognised the necessity to reduce the intake of sweet food. Drinking tap water drew the fewest 'important' answers; about 4 out of 10 mothers considered drinking fluoridated tap water important and about 1 in 10 (answered 4 and 5) considered it unimportant. On the other hand, very few mothers (about 1 out of 50) did not think it was important to have any of these good oral health practices.

Since the internal consistency of the 5 items of the OHF scale was low, it would not be meaningful to use the total score to represent OHF. Instead, I decided that the answer of '1' or '2' on the 5-level Likert scale for the 5 OHF questions as a favourable response. Low OHF is represented by 4 or more favourable responses to the 5 OHF questions. In other words, a participant has a low OHF when the responses to 4 of the 5 OHF questions are favourable. The number of participants having favourable responses to the 5 items of the OHF scale is presented on Table 13; about 3 quarters of participants had low OHF.

The OHSE, KCOH and OHF data are presented by mothers' sociodemographics characteristics in Table 14. An income gradient was observed for all 3 psychosocial factors. While higher household income was associated with favourable KCOH and OHF, it was vice versa for OHSE. The other SES indicators such as education level and family size displayed similar gradient for OHSE whereby higher education level or fewer children in the family were more likely to experience lower OHSE. Similarly, older or indigenous mothers were more likely to have lower OHSE.

For KCOH, besides annual income level, no sociodemographic gradient was observed for the other SES indicators such as education level and family size. Similarly, no KCOH differences were observed by age and marital status. However, India-born mothers had a markedly lower KCOH than mothers born elsewhere, while the difference between Aboriginal or Torres Strait Islanders and non-Aboriginal or Torres Strait Islanders was slight.

Older or non-Aboriginal or Torres Strait Islander mothers had lower OHF. Otherwise, no differences in OHF were observed for the other SES proxies such as education level and family size or marital status. Mothers born in India also did not have high OHF.

Table 8. Responses to questions on oral health self-efficacy (OHSE) (brackets contain row percentages)

	Maternal ratings					
	Very confident	Somewhat confident	Not very confident	Not at all confident	I never feel like this	Unknown
OHSE	1	2	3	4	5	
Stress	322 (31.7)	366 (36.7)	146 (14.4)	52 (5.1)	117 (11.5)	12 (1.2)
Depressed	253 (24.9)	270 (26.6)	117 (11.5)	44 (4.3)	322 (31.7)	9 (0.9)
Anxious	276 (27.2)	286 (28.2)	111 (10.9)	42 (4.1)	290 (28.6)	10 (1.0)
No time	246 (24.2)	374 (36.8)	203 (20.0)	69 (6.8)	111 (10.9)	12 (1.2)
Bothered by crying	199 (19.6)	347 (34.2)	231 (22.8)	91 (9.0)	131 (12.9)	16 (1.6)
Child not staying still	233 (23.0)	382 (37.6)	212 (20.9)	73 (7.2)	99 (9.8)	16 (1.6)
Child not feel like brushing	286 (28.2)	360 (35.5)	162 (16.0)	61 (6.0)	136 (13.4)	10 (1.0)
Total					1015 (100.0)	
Missing values					163	
Total participants at 24 months					1178	

Cronbach's alpha = 0.93

Table 9. Categorised total OHSE score (brackets contain column percentages)

Total score	Number of participants
0-6	14 (1.4)
7	88 (8.7)
8-12	167 (16.5)
12-17	363 (35.8)
18-28	299 (29.5)
29-35	84 (8.3)
Total	1178 (100.0)
Missing values	163
High OHSE score (7-12)	255 (25.1)

Table 10. Responses to questions on knowledge of children's oral hygiene (KCOH) (brackets contain row percentages)

	Maternal ratings					
	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Unknown
KCOH	1	2	3	4	5	
Holes in teeth don't matter	9 (0.6)	30 (1.9)	63 (4.0)	222 (14.1)	1241 (78.8)	10 (0.6)
Clean teeth not important	11 (0.7)	12 (0.8)	15 (1.0)	128 (8.1)	1402 (89.0)	7 (0.4)
Cannot do much to stop holes in teeth	5 (0.3)	22 (1.4)	54 (3.4)	218 (13.8)	1268 (80.5)	8 (0.5)
Cannot do much to keep teeth healthy	15 (1.0)	12 (0.8)	13 (0.8)	125 (7.4)	1399 (88.8)	11 (0.7)
No need daily brushing	2 (0.1)	9 (0.6)	28 (1.8)	109 (6.9)	1416 (89.9)	11 (0.7)
No need for own toothbrush	9 (0.6)	17 (1.1)	52 (3.3)	111 (7.0)	1375 (87.3)	11 (0.7)
Total					1575 (100.0)	

Cronbach's alpha = 0.74

Table 11. Categorised total KCOH score (brackets contain column percentages)

Total score	Number of paticipants
6-23	58 (3.7)
24-26	127 (8.2)
27-29	395 (25.4)
30	975 (62.7)
Total	1575 (100.0)
Missing values	20
High KCOH score (27-30)	1370 (88.1)

Table 12. Responses to questions on oral health fatalism (OHF) (brackets contain row percentages)

	Important			Not important	
Oral health fatalism	1	2	3	4	5
Not having too much sweet food	810 (51.4)	406 (25.8)	276 (17.5)	48 (3.0)	23 (1.5)
Using fluoride toothpaste	957 (60.8)	324 (20.6)	210 (13.3)	44 (2.8)	24 (1.5)
Visiting dentist [a]	937 (59.5)	386 (24.5)	118 (11.9)	40 (2.5)	14 (0.9)
Brushing teeth	1463 (92.9)	86 (5.5)	11 (0.7)	2 (0.1)	1 (0.1)
Drinking tap water	614 (39.0)	431 (27.4)	347 (22.0)	83 (5.3)	92 (5.8)
Total				1575 (100.0)	

[a] 1 missing value

Cronbach's alpha = 0.56

Table 13. Number of favourable responses to the OHF scale (brackets contain column percentages

Favourable responses	Number of participants
0	16 (1.0)
1	30 (1.9)
2	97 (6.2)
3	264 (16.8)
4	442 (28.1)
5	726 (46.1)
Total	1575 (100.0)
Low OHF	1168 (74.2)

Favourable response = answer 'important 1 or 2'

Low OHF = 4 or more favourable responses

Table 14. Favourable psychosocial factor scores, by sociodemographic characteristics at baseline (brackets contain row percentages unless otherwise indicated)

	High OHSE[c]	MV[b]	Good KCOH[d]	MV[b]	Low OHF[e]	MV[b]
Maternal age		165		24		20
16-24	39 (34.8)[a]		174 (87.9)		133 (67.9)[a]	
25-34	175 (25.8)		911 (88.3)		722 (74.5)	
35+	40 (18.0)		282 (87.9)		260 (80.5)	
Maternal education		167		24		20
School only	59 (32.8)[a]		302 (87.3)		243 (70.6)[a]	
Vocational	75 (28.1)		375 (90.6)		288 (69.4)	
University	121 (21.5)		689 (87.1)		633 (79.5)	
Household income		207		89		85
<=$40,000	42 (32.3)		194 (84.0)[a]		163 (70.6)[a]	
$40,001-$80,000	83 (26.9)		419 (86.7)		351 (72.1)	
$80,001-$120,000	68 (23.1)		395 (88.8)		338 (76.6)	
>$120,000	49 (20.6)		303 (92.7)		264 (79.8)	
Country of birth		169		30		26
Australia/NZ/UK	203 (26.9)		1052 (90.5)[a]		854 (73.5)	
Asia (not India)	23 (20.0)		141 (80.1)		142 (80.2)	
India	17 (23.0)		82 (74.5)		86 (76.1)	
Other	10 (15.6)		86 (88.7)		78 (80.4)	
Aboriginal or Torres Strait		169		28		24
Yes	3 (12.0)		36 (85.7)		26 (63.4)	
No	250 (25.4)		1329 (88.3)		1135 (75.2)	
Single-parent household		168		25		21
Yes	17 (26.2)		91 (88.3)		74 (74.0)	
No	238 (25.2)		1275 (88.1)		1090 (75.0)	
Number of other children		183		63		59
None	109 (22.6)[a]		624 (87.5)		528 (73.5)	
One	89 (24.4)		476 (87.7)		414 (76.5)	
Two or more	50 (33.8)		232 (90.6)		194 (76.4)	
Total	1178 (100.0)		1575 (100.0)		1575 (100.0)	

[a]P<0.05

[b]MV = missing values

[c]High OHSE score = OHSE score 7-12

[d]Good KCOH score = KCOH score 27 and above

[e]Low OHF score = 4 or more favourable responses (see Table 8)

4.3 Mothers' oral care practices

For home oral self-care, the majority of mothers brushed their teeth twice or more daily across the 24-month (Table 15). However, the proportion of toothbrushing twice or more daily declined towards the end of the 24 months, while the proportion of mothers who brushed once or less than once daily increased. Close to 1 out of 50 mothers did not brush their teeth at all, and that proportion remained fairly constant over the last 12 months of the study.

Throughout the 2 years of follow-up, close to 50% of the mothers had visited a dental professional (Table 16). At baseline, about 7 out of 10 mothers who visited a dental professional went for dental check-ups. However, after giving birth, the proportion making check-up visits declined, and that visiting due to dental problems increased. By 24 months, only 6 out of 10 mothers had visited an oral health professional for a check-up.

Mothers who ended up brushing their teeth twice or more daily at 24 months were considered to have favourable toothbrushing practices (see Table 3 in methods). Overall, slightly more than 6 out of 10 mothers had favourable toothbrushing practices (Table 17). Higher proportions of these mothers were above 35 years old, had attended university or having a household income above A$120,000 per annum. Mothers who were born in Asia (other than India) had the highest rate of favourable toothbrushing practices. By contrast, Indian-born mothers fared the worst. Single mothers also performed significantly poorer than those living in 2-parent households.

Once again, the sociodemographic characteristics of mothers who went for check-ups were similar to those who had favourable toothbrushing practices. Mothers who were above 35 years old, attended university, having a household income above A$120,000 per annum, born in Asia other than India, or living in 2-parent households, tended to visit an oral health professional for check-ups. Mothers who had been born in India appeared the most likely to avoid check-up visits and only seek professional help when pain or problem occurred.

Table 15. Mothers' toothbrushing frequency (brackets contain column percentages)

	At baseline	At 12 months	At 24 months
Brushing per day			
No brushing	2 (0.2)	20 (1.9)	20 (1.7)
Once or less	266 (22.7)	336 (32.6)	405 (34.2)
Twice or more	905 (77.2)	675 (65.4)	744 (63.2)
Unknown	0 (0.0)	1 (0.1)	9 (0.8)
Missing values	5	146	0
All combined	1173 (100.0)	1032 (100.0)	1178 (100.0)

Table 16. Mothers' reason for visiting an oral health professional, by oral health professional visited in the previous 12 months (brackets contain row percentages unless otherwise indicated)

	Check-up	Problem	Missing values	Total[a]
Dental professional visited in previous 12 months				
At baseline	404 (69.5)	177 (30.5)[b]	9	581 (49.7)
At 12 months	317 (67.4)	153 (32.6)[b]	146	470 (45.5)
At 24 months	333 (59.8)	224 (40.2)[b]	0	557 (47.3)
Total				1178 (100.0)

[a]Column %

[b]P<0.05

Table 17. Mothers' oral care practice pattern, by sociodemographic characteristics (brackets contain row percentages unless otherwise indicated)

	Home self-oral care			Professional care[a]		
	Not favourable	Favourable	Mv	Check up	Problem	Mv
Maternal age			150			3
16-24	54 (52.4)	49 (47.6)[b]		14 (11.0)	113 (89.0)[b]	
25-34	256 (36.2)	451 (63.8)		230 (28.9)	567 (71.1)	
35+	63 (28.9)	155 (71.1)		95 (37.8)	156 (62.2)	
Maternal education			153			5
School only	91 (51.1)	87 (48.9)[b]		32 (14.4))	190 (85.6)[b]	
Vocational	114 (43.2)	150 (56.8)		71 (23.6)	230 (76.4)	
University	167 (28.6)	416 (71.4)		236 (36.3)	414 (63.7)	
Household income			63			52
<=$40,000	72 (34.0)	140 (66.0)[b]		20 (13.2)	131 (86.8)[b]	
$40,001-$80,000	140 (29.8)	330 (70.2)		74 (20.3)	291 (79.7)	
$80,001-$120,000	94 (22.9)	316 (77.1)		108 (31.6)	234 (68.4)	
>$120,000	61 (19.3)	255 (80.7)		132 (49.3)	136 (50.7)	
Country of birth			154			8
Australia/NZ/UK	296 (38.0)	482 (62.0)[b]		256 (29.3)	619 (70.7)[b]	
Asia (not India)	25 (22.7)	85 (77.3)		47 (35.6)	85 (64.4)	
India	35 (46.7)	40 (53.3)		8 (8.9)	82 (91.1)	
Other	16 (26.2)	45 (73.8)		26 (35.6)	47 (64.4)	
Aboriginal or Torres Strait			155			6
Yes	9 (39.1)	14 (60.9)		9 (31.0)	20 (69.0)	
No	363 (36.3)	637 (63.7)		329 (28.8)	814 (71.2)	
Single-parent household			152			5
Yes	36 (60.0)	24 (40.0)[b]		12 (16.7)	60 (83.3)[b]	
No	336 (34.8)	630 (65.2)		325 (29.5)	776 (70.5)	
Number of other children			173			29
None	203 (41.5)	286 (58.5)[b]		168 (31.0)	374 (69.0)	
One	107 (29.6)	254 (70.4)		122 (28.6)	304 (71.4)	
Two or more	54 (34.8)	101 (65.2)		43 (23.8)	138 (76.2)	
Total	373 (36.3)	655 (63.7)	150	339 (28.8)	839 (71.2)	0

[a]Data collected at 24 months

[b]$P<0.05$

4.4 Mothers' oral health

Self-reported oral health was used as a proxy for mothers' clinical oral health since there was no clinical examination of the mothers during the SMILE project.

Overall, about 3 out of 10 mothers reported experiencing some form of toothache within the 24 months duration of the study (Table 18). Similarly, there was a higher proportion of toothache complaint in all sociodemographic groups at 24 months than at 6 months and thus coincided with an increase in visiting an oral health professional for the relief of pain or a problem (Table 16). Childbirth appeared to be a predictor of dental toothache and pain/problem visit to an oral health professional.

Maternal toothache complaint followed a gradient across age and SES indicators such as educational level, annual household income, and family size. Mothers who were 16 to 24 years of age, had school level education, were in the lowest annual income group or have 2 or more other children had the highest proportion of toothache complaints. In addition, more mothers born in India had suffered toothaches (than mothers born elsewhere) in the 2 years after childbirth. Similarly, mothers of Aboriginal or Torres Strait ethnicity or from single-parent households also had more toothache complaints.

Table 18. Mothers' experience of toothache in the previous 12 months, by sociodemographic characteristics (brackets contain row percentages unless otherwise indicated)

	At 6 months			At 24 months		
	Yes[b]	No[c]	MV[d]	Yes[b]	No[c]	MV[d]
Maternal age			2			3
16-24	61 (32.4)	127 (67.6)[a]		46 (36.2)	81 (63.8)	
25-34	199 (20.4)	80 (5.9)		188 (23.6)	603 (76.4)	
35+	73 (24.0)	31 (7.6)		64 (25.5)	187 (74.5)	
Maternal education			4			5
School only	88 (28.1)	225 (71.9)[a]		81 (36.5)	141 (63.6)[a]	
Vocational	96 (25.0)	288 (75.0)		79 (26.2)	222 (73.8)	
University	148 (19.2)	622 (80.8)		137 (21.1)	513 (78.9)	
Household income			63			52
<=$40,000	75 (35.4)	137 (64.6)[a]		62 (41.1)	89 (58.9)[a]	
$40,001-$80,000	111 (23.6)	359 (76.4)		103 (28.2)	262 (71.8)	
$80,001-$120,000	74 (18.0)	336 (82.0)		74 (21.6)	268 (78.4)	
>$120,000	57 (18.0)	259 (82.0)		42 (15.7)	226 (84.3)	
Country of birth			9			8
Australia/NZ/UK	258 (23.5)	839 (76.5)		217 (24.8)	658 (75.2)	
Asia (not India)	33 (20.4)	129 (79.6)		33 (25.0)	99 (75.0)	
India	27 (23.7)	87 (76.3)		31 (34.4)	59 (65.6)	
Other	12 (13.5)	77 (86.3)		16 (21.9)	57 (78.1)	
Aboriginal or Torres Strait			0			6
Yes	1 (12.5)	7 (87.5)		9 (31.0)	20 (69.0)	
No	333 (22.8)	1130 (77.2)		288 (25.2)	855 (74.8)	
Single-parent household			5			5
Yes	28 (29.5)	67 (70.5)		24 (33.3)	43 (66.7)	
No	305 (22.2)	1066 (77.8)		274 (24.9)	827 (75.1)	
Number of other children			39			29
None	135 (19.5)	556 (80.5)		111 (20.5)	431 (79.5)[a]	
One	118 (23.2)	390 (76.8)		116 (27.2)	310 (72.8)	
Two or more	74 (31.8)	159 (68.2)		63 (34.8)	118 (65.2)	
Total	1471 (100.0)			1178 (100.0)		

[a]P<0.05

[b]Yes=Very often, often or sometimes

[c]No=Hardly ever, never or unknown

[d]MV = missing values

4.5 Children's oral care practices

Children's oral care practices consisted of 2 components; one is home self-care (toothbrushing) and the other, preventive professional care (check-up visits).

The increase in daily toothbrushing from 6 months to 24 months coincided with the eruption of the primary dentition (Table 19). By 24 months, when all the primary teeth had erupted, almost 9 out of 10 children had their teeth brushed at least once daily. Some 7 out of 20 mothers brushed twice daily.

By 24 months, more than 8 out of 10 mothers used toothpaste when they brushed their children's teeth (Table 20). This meant that almost all toothbrushing activities involved the usage of toothpaste.

Children who ended up having their teeth brushed twice or more at 24 months were considered to have a favourable toothbrushing practice (see Table 4 in the Methods section). Overall, almost 4 out of 10 children had favourable toothbrushing patterns (Table 21). There was no distinct pattern observed for maternal age, SES indicators such as education level, income and family size, and country of birth. Aboriginal or Torres Strait mothers and those from single households were likely to have a more favourable toothbrushing pattern (albeit with small sample sizes).

Some 1 out of 4 mothers had high OHSE scores (Table 22). Although high OHSE was associated with only slightly higher toothpaste usage, the children's toothbrushing frequency of twice or more daily was significantly higher. For KCOH, about 9 out of 10 mothers had good KCOH. Good KCOH was associated with children's toothbrushing twice or more daily but not with toothpaste usage. Similarly, more favourable responses to the 5 questions on OHF did not register any difference in toothpaste usage. Some 7 out of 10 mothers had at least 4 favourable responses to the 5 OHF questions and these mothers were more likely to brush their children's teeth twice or more daily than mothers who had fewer than 4 favourable responses.

Likewise, mothers who had favourable toothbrushing patterns were 3 times more likely to brush their children's teeth twice or more daily than mothers not having favourable toothbrushing patterns. Toothpaste usage was consistent between the 2 groups of

mothers. However, mothers' oral health status, with self-reported toothache as a proxy, was not associated with children's toothbrushing frequency or toothpaste usage.

For children's professional preventive oral care, close to 2 out of 10 children had visited an oral health professional for a check-up (Table 23). Mothers who went for dental check-up were more likely to bring their children for check-ups as well. Otherwise, mothers' toothbrushing pattern and psychosocial factors such as OHSE, KCOH or OHF were not associated with children's professional preventive oral care.

Table 19. Frequency of children's toothbrushing/cleaning daily (brackets contain column percentages)

	At 6 months	At 12 months	At 24 months
Twice or more	58 (5.3)	164 (13.9)	401 (34.0)
Once or more daily	187 (17.1)	549 (46.6)	641 (54.4)
Other	850 (77.6)	465 (39.5)	136 (11.5)
Missing values	83	0	0
Total	1095 (100.0)	1178 (100.0)	1178 (100.0)

Other = Less than one time per day, none, N/A or unknown

Table 20. Usage of toothpaste during child's teeth cleaning (brackets contain column percentages)

	At 12 months	At 24 months
Yes	289 (28.0)	999 (84.8)
No	743 (72.0)	179 (15.2)
Missing values	146	0
Total	1032 (100.0)	1178 (100.0)

Table 21. Categorised changes in children's toothbrushing practices, by sociodemographic characteristics (brackets contain row percentages unless otherwise indicated).

	Not favourable	Favourable	Total[a]	Missing values
Maternal age				84
16-24	71 (61.2)	45 (38.8)	116 (10.6)	
25-34	444 (59.8)	299 (40.2)	743 (67.9)	
35+	154 (65.5)	81 (34.5)	235 (21.5)	
Maternal education				87
School only	116 (59.5)	79 (40.5)	195 (17.9)	
Vocational	181 (64.2)	101 (35.8)	282 (25.8)	
University	369 (60.1)	245 (39.9)	614 (50.3)	
Household income				127
<=$40,000	83 (64.3)	46 (35.7)	129 (12.3)	
$40,001-$80,000	208 (60.8)	134 (39.2)	342 (32.5)	
$80,001-$120,000	191 (58.6)	135 (41.4)	326 (31.0)	
>$120,000	160 (63.0)	94 (37.0)	254 (24.2)	
Country of birth				89
Australia/NZ/UK	507 (61.2)	322 (38.8)	829 (70.1)	
Asia (not India)	73 (61.9)	45 (38.1)	118 (10.8)	
India	50 (62.5)	30 (37.5)	80 (7.3)	
Other	37 (59.7)	25 (40.3)	62 (5.7)	
Aboriginal or Torres Strait				89
Yes	14 (56.0)	11 (44.0)	25 (2.3)	
No	650 (61.1)	414 (38.9)	1064 (97.7)	
Single-parent household				88
Yes	43 (67.2)	21 (32.8)	64 (5.9)	
No	623 (60.7)	403 (39.3)	1026 (94.1)	
No of other children at home				109
One	324 (63.2)	189 (36.8)	513 (48.0)	
Two	234 (59.8)	157 (40.2)	391 (36.6)	
Three or more	98 (59.4)	67 (40.6)	165 (15.4)	
Overall	669 (61.1)	426 (38.9)	1178 (100.0)	83

[a]Column %

Table 22. Children's toothbrushing with toothpaste and frequency at 24 months, by psychosocial factors, maternal oral care practices and oral health status (brackets contain row percentages unless otherwise indicated)

	Child's (home self-care) toothbrushing at 24 months					
	With toothpaste		Frequency			
	Yes	No or unknown	Once, none, unknown or N/A	Twice or more	Total[a]	Missing values
High OHSE score (7 to 12)[c]						163
No	638 (83.9)	122 (16.1)	527 (64.3)	233 (30.7)[b]	760 (74.9)	
Yes	226 (88.6)	29 (11.4)	144 (56.3)	111 (43.5)	255 (25.1)	
Total						
Good KCOH score (≥ 27)[d]						67
No	110 (84.6)	20 (15.4)	98 (75.4)	32 (24.6)	130 (11.7)	
Yes	836 (85.2)	145 (14.8)	631 (64.3)	350 (35.7)	981 (88.3)	
Total	946 (85.1)	165 (14.9)	729 (65.6)	382 (34.4)	1111 (100.0)	
Number of favourable responses for OHF[e]						0
0	55 (80.9)	13 (19.1)	49 (72.1)	19 (27.9)[b]	68 (5.8)	
1	20 (95.2)	1 (4.8)	16 (76.2)	5 (23.8)	21 (1.8)	
2	60 (84.5)	11 (15.5)	57 (60.3)	14 (19.7)	71 (6.0)	
3	154 (83.2)	31 (16.8)	130 (70.3)	55 (29.7)	185 (15.7)	
4	281 (87.5)	40 (12.5)	215 (67.0)	166 (33.0)	321 (27.2)	
5	429 (83.8)	83 (16.2)	310 (60.5)	202 (39.5)	512 (43.5)	
Total	999 (84.8)	179 (15.2)	777 (66.0)	401 (34.0)	1178 (100.0)	
Mothers' favourable toothbrushing pattern						150
No	315 (84.5)	58 (15.5)	317 (85.0)	56 (15.0)[b]	373 (36.3)	
Yes	562 (85.8)	93 (14.2)	357 (54.7)	298 (45.3)	655 (63.7)	
Total	877 (85.3)	151 (14.7)	674 (65.6)	354 (34.4)	1028 (100.0)	
Reason for mother's dental visit						0
Check-up	286 (84.4)	53 (15.6)	218 (64.3)	121 (35.7)	339 (28.8)	
Pain/unknown	713 (85.0)	126 (15.0)	559 (66.6)	280 (33.4)	839 (71.2)	
Total	999 (84.8)	179 (15.2)	777 (66.0)	401 (34.0)	1178 (100.0)	

[a]Column %

[b]P<0.05

[c]High OHSE score = OHSE score 7-12

[d]Good KCOH score = KCOH score 27 and above

[e]Favourable response = answer 'important 1 or 2' for OHF questions

Table 23. Children's reason for visiting an oral health professional at 24 months, by mothers' oral health knowledge and beliefs (brackets contain row percentages unless otherwise indicated)

	Children's reason for visiting an oral health professional at 24 months			
	Check-up	Problem or unknown	Total[a]	Missing values
High OHSE score (7 to 12)[c]				163
No	128 (16.8)	632 (83.2)	760 (74.9)	
Yes	47 (18.4)	208 (81.6)	255 (25.1)	
Total	175 (17.2)	840 (82.8)	1015 (100.0)	
Good KCOH score (≥ 27)[d]				
No	25 (19.2)	105 (80.8)	130 (11.7)	67
Yes	169 (17.2)	812 (82.8)	981 (88.3)	
Total	194 (17.5)	917 (82.5)	1111 (100.0)	
Number of favourable responses for OHF[e]				
0	7 (10.3)	61 (89.7)[b]	68 (5.8)	0
1	0 (0.0)	21 (100.0)	21 (1.8)	
2	9 (12.7)	62 (87.3)	71 (6.0)	
3	30 (16.2)	155 (83.8)	185 (15.7)	
4	61 (19.0)	260 (81.0)	321 (27.3)	
5	95 (18.6)	417 (81.4)	511 (43.4)	
Total	202 (17.1)	976 (82.9)	1178 (100.0)	
Mothers' favourable toothbrushing pattern				150
No	67 (18.0)	306 (82.0)	373 (36.3)	
Yes	114 (17.4)	541 (82.6)	655 (63.7)	
Total	181 (17.6)	847 (82.4)	1028 (100.0)	
Reason for mother's dental visit				0
Check-up	76 (22.4)	263 (77.6)[b]	339 (28.8)	
Pain/unknown	126 (15.0)	713 (85.0)	839 (71.2)	
Total	202 (17.1)	976 (82.9)	1178 (100.0)	

[a]Column %

[b]P<0.05

[c]High OHSE score = OHSE score 7-12

[d]Good KCOH score = KCOH score 27 and above

[e]Favourable response = answer 'important 1 or 2' for OHF questions

4.6 Multivariate analysis

Multivariate analysis was carried out with Poisson regression to obtain adjusted prevalence ratios. After controlling for possible confounders and mediators with the multivariate regression model, favourable maternal toothbrushing practice was found to be strongly associated with the children's toothbrushing practice (Model 1 in Table 24). Mothers who had a favourable toothbrushing pattern were 3 times more likely to brush their children's teeth twice or more daily. Only OHF variables remained associated with children's toothbrushing practice.

Similarly, for the children's visiting an oral health professional for check-ups, the family size was the only variable that remained significant after adjusting for the other covariates (Model 2 in Table 24). Mothers with more than one child were less likely to take their children for check-up visits.

Table 24. Multivariate logistic regression models for children's oral care practices and mothers' sociodemographic characteristics, psychosocial factors, oral care practices and oral health status

Mothers' characteristics	Children's oral care practices					
	Model 1. Toothbrushing twice or more daily			Model 2. Visit to oral health professional for check-ups		
	PR[b]	95% CI[c]	*P*-value	PR[b]	95% CI[c]	*P*-value
Maternal age[d]	0.98	0.96, 1.00	0.088	1.00	1.00, 1.00	0.335
Household income						
<=$40,000[a]						
$40,001-$80,000	1.04	0.74, 1.46	0.818	1.02	0.97, 1.08	0.415
$80,001-$120,000	1.06	0.76, 1.51	0.711	1.01	0.95, 1.07	0.840
>$120,000	0.92	0.63, 1.33	0.654	1.00	0.93, 1.07	0.926
Maternal education						
School only[a]						
Vocational	0.79	0.59, 1.04	0.095	1.02	0.98, 1.07	0.324
University	0.87	0.67, 1.12	0.273	1.00	0.96, 1.05	0.882
Country of birth						
Australia/NZ/UK[a]						
Asia (not India)	0.72	0.50, 1.03	0.070	0.94	0.89, 1.00	0.055
India	1.10	0.72, 1.69	0.650	1.03	0.98, 1.09	0.219
Other	0.74	0.47, 1.16	0.193	0.97	0.91, 1.04	0.355
Aboriginal or Torres Strait						
Yes[a]						
No	0.82	0.35, 1.90	0.646	0.95	0.82, 1.10	0.485
Single parenthood						
Yes[a]						
No	0.83	0.54, 1.32	0.399	1.02	0.95, 1.10	0.498
Family size						
One[a]						
Two	1.09	0.88, 1.35	0.428	0.97	0.94, 1.00	0.047
Three or more	1.08	0.80, 1.44	0.621	0.92	0.87, 0.97	0.002
OHSE						
Low[a]						
High	0.99	0.97, 1.00	0.099	1.00	1.00, 1.00	0.640
KCOH						
Good[a]						
Not good	1.06	1.00, 1.13	0.064	1.00	0.99, 1.01	0.840
OHF[d]	0.96	0.92, 1.00	0.040	1.00	1.00, 1.01	0.207
Mothers' toothbrushing frequency						
Not Favourable[a]						
Favourable	3.04	2.26, 4.09	<0.001	1.02	0.99, 1.06	0.152
Mothers' reason for professional visit						
Check-up[a]						
Pain/problem	1.05	0.85, 1.29	0.648	1.04	1.01, 1.08	0.021

		IRR[b]	95% CI[c]	*P*-value	IRR[b]	95% CI[c]	*P*-value
	Mothers' oral health status (toothache)						
Yes[a]							
No		0.98	0.78, 1.23	0.851	1.01	0.98, 1.05	0.456

[a]Reference category

[b]Prevalence ratio

[c]CI=confidence interval

[d]Continuous variable

5. Discussion

This study examined the factors affecting the children's oral care practices in the first 24 months of life. The discussion starts with a summary of the findings, and then the relation of the findings to the current knowledge of children's oral care practices and their implications are discussed. Following that, the strengths and weaknesses of the study are presented. The discussion section concludes with some suggestions for future directions to be taken.

5.1 Summary of findings

Mothers' oral care toothbrushing pattern and oral health fatalism were associated with children's toothbrushing frequency. For the children's visiting of an oral health professional for check-ups, the family size was the only predictor. Mothers' oral care practices and oral health deteriorated towards the end of the 24-month study. Mothers born in India appeared to have the most unfavorable oral care practices and oral health. Fewer than half of the mothers considered drinking fluoridated water important.

5.2 Comparison of findings with current knowledge of children's oral care practices

The factors affecting the children's oral care practices are considered in relation to current knowledge.

5.2.1 Association of mothers' oral care practices with children's oral care practices

The findings of the association of favourable maternal home oral self-care toothbrushing pattern with favourable children's home oral care practices at 24 months by the SMILE study are consistent with findings from other studies that have investigated the factors affecting children's oral care practices. However, the design of those studies was cross-sectional, and mothers' toothbrushing patterns were not monitored over time. Nonetheless, the current study supports the findings by Mohebbi et al, who did a cross-sectional study of children aged 1 to 3 years in Teheran, Iran. They found that mothers' toothbrushing frequency was the only independent variable in a multivariate analysis that was associated with children's twice-daily teeth cleaning; other variables representing self-efficacy, oral health knowledge, and SES were not

(Mohebbi et al, 2008). Similarly, in another Iranian study of 4- to 6-year-old children, Soltani et al described the association of favourable maternal toothbrushing with favourable child toothbrushing (Soltani et al, 2017). Since a child's favourable toothbrushing pattern is likely to lead to lower ECC experience, favourable parental toothbrushing behaviours are also likely to be associated with lower caries experience. Therefore, it is not surprising that Wigen and Wang found that favourable parents' toothbrushing behaviours were associated with lower caries experience in 5-year-old children in Norway after controlling for SES, professional dental visit, sugar intake and self-efficacy (Wigen and Wang, 2010). Besides favourable parents' toothbrushing behaviours, they also found higher parental educational level, children who started toothbrushing early, and having parent who were Westerners, to be associated with lower caries experience.

The utilisation of dental services for preventive oral care is commonly studied for its association with socioeconomic and demographic characteristics; this is because it involves affordability, accessibility, valuation of dental care by the parents, and the perceived need for oral care (Badri et al, 2014). Few studies have documented the relationship between mothers' oral care practices and their children's utilisation of dental services for preventive oral care. Even when it has been described, this relationship was not the primary topic of discussion. Two studies, one in Brazil and the other in Belgium, reported that mothers' regular preventive dental attendance predicted their pre-school children's preventive dental attendance and earlier first visits respectively (Goettems et al, 2012; Leroy et al, 2013). However, the findings of the current study did not support their findings. Although the bivariate analysis showed that mothers who went for dental check-up were more likely to bring their children for check-ups as well, this association did not persist after controlling for confounding and mediating variables with the multivariate regression model. The reason for the contradiction could be that both the studies by Goettems et al and Leroy et al did not include mothers' toothbrushing pattern as an independent variable.

5.2.2 Association of psychosocial factors with children's oral care practices

After adjusting for possible confounders or mediators with the multivariate analysis, the association of psychosocial factors such as oral health-related self-efficacy (OHSE) and knowledge of children's oral hygiene (KCOH) with children's oral care practices

was no longer significant, and a higher oral health fatalism (OHF) had only a small negative impact on children's toothbrushing.

Maternal self-efficacy has been found to be a predictor of pre-school children's oral health practices when some SES and sociodemographic measures were controlled (Finlayson et al, 2007; de Silva-Sanigorski et al, 2013). However, when this study included mothers' oral care practices and oral health status with SES and sociodemographic measures in the adjustment, the association of OHSE with children's oral care practices was no longer apparent. On another note, the internal consistency of the 7 items of the OHSE scale was relatively high. This was similar to the internal consistency of the 9 items in the original scale that was used by Finlayson et al to analyse US African American mothers' OHSE and KCOH (Finlayson et al, 2005). This suggests that the OHSE scale has the potential to be widely used in epidemiological studies.

The findings in this study on the effects of maternal KCOH on children's oral care practices are consistent with those found in a study conducted on Australian children aged 5 to 12 years by de Silva-Sanigorski et al, albeit with a different scale. That study showed that good KCOH did not necessarily lead to favourable children's oral care practices (whether home self-care or preventive visits to an oral health professional) and over 90% of the parents that participated in the study had good oral health knowledge of the importance of toothbrushing, dental plaque control and cariogenic effect of sugar (de Silva-Sanigorski et al, 2013). Similarly, in this study, close to 90% of mothers were categorised as having good KCOH; these mothers had 'maximum points' answers to at least half of the questions in the KCOH scale. This confirms that Australian mothers are likely to possess sufficient knowledge of children's oral health. The KCOH scale used in this study is similar to that developed by Finlayson et al and all 6 items of the original scale were included. The 6 items had relatively high internal consistency, which was similar to that reported by Finlayson et al (Finlayson et al, 2005).

It is expected that the higher the level of OHF, the less favourable the children's oral care practices will be. It is also interesting to compare the item responses in the OHF scale with those from other studies. The OHF scale was developed to assess the oral health beliefs of participants in the Dunedin Multidisciplinary Health and Development

Study (Broadbent et al, 2006). In that study, the item pertaining to the importance of drinking fluoridated water had the most unfavourable responses, but toothbrushing had the most among the participants at age 26. Such a pattern of responses was observed in the current study, albeit with an even smaller proportion of participants (about 4 out of 10) finding drinking fluoridated water important. On the other hand, almost all participants in both studies strongly agreed on the importance of toothbrushing for their oral health. The findings are also in line with those from a study by Gussy et al on oral health-related knowledge and beliefs of parents with children aged 12 to 24 months living in rural areas of Victoria, Australia (Gussy et al, 2008). Although the majority of those parents believed in the importance of toothbrushing, their views on fluoride usage and water fluoridation were mixed.

5.2.3 Association of mothers' sociodemographics characteristics with children's oral care practices

Family size was the only sociodemographic factor that remained associated with the children's professional preventive oral care after adjustment. Generally, family size affects the resource allocation for each child and, since economic, cultural or organisational barriers can impede the utilisation of dental services, it is not surprising that visits to an oral health professional are fewer for larger households. Although family size is one proxy measure for SES, it is not as commonly used as a SES proxy in epidemiological studies (Foley and Akers, 2019). Nonetheless, this association of family size (acting as a proxy for SES) with utilisation of dental services for preventive care is consistent with the well-established association of lower SES with lower dental service usage (Badri et al, 2014; Curi et al, 2018).

A unique finding was that, among the Asian-born mothers, those born in India had the least favourable oral care practices of toothbrushing and visiting an oral health professional. Although they had the highest rate of toothache, their rate of dental visiting (for either a check-up or a problem) was the lowest. However, although they had poor oral care practices themselves, their children's oral care practices were not affected, with oral self-care pattern among their children being similar to those of other children. An Australian study by Christian et al showed that the utilisation of dental services by Asian and Middle-Eastern migrant children aged 4 and below in

metropolitan Melbourne was lower than the national average, and that those with parents not having English as the preferred spoken language were less likely to visit an oral health professional than those with English-speaking parents (Christian et al, 2015). Likewise, in the 2007 US National Survey of Children's Health, Black or Hispanic parents reported poorer oral health for their children aged 2 to 17 (Fisher-Owens et al, 2013). However, after adjustment for child, family and community level risk factors and poverty status, those disparities diminished. This is similar to the findings of this study and could be attributed to socioeconomic and other child, family, and community level factors rather than just solely cultural ones.

Although Aboriginal or Torres Strait mothers had more toothache complaints than non-indigenous mothers at 24 months, their oral care practices were rather similar. The oral care practices of the children were also rather similar. However, Butten et al and Ju et al found that Aboriginal and Torres Strait Islander children had poorer oral health and more unfavourable oral care practices (Butten et al, 2019). Ju et al, who analysed data from Australia's 2012-2014 National Child Oral Health Study, also had similar findings (Ju et al, 2019). The inconsistency between the findings of this study and those of the other 2 studies could be due to the relatively small sample size (fewer than 30 at 24 months) of indigenous participants.

5.2.4 Changes in the mothers' and children's oral care practices in the first 2 years of the child's life

The periodically collected data during the 24 months documented the changes that took place in the mothers' and children's oral care practices in the first 2 years of the child's life. For children's oral care practices, daily toothbrushing increased from 6 to 24 months, coinciding with the eruption of the primary dentition. By 24 months, 34.0% of children brushed twice or more daily and fluoride toothpaste were mostly used. This finding is slightly lower than the national average whereby 49.7% of 2 to 3-year-old Australian children brushed twice or more daily with toothpaste (Do and Spencer, 2016). It was also lower than for 2-year-old children in Sweden, of whom 77.3% brushed twice daily with toothpaste (Boustedt et al, 2019).

On the other hand, perhaps it was due to the burden of attending to the children that the quality of mothers' oral care practices and oral health declined during the period from

childbirth to 24 months. The proportion of mothers brushing their teeth twice or more daily declined towards 24 months while the proportion of those who did no brushing (1 out of 50 mothers) remained constant throughout. Likewise, after giving birth, the proportion of mothers going for check-up visits also declined as expected, there were more toothache experiences and the proportion of problem visits increased. To the best of my knowledge, no studies have reported on oral care practices of Australian mothers during the 24 months post-partum period. However, there is evidence that mothers' oral care practices and oral health worsen during pregnancy but during the post-partum period, the gingiva tissue mostly returns to its pre-pregnancy condition (Morelli et al, 2018).

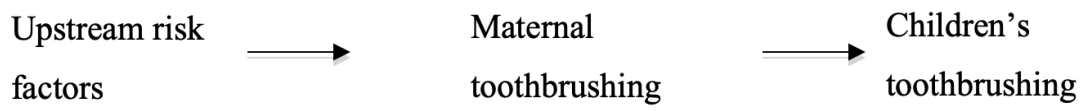
5.3 Implications of the findings

The implications of the factors affected the children's oral care practices are examined in this section.

5.3.1 Maternal toothbrushing as a mediating factor for the effects of upstream factors on children toothbrushing

The strong association between favourable children toothbrushing frequency and favourable mothers' toothbrushing pattern shown in the SMILE study after adjustment implies that maternal home oral self-care practices (toothbrushing) mediate the effects of upstream influence on children toothbrushing (Figure 2).

Figure 2. Mediating effect of maternal toothbrushing on impact of upstream risk factors on children toothbrushing



In a traditional mediation analysis, variables that are suspected to have a mediating effect are adjusted to see how much the exposure–outcome association changes (Pearce and Vandenbroucke, 2016). The changes in the relative risk value (adjusted value is usually lower) will be due to the effect of the mediating variable/variables. Accordingly, in this study, when the associations between the independent factors and children's oral care practices 'were reduced' after adjustment, that attenuation could be due to the mediating effect of maternal oral care practices. The association of mothers' oral care practices and children's oral care practices remained strong, implying that other independent factors had no mediating effect on it.

The links among upstream factors –that are socioeconomic, cultural, or psychosocial– are complex and overlapping (Borutta et al, 2010). Many possible pathways can link the well-established risk factors of ECC such as low SES and unfavourable psychosocial skills, and indigenous ethnic status to children toothbrushing, but the reasons for unfavourable children's toothbrushing practices have not been fully explored (Kim Seow, 2012). The strong association between favourable maternal toothbrushing pattern and favourable child toothbrushing frequency in this study suggests that this is one pathway that these upstream risk factors could have taken to influence the children's oral care practices.

5.3.2 Short- and long-term benefits of favourable maternal oral care practices

The strong association between favourable children toothbrushing frequency and favourable mothers' toothbrushing pattern shows that mothers' oral health behaviours and beliefs on oral health have an impact on the children's oral care practices. Very young children are very much dependent on their mothers to help in maintaining good oral health. When mothers are motivated to maintain good oral hygiene themselves, it is likely they would also pay attention to the oral care practices of their children. This

could be the reason that the two studies (Mohebbi et al and de Silva-Sanigorski et al) and the current study found that maternal favourable self-care oral practices are associated with the child's self-care oral practices (Mohebbi et al, 2008; de Silva-Sanigorski et al, 2013).

Having a mother with favourable toothbrushing practices during her child's initial years appears to have medium to long-term oral health benefits for that child. The prevalence and frequency of toothbrushing with toothpaste appear to increase with age. At the national level in Australia, 49.7% of 2 to 3-year-old children brushed twice or more daily with toothpaste and 68.8% of 5 to 14-year-old did so; the toothbrushing frequency rate was rather constant after aged 5 (Do and Spencer, 2016). Similarly, a Swedish a birth cohort study observed that 77.3% of 2-year-old children brushed twice daily with toothpaste, with that increasing to 90.0% by the age of 5 (Boustedt et al, 2019). This implies that toothbrushing habits developed at age 2 are likely to persist throughout childhood; that is, that there is a high degree of continuity in early toothbrushing practices among children, and that mothers play an important role in establishing and maintaining those practices.

Children who have mothers with favourable home oral care practices are likely to have an advantage in starting with favourable oral care practices and then enjoying better oral health later on. Thus, it is not surprising that in Sweden, Isaksson et al observed that favourable parents' oral health behaviours and attitudes when their children were 1 to 3 years old were associated with a low prevalence of proximal caries by the time the children had reached 20 years of age (Isaksson et al, 2019). Similarly, the Dunedin Multidisciplinary Health and Development Study showed that children of mothers with poor oral health (assuming they had unfavourable oral care practices) were more likely to have poor oral health as adults 3 decades later (Shearer et al, 2011). Thus, the focus of any intervention to improve the oral health of children should also be on the maternal oral care practices.

5.3.3 Oral health promotion/intervention needed to improve both mothers and children oral care practices

In spite of the important role that mothers play in their children's oral health, it appears to be overlooked in favour of the children's oral health. For example, Vamos et al

reported that oral health promotion programs tended to neglect the mothers' oral health and appeared to be biased towards the children's oral health (Vamos et al, 2015). In their systematic review on prenatal oral health promotion and interventions, they found that most of the studies focused on the knowledge of children's oral health. Other studies described mothers' self-efficacy and other psychosocial beliefs in relation to the children's oral care practices and only one study focused on pregnant women's oral hygiene practices, utilisation of oral health services, and oral health status.

With the strong association of mothers' oral self-care practices with the children's oral self-care practices, oral health promotion and interventions that are effective in improving the children's oral care practices need to target the mothers' oral health behaviours and beliefs as well as all the multi-level factors that can bring about a change in their oral health behaviour. Multiple levels of factors can influence health behavior and belief of the mothers; such factors are at the intrapersonal, interpersonal, organisational, community, and public policy. Some upstream risk factors are more amendable than others. The association of mothers' oral care practices with upstream factors such as SES and psychosocial factors is widely reported (Sallis et al, 2015). Factors such as SES, ethnicity, and marital status are obviously less amendable than the psychosocial factors and maternal oral care practices. Although reducing the effects of the less amendable upstream risk factors that are involved in the development of ECC would likely produce a longer-term effect, it is not easily attainable. Attention to the amendable risk factors may be more feasible to produce a measurable improvement in the midst of ongoing efforts to reduce the effects of the less amendable upstream risk factors.

One of the amendable upstream factors involves the psychosocial aspects of oral health behaviour and belief. Self-efficacy in oral health behavior is a popular psychosocial factor to work on because the methods used to increase oral self-care ability can be incorporated in oral health promotion and intervention programs that modify it (Kakudate et al, 2010). Self-efficacy can be improved by personal experiences, persuasion, vicarious experiences learned from observing others and modeling. By using personal experience to increase self-efficacy, it is possible that mothers' successful experience in maintaining good oral health can instill a strong belief of their ability to help their children achieve good oral care practices. This is perhaps why the

study by de Silva-Sanigorski et al showed that mothers with high efficacy had favourable maternal oral care practices/oral health and their children also having favourable oral care practices (de Silva-Sanigorski et al, 2013).

Although Henry et al found that current evidence on the effectiveness of oral health programs in reducing the experience of ECC was weak, anticipatory guidance given to pregnant mothers appeared to be effective (Henry et al, 2017). In their systematic review on oral health programs for pregnant mothers to prevent ECC, they also found that there were not many trials, and the most effective intervention could not be ascertained. In a randomised controlled trial conducted in Adelaide, South Australia, Plutzer et al provided pregnant women in the intervention group anticipatory guidance through a series (3 rounds) of printed instruction on oral care for themselves and their children (Plutzer and Spencer, 2008). The first round of instruction was provided during the enrolment phase of the study, and the focus was on the mothers' oral health. The 2nd and 3rd rounds were conducted when the child was 6 and 12 months respectively. The printed information was mailed to the mothers. Mothers in the control group received no contact after enrolment. The prevalence of severe ECC was lower in the children of the intervention group than in the control group when they were examined at about 22 months after birth. When the children were 6-7 years old, those in the intervention group had fewer toothaches and less dental caries experience than other school children, albeit with a smaller difference than with the findings at 22 months (Plutzer et al, 2012). Similarly, Cibulka et al conducted as a randomised controlled trial that focused on oral self-care practices of low-income pregnant English speaking mothers in the US Midwest (Cibulka et al, 2011). The mothers in the intervention group were provided with toothbrushes and toothpaste after a visual and oral presentation on oral self-care and pregnancy issues. They found that favourable self-reported oral health increased significantly in the intervention group of mothers and these mothers experienced an increase in the frequency of toothbrushing and flossing, reduction in sugary drinks intake, and had made twice as many visits for a preventive dental check-up than the control group by the time the study was over. Better mothers' oral care practices could translate to better oral care for their children after birth. Hence, oral health promotion/intervention can be successful when the focus is not only on reducing ECC but also on the mothers' oral care practices.

Pregnancy also seems to be a critical period for oral health promotion because new mothers are particularly receptive to advice on infant oral healthcare before and just after delivery (Clifford et al, 2012). Clifford et al found that Australian mothers generally supported receiving oral health information and the mothers indicated that the most appropriate time to receive the information was during the later stage of pregnancy and when their children's teeth eruption commenced.

5.3.4 Pregnancy as a possible risk factor for mothers' oral care practices and oral health

While pregnancy is a critical period for oral health promotion, post-partum can be a stressful period and the negative effects of post-partum depression are well established (Letourneau et al, 2012). In this study, it appears that mothers neglected their oral care practices, resulting in a decrease in toothbrushing frequency and preventive dental visits.

However, most epidemiological dental studies on pregnancy have examined its effects on periodontal conditions and few have had long enough post-partum follow-ups to explore the effects of pregnancy and parity on periodontal health (Morelli et al, 2018). Epidemiological studies that have examined the relationship between dental caries and the outcomes of pregnancy were even fewer than those on periodontal diseases, and their findings are conflicting (Viera et al, 2019). Dental caries detected post-partum could also have been present even before pregnancy.

Nonetheless, the unfavourable post-partum maternal oral care practices found in this study could lead to poorer oral health later on. This lends support to the hypothesis that pregnancy is a risk factor and that the number of pregnancies contributes to the accumulation of risk for oral diseases (Russell et al, 2008).

5.3.5 The effect of acculturation on children's oral care practices

Host language proficiency is commonly considered a key component of acculturation. Generally, higher level of acculturation is associated with better oral health status and practices (Dahlan et al, 2019). Thus, the Australian study by Christian et al found that Asian and Middle-Eastern children of non-English-speaking parents had poorer oral

care practices (Christian et al, 2015). By contrast, in the current study, all participants, (including those born in Asia) had attained a relatively high level of acculturation because they were able to read and understand the English language; their children had similar oral care practices to those of other children, even though the mothers themselves had markedly poorer oral health practices than other mothers. This confirms that acculturation is an important determinant of oral care practices. Mothers who are born overseas but able to speak and understand the language of the host country are more likely to conform to the social norms and adopt the oral care practices of the host country for their children. In the context of this study, this approach by the English-speaking India-born mothers led to an improvement of their children oral care practices as compared to their own, so speaking and understanding the host country's language may break the inter-generational transfer of unfavourable oral care practices from mother to child.

On the other hand, the India-born mothers, even though they are English speaking, had markedly poorer oral health practices and oral health than other mothers. The SMILE project has also found Indian-born mothers who were without tertiary education were more likely to put their children to bed with a bottle (Ha and Do, 2018). This finding is likely related to their culture and beliefs. A community's culture influences its beliefs, values, and customs, and these factors can affect views on oral health and usage of oral health services (Fisher-Owens et al, 2007). According to Fisher-Owens et al, acculturation operates at the family level, while beliefs, customs, and values do so at the community level. This implies that the Indian-born participants were able to cling to their ethnic beliefs, customs and values after they moved to Australia and that this still had a negative impact on their oral health practices. They also could have reasons similar to those given by Chinese Asian migrants (from Hong Kong or Southern China) living in Melbourne for avoiding visiting an oral health professional (Mariño et al, 2010). First, dental treatment is likely to be cheaper in Asia (and in this context, India). Since dental services in Australia are provided overwhelmingly by private dentists, and fee-for-service is the usual payment mode, they may try tolerating some dental discomfort until they can return to India for treatment. Second, they may prefer to be treated by Indian oral health professionals.

5.3.6 Awareness of the importance of fluoride in reducing ECC

For very young children, the aim of toothbrushing is to get sufficient exposure to fluoride; and thus, the usage of fluoride toothpaste during toothbrushing is essential (Walsh et al, 2019). While almost all mothers in this study strongly agreed on the importance of toothbrushing in maintaining the good oral health of their children, they were not so convinced about the important role fluoride played in the reduction of ECC.

The differences in oral health beliefs observed could imply that the frequency of children's toothbrushing was unrelated to knowledge about the cause of dental caries or the efficacy of fluoride toothpaste but affected by social norms (Gussy et al, 2008). On the contrary, the lower rate of acceptance for fluoride usage could be due to limited knowledge about the role of community water fluoridation and fluoride toothpaste in preventing dental caries or some mothers could have a negative opinion on fluoride. For mothers who had not stayed long enough in Australia, fluoride could be a new concept. Riggs et al found in their qualitative study that almost all migrants participants from Pakistan, Lebanon, and Iraq had very limited knowledge about fluoride and those who had, had learned about it at a recent 'community peer education' program, in schools, by listening to radio programs, or even from a hairdresser (Riggs et al, 2015). Knox et al investigated the reasons behind the strong opposition to water fluoridation in regional New South Wales and classified the reasons for opposition into 5 themes (Knox et al, 2017). They were scepticism (mainly about whether fluoride was beneficial in preventing caries), health effects (water fluoridation might exacerbate pre-existing disease symptoms), ethics (not able to choose not to have water fluoridation because water fluoridation has been classed as mass medication that contravened the United Nations human rights issues), environmental impacts (downstream environmental effects on plants, agriculture, and invertebrates), and economics (the set-up and maintenance costs of a water fluoridation program). The participants also suggested educational programs conducted by oral health professionals that specifically target only those in need of fluoride treatment as one of the alternatives to water fluoridation. Those who were adamantly against fluoride believed that it was harmful.

5.4 Strengths and weaknesses of the study

This section considers the main deficiencies and strengths of the SMILE project.

5.4.1 Weaknesses of the study

There are 2 main weaknesses to be considered in this study. First, there are 3 possible sources of bias in the make-up of the cohort. Mothers who were unable to understand English was left out. Host language proficiency is one of the most influential behavioral acculturation indicators because a person who speaks the host country's local language likely has more confidence to socialise and has better access to oral health services (Dahlan et al, 2019). Hence, mothers who had a low level of acculturation were likely to have been left out of the SMILE cohort. Second, the attrition over time of close to half (44.2%) the original number of participants did mean that a substantial amount of information was forgone. The rate of attrition was not constant; more than half of the number of participants who dropped out had done so by the 3-month stage of the SMILE project; this implies that much information might have already been lost at a relatively early stage of the study. Furthermore, the examination of the sociodemographic characteristics of the participants who dropped out showed that the attrition was not random: those participants tended to have lower SES and less favourable oral care practices or oral health. Third, participants with poor literacy might have misunderstood the survey questions, and their responses might not fully represent their views. On the whole, these 3 issues could induce inaccuracy to the results and the first 2 issues could cause the actual observed associations to be even less favourable than that those which were observed.

Finally, no intra-oral examination was carried out on the mothers, and so self-reported oral health data were used to describe their oral health. In spite of the possibility of recall or social desirability bias, self-report measures of oral health status are an effective measure for detecting oral disease in epidemiological studies (Thomson et al, 2012; Myers-Wright et al, 2018).

5.4.2 Strengths of the study

Despite the weaknesses described above, the SMILE project had taken steps to produce a sample that was representative of the Australian women of child-bearing age. First, the sample was taken from the 3 largest public hospitals in Adelaide where 60% of all live births occurred. Second, with the anticipation of uneven attrition that could result in the disproportionate loss of lower SES mothers, the oversampling of these mothers

was done in anticipation of that differential attrition. At baseline, 26.8% of the participants had only a school-level education. This proportion was higher than the national average whereby, in 2009, about 18% of people aged 20 to 24 years had not attained a qualification at Certificate III or above (comprising vocational and higher education qualifications) or were studying to obtain higher education qualifications at these levels.[4] Eventually, one in five mothers who remained throughout the 2-year SMILE project had no vocational or tertiary education. This proportion is similar to the national estimate of about 18%.

The longitudinal design of the SMILE project provided an appropriate design and high-validity data that allowed examination of the changes in the determinants over the first 2 years of the child's life. This is a critical period of developmental changes when the teeth are starting to appear. The periodicity of data collection showed the changes in determinants over time and provided the possibility of identifying developmental patterns. This improved the accuracy of the data because the series of data collected within these 2 years provided directionality to the observed changes in particular variables of interest.

5.5 Future directions

The current pattern in children's oral care practices is that older Australian children are having higher rates of twice-daily toothbrushing and visits to an oral health professional than the younger ones (Do and Spencer, 2016; Stormon et al, 2019a). Most children also had adequate access to oral care and more than half of them made their first visit to an oral health professional below the age of 5. Although there are oral health programs that aim to prevent the development of ECC, the disadvantaged groups in the population still suffer poorer oral health. The prevalence of dental caries was still higher in older children and peaked at the age of 8. Currently, in 2019, the Australian government reported that 42.0% of children aged 5 to 12 had dental caries in the primary teeth and 1 out of 4 of caries were untreated.[5] The approach of current oral health interventions may need fine-tuning, and the findings of this longitudinal study

[4] http://www.abs.gov.au/ausstats/abs@nsf/Lookup/4250.0.55.001Main+Features32009

[5] https://www.aihw.gov.au/reports-data/health-conditions-disability-deaths/dental-oral-health/overview

may be useful in assisting with the design of interventions to reduce the caries burden and contribute to the pool of epidemiological evidence on children's oral care practices in Australia.

5.5.1 Approach in oral health interventions

Early intervention that engaged new mothers has been widely accepted as a strategy in preventing ECC (Henry et al, 2017). The strong association between favourable maternal oral self-care (toothbrushing pattern) and favourable child toothbrushing frequency implies that the provision of oral health interventions during the critical period of pregnancy needs to focus on both maternal and child oral care practices instead of solely on the latter. The factors affecting the development of ECC are complex and according to Fisher-Owens et al, they can be organised into individual, family and community levels (Fisher-Owens et al, 2007). In each level, there are 5 domains, namely a child's genetics and biology, social environment, physical environment, health-influencing behaviours, and medical and dental care. Since the factors are multi-leveled, the approach of interventions needs to target factors at all levels to be effective.

Health interventions in the form of oral health education programs and promotion usually target factors that are amendable and these factors tend to be at the individual and family level. One of the amendable factors is self-efficacy. Self-efficacy can be improved through personal experiences, persuasion, vicarious experiences learned from observing others and modeling; these 4 methods are included in most oral health programs and promotions (Kakudate et al, 2010). According to the model by Fisher-Owens et al, the self-efficacy of the child is a factor under the domain of health-influencing behaviours at the individual level while the self-efficacy of the mothers is a factor under the domain of health-influencing behaviours at the family level. For young children, who are fully dependent on their mothers to maintain their oral health, the focus should be on the family-level factors; that is, on improving the self-efficacy of the mothers.

For oral health educational programs to be successful, an effort is needed to engage the mothers regularly. Plutzer et al showed that by using anticipatory guidance in an oral health education program for pregnant Australian mothers – together with counseling

and delivery of regular preventive oral care to the mothers – was effective in reducing the experience of ECC of their children (Plutzer and Spencer, 2008). Similarly, Chaffee et al also found that dental caries experience was lesser in children whose mothers were in frequent connection with health centres (Chaffee et al, 2013).

Clifford et al pointed out that Australian mothers were particularly receptive to advice on infant oral healthcare during pregnancy, and some mothers in their study mentioned that they preferred receiving children's oral care instructions when their children's teeth were erupting (Clifford et al, 2012). Therefore, during antenatal classes, oral health education should focus on mothers' oral care practices and later after birth, on their children's oral health. Using data from the SMILE study, Ha and Do found that mothers who took their children for dental check-ups/oral hygiene instructions during the 24 months were more likely to brush their children's teeth before bed (Ha and Do, 2018).

Pregnancy is a stressful period that could affect maternal oral care practices and oral health. In the SMILE study, mothers who were receiving lay support were more likely to brush their children's teeth before bed (Ha and Do, 2018). Currently, in Australia, an example of support given to mothers with an infant at the national level is Health Direct[6]. However, this requires the initiative of mothers to contact the agency. More efforts may be needed to seek out mothers who need help.

For India-born mothers, speaking and understanding the host country's language seems to break the inter-generational transfer of unfavourable oral care practices from mother to child. However, it may take some time for an adult to pick up a new language. Although the reason for the India-born mothers having poorer oral health and oral care practices than mothers born in other parts of Asia is still unknown, oral health

[6] https://www.pregnancybirthbaby.org.au/support-for-parents (Health Direct is a free-of-charge health service provided by the Australian government whereby a person can receive health advice and direction to services).

programs and practices that are culturally safe may be helpful in encouraging the mothers to improve their oral care practices.

Solely focusing on changing oral health behaviours and beliefs may be ineffective in the longer term unless the political and economic drivers in society that create social inequalities are tackled (Watt and Sheiham, 2012). This will require the involvement of national policy makers and professional organisations. Oral health professionals need to continue engaging with them and provide inputs concerning oral health.

5.5.2 Recommendation for future research topics

Findings from epidemiological research can guide future studies, health care funding, and policies to improve the oral health of the population. Recently, the studies that have focused on Australian children's oral health have been mostly cross-sectional in design (Leong et al, 2013; Stormon et al, 2019b). The majority of the studies used questionnaires instead of clinical records and examination as measures. Using the conceptual model by Fisher-Owens et al to as a guide to describe factors affecting the development of ECC, the social environment (defined by the relationships and interactions between child and parent at the family level), was shown to have been under-investigated in Australian literature (Stormon et al, 2019b). Factors at the individual level (such as physical attributes, and health behaviours and practices) were the most commonly researched and monitored by national surveys. At the family level, the association between SES and children's oral health was frequently researched while the physical environment at the community level (studies reporting on the effectiveness of water fluoridation) received much focus. However, family-level influences on children's oral health, (especially the influence of relationships and interactions between parent and child,) are relatively under-investigated in Australia (Stormon et al, 2019b).

Although the SMILE study had provided information on factors influencing children's oral care practices during the post-partum period, there is still a lack of similar research on the relationship and interactions between parent and child during this period. The association between mothers' oral care practices and children's oral care practices needs further exploration because this association, if well established, could determine the most effective approach for oral health education with the mothers of young

children. Further studies are needed to find out the reasons for the deterioration of mothers' oral care practices and oral health during the time period between childbirth and 24 months. India-born mothers appeared to have the worst oral health and care practices among the mothers and this finding also requires further investigation, particularly of ways in which this disadvantage can be overcome.

6. Conclusion

This was a secondary analysis of the data from the longitudinal birth-cohort SMILE study that examined the first 2 years of the life of children born in Adelaide, Australia. Data on factors that influenced the oral care practices of the children were analysed. These factors were the sociodemographic characteristics, psychosocial factors (such as OHSE, KCOH, and OHF), mothers' oral care practices, and mothers' oral health status.

Mothers' favourable home self-care practices (toothbrushing pattern 24 months post-partum) were strongly associated with favourable children's home oral care practices (toothbrushing frequency). Mothers with unfavourable oral care practices were likely to be younger, of low SES, single parents, Aboriginal or Torres Strait Islanders, or born in India. Since mothers' home self-care oral practices were strongly associated with favourable children's home oral care practices — and young children are very much dependent on the mothers in caring for their oral health, — any oral health programs to curb the development of ECC would need to target the mothers and not just the children's oral care practices.

This study also identified the post-partum period to be a stressful one, in that mothers' oral care practices and oral health deteriorated towards the end of 24 months after childbirth. India-born mothers appeared to have exceptionally poorer oral health and oral care practices than other mothers. Further research is needed to identify these causes.

7. References

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8. Appendix: SMILE Study questions used in this thesis

At baseline (Wave 1)

For independent variables

1. Mothers' sociodemographic details

Maternal age: *What is your age?*

(Answer is true numeric variable in years)

Maternal education: *What is the highest level of education you have?*

1- Some high school

2- Completed high school

3- Some vocational training e.g trade

4- Completed vocational training

5- Some University or College

6- Completed University or College

7- Postgraduate

Household income: *Which category does your total household income (before tax) fall into? Include any salaries, pensions, allowances, benefits etc from all persons in the household*

1- Up to $20000

2- $20001 to $40000

3- $40001 to $60000

4- $60001 to $80000

5- $80001 to $100000

6- $100001 to $120000

7- $120001 to $140000

8- $140001 to $160000

9- $160001 to $180000

10- Over $180000

Country of birth: *In which country were you born?*

1- Australia

2- Other country (please specify)

Indigenous status: *Is your child of Aboriginal or Torres Strait Islander origin?*

1- No

2- Yes, Aboriginal

3- Yes, Torres Strait Islander

Marital status: *Is your child main place of residence a .....?*

1- One-parent household

2- Two-parent household

Family structure: *How many OTHER children do you have at home?(Do not count your new baby)*

(Answer is true numeric variable)

Number of children: *How many OTHER children do you have at home? (Do not count your new baby)*

(Answer is true numeric variable)

2. Mothers' oral care practices

Toothbrushing frequency: *In a typical day, how many times do your brush your teeth?*

(Answer is true numeric variable)

Visit to oral health professional

Last visit: *How long ago did you LAST see a dental professional about your teeth, dentures or gums?*

1- Less than 6 months ago

2- 6 months to less than 1 year ago

3- 1 year to less than 2 years ago

4- 2 years to less than 5 years ago

5- 5 years to less than 10 years ago

6- 10 years or more ago

Reason for visit: *What was the reason for your LAST visit to a dental professional?*

1- Check-up

2- Problem with pain

3- Problem (other than pain)

At 3 months (Wave 2)

For independent variables

Psychosocial measures

1. Knowledge of children's oral hygiene (KCOH): *How much do you agree with each of the following statement?*

1. Holes in baby teeth don't matter much since baby teeth they will fall out anyway.

2. Keeping baby teeth clean is not very important because they fall out anyway.

3. There is not much I can do to stop my child from getting holes in the teeth.

4. There is not much I can do to help my child have healthy teeth.

5. Children don't need to brush every day until they get their adult teeth.

6. Children don't really need their own toothbrush until all their teeth come.

Answers to all the above statements:

1- Strongly agree

2- Somewhat agree

3- Neither agree nor disagree

4- Somewhat disagree

5- Strongly disagree

6- Unknown

2. Oral health-related fatalism (OHF): *How important do you rate the following in relation to your dental health?*

1. Not having a lot of sweet food (5-point scale)

2. Using fluoride toothpaste (5-point scale)

3. Visiting dentists (5-point scale)

4. Brushing teeth (5-point scale)

5. Drinking tap (fluoridated) water (5-point scale)

Answers to all the above queastions:

1- Important

5- Not important at all

6- Unknown

At 6 months (Wave 3)

For independent variables

Mothers' self-reported oral health status

Toothache in the last 12 months: *During the last 12 months, how often have you got a toothache?*

1- Very often

2- Often

3- Sometimes

4- Hardly ever

5- Never

9- Unknown

For dependent variables

Child's self-care practices at home

1. Toothbrushing frequency: *How often do you usually clean your child's gum or teeth?*

1- Three times or more per day

2- Two times per day

3- One time per day

4- Less than one time per day

9- Unknown or N/A

2. Fluoride usage: *Was toothpaste used when your child's teeth were cleaned?*

1- Yes, regularly

2- Yes, occasionally

3- No

9- Unknown or N/A

At 12 months (Wave 4)

For independent variables

Mothers' oral care practices

1. Toothbrushing frequency: *How many times do your brush your teeth yesterday?*

1- Did not brush

2- Once

3- Twice

4- 3 times or more

9. Unknown

2. Visit to oral health professional

Last visit: *Have you seen a dental professional about your teeth, dentures or gums in the last 12 months?*

1- Yes

2- No

9- Unknown

Reason for visit: *What was the reason for your visit?*

1- Check-up

2- Relief of pain

3- Other reasons

9- Unknown

For dependent variables

1. Child's self-care practices at home

1. Toothbrushing frequency: *(2 sets of data were combined)*

How often do you usually clean your child's gums or teeth WITHOUT toothpaste?

How often are your child's teeth brushed WITH toothpaste?

1- Three times or more per day

2- Two times per day

3- One time per day

4- Less than one time per day

9- Unknown or N/A

2. Fluoride usage: *Are your child's gums/teeth cleaned WITH toothpaste?*

1- Yes

2- No

9- Unknown

2. Professional care: *Has your child been seen by a health professional about his/her teeth and/or gums? Check-up.*

1- Yes

9- Unknown, no, N/A

At 24 months (Wave 5)

For independent variables

1. Mothers' oral care practices

Toothbrushing frequency: *How many times do your brush your teeth yesterday?*

1- Did not brush

2- Once

3- Twice

4- 3 times or more

9. Unknown

Visit to oral health professional

Last visit: *Have you seen a dental professional about your teeth, dentures or gums in the last 12 months?*

1- Yes

2- No

9- Unknown

Reason for visit: *What was the reason for your visit?*

1- Check-up

2- Because of pain

3- Because of other problems

9- Unknown or N/A

2. Psychosocial measures

Oral health-related self-efficacy (OHSE):

1. How confident do YOU feel about your ability to brush your child's teeth at night when you are under a lot of stress?

2. How confident do YOU feel about your ability to brush your child's teeth at night when you are depressed?

3. How confident do YOU feel about your ability to brush your child's teeth at night when you are anxious?

4. How confident do YOU feel about your ability to brush your child's teeth at night when you feel you do not have the time?

5. How confident do YOU feel about your ability to brush your child's teeth at night when you are bothered by your crying child?

6. How confident do YOU feel about your ability to brush your child's teeth at night when you are bothered because your child doesn't stay still when you want him or her to brush?

7. How confident do YOU feel about your ability to brush your child's teeth at night when you are told by your child that he or she does not feel like brushing right now?

Answers to all 7 questions

1- Very confident

2- Somewhat confident

3- Not very confident

4- Not at all confident

5- I never feel like this

99- Unknown

3. Mothers' self-reported oral health status

Toothache in the last 12 months: *How often during the last 12 months did YOU have a toothache?*

1- Very often

2- Often

3- Sometimes

4- Hardly ever

5- Never

9- Unknown

For dependent variables

Child's self-care practices at home

Toothbrushing frequency: *How often do you usually brush YOUR CHILD'S teeth?*

1- Three times or more per day

2- Two times per day

3- One time per day

4- Less than one time per day

9- Unknown or N/A

Fluoride usage: *Is YOUR CHILD's cleaned with toothpaste?*

1- Yes

2- No

99- Unknown

Professional care: *What was the reason for the visit to a healthcare professional about his/her teeth and/or gums during the last 12 months?*

1- Check-up/Oral hygiene instruction

2- Dental pain

3- Other

99- Unknown or N/A