

A Literature Review on Oral Health in Preschoolers

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EXECUTIVE SUMMARY

Oral health is a major public health issue affecting all population groups. Poor oral health during childhood is directly associated with poor oral health outcomes in adulthood as people remain more susceptible to developing dental caries throughout their lives. Oral health has an impact on all systems of the body. For example, Early Childhood Caries (ECC) can lead to more widespread health issues, such as diabetes and cardiovascular disease.

The Ministry of Health has set oral health as one of the 13 health priorities. In 2006, they released a vision statement 'Good Oral Health for All, for Life' to guide the work in oral health. The vision statement identifies children as one of the four priority groups to benefit from improved oral health services. This is important because ECC is the most common chronic childhood disease in New Zealand.

In 2015, the Ministry of Health contracted the Health Promotion Agency (HPA) to conduct a literature review that would inform future development of oral health promotion initiatives for preschoolers (children aged under-five). The aims of this narrative review are to collate and synthesise the national and international evidence of preschool oral health promotion and social marketing initiatives, and the evidence on improving parents' and caregivers' knowledge, attitudes and behaviours around preschool oral health.

The key findings from the review of the literature are that, overall, parents have a low level of knowledge about the practices needed to ensure good oral health for their preschool-aged children and a poor understanding of the importance of primary teeth. The risk factors for poor oral health status in preschoolers include parental education level, family socio-economic status, and maternal knowledge of oral health. The main motivators for parents to achieve good oral health could be the child's health and cosmetic appearance. Improvements in preschoolers' oral health have been achieved through many different oral health interventions. The most promising interventions involve the provision of toothbrush and toothpaste packs to parents together with educational messages or motivational interviewing. Generally, the majority of the evidence in this review is from overseas, as there is a lack of New Zealand research on preschoolers' oral health and the related attitudes and behaviours of parents. Therefore, to fully inform oral health programmes that will work in the local context, further New Zealand research needs to be conducted.

The key recommendations are to:

- work with parents and caregivers to create health promotion messages that convey the importance of caring for primary teeth, as well as the age of when tooth brushing should begin and when a child's first visit to the dentist should occur
- ensure health promotion interventions prioritise (and are accessible to) high-risk populations, including parents and caregivers with a low education level and low socio-economic status
- design oral health promotion programmes that employ more than one intervention method
- conduct further research in New Zealand to ensure that the evidence used to build oral health promotion programmes is relevant.

INTRODUCTION

Oral health is a major public health issue affecting all groups of the population. Poor oral health during childhood is directly associated to poor oral health outcomes in childhood and throughout adulthood, as people remain susceptible to developing dental caries throughout their lives (Kawashita, Kitamura, & Saito, 2011). Previous studies have demonstrated the link between oral health and other health issues, for example, early childhood caries (ECC) can lead to comorbid health issues including diabetes and cardiovascular disease (Kawashita et al., 2011; Satur, Gussy, Morgan, Calache, & Wright, 2010). The World Health Organization (WHO) understands the major impact oral health has on the health of an individual, as well as the population, and has placed major emphasis on improving oral health in all populations (World Health Organization, 2015b).

The New Zealand Ministry of Health also recognises the importance of addressing oral health issues in this country. Improving oral health is, therefore, one of the 13 population health priorities outlined in the New Zealand Health Strategy, and is one of the 12 priorities for Māori health (Ministry of Health, 2006). In 2006, the Ministry of Health also published the vision statement 'Good Oral Health for All, for Life', which presents the overall vision and action areas of oral health policy work from 2006 to 2016 (Ministry of Health, 2006). Oral health is also included in the Pacific Health Strategy as an area they want to improve on (Ministry of Health, 2014a). ECC is the most common chronic childhood disease in New Zealand, and the rate of ECC occurs in unequal proportions among different population groups. Higher rates of ECC are seen among Māori and Pacific children, children of higher deprivation levels, and throughout certain geographical regions (Ministry of Health, 2006). In response to the situation in New Zealand, one of the seven priorities in the Ministry of Health's vision is reducing inequalities that exist in oral health, and children are highlighted as a priority group (Ministry of Health, 2006).

In 2015, the Ministry of Health contracted the Health Promotion Agency (HPA) to conduct a literature review that would inform future development of preschool (children aged under five) oral health promotion initiatives. The aims of this review are to collate and synthesise the national and international evidence of the impact of different preschool oral health promotion and social marketing initiatives, as well as the evidence on interventions that can improve parents' and caregivers' knowledge, attitudes and behaviours around preschool oral health.

It is important to recognise that New Zealand has a unique demographic composition, which is reflected in the environment of New Zealand's ethnically diverse population and the large socio-economic gradient. The inclusion of international studies in this review will provide an overview of the common elements of effective preschool oral health initiatives; however, some of the findings would require further testing with the New Zealand audience.

This literature review is structured as follows. The background section will cover the aetiology of dental caries and ECC, the epidemiology, risk factors, and health impacts of ECC, the importance of health promotion and oral health education in improving oral health status and oral health policy. This is followed by the methods section that will describe the search strategy and the inclusion and exclusion criteria for the review. The subsequent findings section will be grouped by the following headings: 1) parents and caregivers' knowledge of oral health for their preschool children, 2) motivators and barriers to good oral health for preschool children, and 3) oral health promotion interventions. This will then be followed by a summary chapter. Definitions of technical or unusual terms are included in Appendix 1.

BACKGROUND

AETIOLOGY OF DENTAL CARIES

Dental caries, also known as tooth decay, is a common infectious disease, where acid-producing bacteria, known as Mutans Streptococci (MS), live in the tissues of the mouth and metabolise sugars (American Academy of Pediatric Dentistry, American Academy of Pediatrics, & American Academy of Pediatric Dentistry Council on Clinical Affairs, 2005). Overtime, the acid produced demineralises the tooth structure causing caries. The disease can develop in childhood as aggressive tooth decay; this is known as Early Childhood Caries (ECC) (Selwitz, Ismail, & Pitts, 2007). Key methods of preventing dental decay include brushing teeth twice daily with fluoride toothpaste, drinking fluoridated water and limiting the consumption of sugary foods and drinks (Satur et al., 2010).

A range of risk factors for developing caries have been identified and these include smoking, alcohol consumption, high sugar diets and frequent snacking (Harris, Nicoll, Adair, & Pine, 2004). Poor dental hygiene and dental care can significantly increase an individual's risk of developing dental caries; poor hygiene includes not brushing teeth regularly with fluoride toothpaste and not visiting the dentist regularly. Societal influences also impact an individual's susceptibility to developing dental caries and poor oral health including a low socio-economic status and living in an area without fluoridated drinking water (Harris et al., 2004).

Early childhood caries

ECC is a specific form of caries of the primary teeth of infants and toddlers (Ministry of Health, 2008a). The American Academy of Paediatric Dentistry states that 'in children younger than three years of age, any sign of smooth-surface caries is indicative of severe ECC' (American Academy of Pediatric Dentistry et al., 2005, p.50). Teeth are at risk of dental decay as soon as they erupt into the mouth (Ministry of Health, 2008a), and while ECC commonly form on the upper front teeth, other teeth can also be affected.

The causation of ECC involves a complex interaction between a myriad of biological, social and economic factors, not dissimilar to factors that increase susceptibility of developing caries at later life stages (Ashkanani & Al-Sane, 2012). ECC can occur in all populations; however, disadvantaged children are most vulnerable and consequently, often have a higher prevalence than children with a higher socio-economic status (Vargas & Ronzio, 2006; Williams, Whittle, & Gatrell, 2002).

EPIDEMIOLOGY

Dental caries are one of the most prevalent health issues in New Zealand across all age groups. This includes the under-five age group, with ECC being the most common chronic childhood disease (Bach & Manton, 2014). The status of oral health varies widely between different population groups within New Zealand, with particular ethnic groups (Māori and Pacific people), lower socio-economic groups and rural populations often having poorer levels of oral health compared to other groups of the population (Ministry of Health, 2006). With a unique and ethnically diverse population, New Zealand is faced with a challenging situation for many public health concerns, including oral health.

ECC is a large public health problem both internationally and in New Zealand. An international review of ECC literature indicated that in developed countries ECC prevalence ranges between 1-12%, however, in undeveloped countries, the rate can be as high as 70% (Milnes, 1996). In New Zealand, the current status of oral health is at epidemic proportions, with the most recent data available from the Ministry of Health indicating that approximately 50% of five-year-old children have caries (Ministry of Health, 2011). There is concern that over the past decade there has been no change in the prevalence of ECC in New Zealand (Bach & Manton, 2014).

One of the challenges for New Zealand is the ethnic differences in oral health status that exist within its population. The 2009 Oral Health Survey found that Māori (48%) and Pacific (47%) children were less likely to be caries free than Asian (66%) and European/Other (62%) children (Ministry of Health, 2010). The 2002 National Nutrition Children's Survey found that Māori children were more likely to experience dental pain than European/Other children. The results from the survey also showed that Pacific children were more likely to have had a tooth extracted due to decay than non-Pacific children. Ethnicity differences were also found in the 2006/07 New Zealand Health Survey whereby Māori children aged two to four years were more likely to have one or more fillings, and to have had a tooth removed compared to all other New Zealand children between the ages of 0 and 14 years. These findings are consistent with international evidence, with multiple findings showing that indigenous children have worse oral health than non-indigenous children (Jamieson, Armfield, & Roberts-Thomson, 2007; Jamieson, Armfield, & Roberts-Thomson, 2006a; Jamieson, Parker, & Armfield, 2007; Jamieson & Roberts-Thomson, 2006).

RISK FACTORS FOR DEVELOPING EARLY CHILDHOOD CARIES

Previous research has identified a range of risk factors for developing ECC. Understanding the relationships between ECC and modifiable and non-modifiable risk factors is crucial in the development and delivery of oral health promotion initiatives. These factors can be broadly grouped into the following categories: microbiological, diet, socio-economic and environmental; each is discussed further below.

Microbiological

As previously mentioned, MS is acid-producing bacteria living in the tissues of the mouth. Infants whose mothers have high levels of MS are at a greater risk of ECC than infants whose mothers have low levels of MS (American Academy of Pediatric Dentistry et al., 2005). Parents can pass MS to infants through sharing of saliva, this is commonly done through kissing the child on the mouth and/or placing the child's utensils or bottle into the parent's mouth (Sakai et al., 2008). Therefore, treating a parent's dental caries or reducing the MS level of the parent, may decrease the risk of developing ECC in the child (Segura et al., 2014).

Studies have also shown a correlation between visible plaque and the risk of ECC (Tinanoff & Reisine, 2009). For example, it is found that young children who had visible accumulation of plaque at the age of 12 months have a much higher risk of ECC by age three, compared with children who were free of plaque at 12 months of age (Habibian, Roberts, Lawson, Stevenson, & Harris, 2001). Proper tooth brushing is very important in the role of applying fluoride to the teeth and eliminating dental plaque, and therefore, is a preventative method for ECC. Research has demonstrated that children who begin with tooth brushing

before 12 months have a much lower caries risk than children with whom tooth brushing began after 13 months of age (Hallett & O'Rourke, 2003). Preschool children who had their teeth regularly brushed by parents (compared to those who brushed their own teeth), also had much lower levels of plaque (Habibian et al., 2001).

Diet

Food and beverage consumption have a major impact on an individual's experience of caries, both in childhood and in adulthood. High sugar intakes increase the amount of MS in the mouth, which in turn increases the chance of destruction of teeth.

In terms of developing ECC, the overall amount of sugar consumed by a child has been highlighted in research as a strong risk factor (Colak, Dülgergil, Dalli, & Hamidi, 2013) and in a recent report by the WHO, the positive relationship between intake of free sugars and the number of dental caries was documented (World Health Organization, 2015). Apart from the overall amount of sugar consumption, other dietary risk factors include the timing of consumption. In particular, ECC is associated with frequent night time bottle feeding with milk or sugary drinks (American Academy of Pediatric Dentistry et al., 2005), and snacking in between meal times (Colak et al., 2013). The New Zealand Ministry of Health suggests that many children will need a 'mid-morning' and 'mid-afternoon' snack, however, the timing and composition of these snacks is important both nutritionally and in relation to reducing dental caries (Ministry of Health, 2012).

Socio-economic

There is substantial evidence that suggests that lower socio-economic groups have poorer oral health, compared to higher socio-economic groups. This disparity in oral health status is also found among children (Harris et al., 2004; Kawashita et al., 2011). Pieper and colleagues (2012) stated that the disparity could be a result of different behavioural patterns between parents of different socio-economic status. For example, preschoolers of a lower socio-economic status are more likely to use baby bottles improperly, have infrequent and poor technique of teeth brushing, have high sugar consumption and were less likely to use preventative dental services (Pieper et al., 2012). These behaviours are risk factors of poor oral health in preschoolers.

This relationship between oral health status and socio-economic status are visible in New Zealand, with children from lower socio-economic families on average having a higher rate of caries compared to children from higher socio-economic families (Ministry of Health, 2006).

Environmental

Severe health inequalities exist in oral health, both internationally and in New Zealand. In New Zealand the prevalence and severity of the oral health status of children varies considerably between geographic regions; rural-based children have a much higher risk of poor oral health than urban-based children due to fluoridation of the water and access to dental care (Ministry of Health, 2006). Specifically, the proportion of caries free children (under the age of five) is significantly higher among those who live in areas of fluoridated water supply, compared with those who live in areas where the water supply is not fluoridated (Ministry of Health, 2006).

HEALTH IMPACTS OF EARLY CHILDHOOD CARIES

Preschool years are a critical period in the development of a healthy child (Watt, Stillman-Lowe, Munday, Plimley, & Fuller, 2001). The consequences of poor oral health in children reach beyond dental problems, with oral health being associated with overall systematic health as well as one's quality of life. Poor oral health can have a negative impact on a child's ability to eat, sleep and socialise and can affect the individual's ability to learn (Bach & Manton, 2014). Children who reported having at least one decayed tooth that involved the nerve, were on average one kilogram lighter than their decay-free peers (Sheiham, 2006). Therefore, poor oral health can have a detrimental impact on the health of the child (Sheiham, 2006).

ECC is also a major predictor of adult oral health, with ECC signifying a much higher chance of having caries as an adult (Riter, Maier, & Grossman, 2008; Van den Branden, Van den Broucke, Leroy, Declerck, & Hoppenbrouwers, 2013). Also, strong evidence now exists that demonstrates the flow on effect that dental caries can have on other health conditions, including cardiovascular disease, diabetes and pneumonia (Satur et al., 2010).

HEALTH PROMOTION AND ORAL HEALTH EDUCATION

Health promotion is a preventative strategy used to help improve the health of a population by empowering individuals, groups and communities with tools to advance their health and wellbeing (Ministry of Health, 2008b). Oral health promotion should be based on the principles of the Ottawa Charter, which suggest that all members of the population, not just those individuals at risk, need to be involved in eradicating the causes of ill health (Ministry of Health, 2008b). In New Zealand, the Treaty of Waitangi principles of partnership, participation and protection should also guide health promotion programmes and interventions (Ministry of Health, 2003).

ECC is a disease that exists in chronic proportions worldwide; however, it is highly preventable (Rothnie, Walsh, Wang, Morgaine, & Drummond, 2012). Health promotion strategies are particularly valuable as they provide an avenue by which oral health status can be improved, and where ECC prevalence can be reduced worldwide (Arrow, Raheb, & Miller, 2013). Many of the risk factors are modifiable, including diet, plaque control, fluoridation of the water and regular dental checkups (Gussy, Waters, Riggs, Lo, & Kilpatrick, 2008a; Rothnie et al., 2012). Controlling these factors is important in reducing the prevalence of ECC and future dental problems (Gussy et al., 2008).

The most efficient way to prevent dental caries, including ECC, is through the regular use of fluoridated toothpaste (Huebner & Milgrom, 2014; Marinho, Higgins, Logan, & Sheiham, 2003). Multiple studies have shown the effectiveness of brushing more than once a day and the importance of having adults assisting their children; however only 66% of New Zealand parents with children aged two to four, brushed their children's teeth twice a day (Ministry of Health, 2010). Oral health promotion is needed to ensure that parents and caregivers truly understand the risk factors of ECC, as well as the consequences, and interventions need to focus on the effectiveness of tooth brushing with fluoridated toothpaste and on the attention, technique and care of the parents and caregivers (Ismail, Tanzer, & Dingle, 1997). Documents that outline strategic directions form the basis of Government's policies that direct public health promotion. The following section outlines the various policies that exist in the field of oral health promotion.

POLICY

World Health Organization (WHO)

The WHO provides overarching guidance for the prevention of disease. The WHO has placed emphasis on non-communicable diseases with priority given to diseases linked by common, preventable and lifestyle related risk factors (such as diet and tobacco use), including oral health, with a particular focus on disadvantaged and poor populations. In 2007, the WHO introduced a strategy to improve oral health. The Global Oral Health Programme (GOHP) has developed policies for the improvement of oral health in the 21st century. The GOHP's four strategic directions are to:

1. reduce oral disease burden and disability, especially in poor and marginalised populations
2. promote healthy lifestyles and reduce risk factors to oral health that arise from environmental, economic, social and behavioural causes
3. develop oral health systems that equitably improve oral health outcomes, respond to people's legitimate demands, and are finally fair
4. framing policies in oral health, based on integration of oral health into national and community health programmes, and promoting oral health as an effective dimension for development policy of society (World Health Organization, 2015b).

This section has discussed oral health policy at a global level and the following section will discuss the policy in America.

The American Academy of Paediatric Dentistry (AAPD)

The AAPD has updated its policy on ECC in 2014 (A collaborative effort of the American Academy of Pedodontics and the American Academy of Pediatrics). The following preventive practices are recommended to decrease a child's risk of developing ECC:

1. reduces the parents' or siblings' MS levels to decrease transmission of cariogenic bacteria
2. minimise saliva-sharing activities
3. implement oral hygiene measures no later than the time of eruption of the first primary tooth, this includes, tooth brushing performed for children by a parent twice a day, a 'smear' (under three years) or 'rice-size' (three to six years) amount of fluoridated toothpaste should be used
4. provide professionally-applied fluoride varnish treatments for children at risk for ECC
5. establish a dental home (i.e. an ongoing relationship between the dentist and the patient) within six months of eruption of the first tooth and no later than 12 months of age to conduct a caries risk assessment and provide parental education for prevention of oral diseases
6. avoid high frequency consumption of liquids and/or solid food containing sugar
7. work with medical providers to ensure all infants and toddlers have access to dental screenings, counselling, and preventive procedures.

This section has focused on oral health policy in the United States of America; the following section will discuss New Zealand's policy.

New Zealand

Fully public funded dental care is available for all New Zealand children and adolescents from birth until the age of 18. However, as previously stated the Ministry of Health has noted the high rate of ECC and the inequalities that exist in New Zealand children and concluded that the intervention of health care is occurring too late (Ministry of Health, 2006). As a result, the Ministry of Health made the initial stages of the new oral health vision to 'Re-orientating Child and Adolescent Oral Health Services'. Targeting children and adolescents will enable individuals to have good oral health later in life. In 2005, in an effort to work towards this action area, all district health boards (DHBs) were required to 'demonstrate a strong commitment to preschool oral health, for both initial funding and ongoing monitoring purposes' (Ministry of Health, 2006).

In the vision statement set in 2006 it was said that, over the next ten years the Ministry will work with DHBs and other oral health service providers towards:

- creating an environment that promotes good oral health
- delivering oral health services that promote, improve, maintain and restore oral health throughout the life course
- delivering publicly funded services that are accessible, appropriate, and proactively address the needs of those at greatest risk for poor oral health
- delivering publicly funded oral health services that are part of the community (Ministry of Health, 2006).

In New Zealand improving oral health is one of the Government's 13 health priorities and one of the 12 priorities of the Māori Health Strategy. The Ministry of Health's vision for oral health is 'Good oral health for all, for life', with children and adolescents (aged from birth to 18 years) being one of the priority groups (Ministry of Health, 2006).

The seven action areas outlined in the vision statement are:

1. re-orientate child and adolescent oral health services
2. reduce inequalities in oral health outcomes and access to oral health services
3. promote oral health
4. build links with primary health care
5. build the oral health workforce
6. develop oral health policy
7. research, monitoring and evaluation.

Consistent with international evidence, the Ministry of Health recommends that preschool children brush their teeth at least twice a day with parental assistance. Parental assistance is recommended until the child is about eight years old (Ministry of Health, 2013). It is an aim of the Ministry of Health to have all children enrolled into the Community Oral Health Service (COHS) (formerly the School Dental Service). The Ministry of Health also recommends Māori, Pacific and new migrant background children and children living in low decile areas enrol in the COHS by the age of one and children in all other groups should enrol by their third birthday (Ministry of Health, 2006).

The following section introduces the method employed to conduct this narrative literature review.

AIMS AND METHODOLOGY

AIMS

The aims of this literature review are to collate and synthesise the national and international evidence for:

- the impact of differing preschool oral health promotion and social marketing initiatives
- parents' and caregivers' knowledge of preschool oral health and their associated attitudes and behaviours.

METHODOLOGY

Search strategy

A rigorous search method was undertaken during the period between 23 February and 27 March 2015. A search of the English literature on oral health in children, published after 1995, was systematically conducted using database and web-based searchers. Specific details of this search have been documented in Table 1 below.

The initial search using electronic databases was conducted by two individuals who have an academic background in public health and library studies respectively; potential papers that resulted from this search were then screened for relevancy. Additional searches were performed through Google Scholar and the Cochrane Library, as well as scanning reference lists of relevant articles. Grey literature and further reports were searched for on Google and on the Ministry of Health and district health board websites.

PubMed, SageJournals, PsycInfo and Proquest were searched using various combinations of 'oral health', 'early childhood caries', 'nursing caries', 'caries prevention', 'oral health education', 'intervention*', 'maternal and children', 'parent*', 'caregiver*', 'mother*', 'father*', 'infant*', 'baby', 'babies', 'preschool*' or 'pre-school*', 'knowledge', 'attitude', and 'parental attitudes'. The search was limited to studies written in English and was restricted to the time period between 1996 to March 2015. Titles and abstracts of search results were assessed for relevance.

To meet the criteria for inclusion the studies had to have:

- had a specific focus on interventions aimed at preventing oral disease in young children, or parental behaviours, knowledge and/or attitudes around oral health in young children
- involved countries with a similar oral health status to New Zealand
- been published between 1996 and March 2015.

New Zealand research on oral health in preschoolers is limited; therefore, the majority of research included in the review is internationally based. However, countries that are most similar to New Zealand were focused on for the purposes of this review. These countries include Australia, Canada and the United Kingdom as they also have large ethnic disparities and the presence and severity of ECC is higher in the indigenous children than in their non-indigenous counterparts (Broughton et al., 2014). Most of the New Zealand literature was found using the Google Search Engine or from the bibliographies of relevant papers.

Table 1: Search strategies and outcomes

Source	Search strategies	Outcomes (search conducted by searcher A)	Outcomes (search conducted by searcher B)
Databases	Two databases were searched: 1) PubMed (1996 to March 2105) 2) Sage Journals (1996 to March 2015) 3) PhysInfo (1996 to March 2015) 4) Cochrane review 5) Proquest (1996 to March 2015)	1) 275 papers were identified, 25 met the inclusion criteria 2) 8 additional papers were identified, 1 paper met the inclusion criteria 3) 98 additional papers were identified, 0 met the inclusion criteria 4) 39 additional papers were identified, 1 paper met the inclusion criteria - Total: 27 papers were identified	1) 44 papers were identified, 8 met the inclusion criteria - - - 2) 35 additional papers were identified, 10 paper met the inclusion criteria Total: 18 papers were identified
Journals	The tables of contents of two journals were scanned to identify further relevant papers: <i>British Dental Journal</i> and <i>The Journal of the American Dental Association</i> from 1996 onwards.	1 additional paper was identified	-
Websites	The following four websites were searched using online search functions and browsing: the Ministry of Health website (http://www.health.govt.nz), the American Academy of Paediatric Dentistry (http://www.aapd.org), the Google Search Engine (www.google.com) and Google Scholar (www.scholar.google.com). Reports and papers published after 1996 until March 2015 were included.	23 additional articles and reports were identified	-
Bibliographies of relevant papers	The bibliographies of relevant papers were checked to identify papers not already found in the other searches.	28 additional papers were identified	-

External academic researchers and experts in the field of oral health promotion were approached to ensure that relevant studies from New Zealand had been located. Five additional studies were identified, of which one was within the scope of this review.

Exclusion of literature

A large amount of literature was found on the relationship between preschoolers' oral health and fluoride varnishes, with key authors in the field being: Ismail et al., Peterson et al., Weintraub et al., Marinho et al., Azarpazhooh et al. (Azarpazhooh & Main, 2008; Ismail et al., 1997; Marinho, Higgins, Logan, & Sheiham, 2002; Petersen & Lennon, 2004; Weintraub et al., 2006). A substantial amount of literature, including systematic reviews, has focused on the effects that diet has on oral health. The key authors in this field are Burt, Lingstrom, Nunn, Tinanoff (Burt & Pai, 2001; Lingström et al., 2003; Nunn, Gordon, Morris, & Walker, 2003; Tinanoff & Palmer, 2000). However, fluoride varnishes and diet are outside the scope of this review, and therefore, the results of the studies will not be explored.

Preparing the report

A total of 97 papers or reports were identified and included in this literature review. The findings of this literature review will be used to inform the development of new oral health promotion initiatives in New Zealand. It is understood that New Zealand has a very unique population composition; unfortunately, there is very limited research available in New Zealand on oral health practices, especially in the preschool population. The lack of national literature means that this report draws heavily on the international literature, and is supplemented with findings from New Zealand when this is available.

As the scope of the literature is broad and the methodologies and outcomes used in these studies are diverse, the literature will be presented as a narrative review as opposed to a systematic review (CEBD, 2015). A narrative literature review discusses and reviews the literature, without generating any pooled information through meta-analysis. This type of review usually gives an overview of a topic, rather than concentrating on a specific question.

FINDINGS

The use of the search strategy, described in the previous section, resulted in a wide range of research literature that facilitated an exploration of the topic of pre-school ECC. This review uncovered definite trends and identified a number of key gaps in our knowledge base. The findings of this review will be synthesised and presented in this section. The findings will be presented in the following order: parents' and caregivers' knowledge of oral health for their preschool children, motivators and barriers for parents to achieving good oral health in preschoolers and oral health interventions that have been implemented.

PARENTS/CAREGIVERS' KNOWLEDGE OF ORAL HEALTH FOR THEIR PRESCHOOL CHILDREN

The oral health status of preschoolers relies heavily on the caregivers; therefore, understanding what parents and caregivers know about oral health is crucial when working towards modifying behaviours and encouraging health promotion (Kay & Locker, 1996). Research has shown that parents' lack of knowledge and negative attitudes towards oral health are strongly associated with an increased caries experience in preschoolers (Ayhan, Suskan, & Yildirim, 1996; Hochstetter, Lombardo, D'eramo, Piovano, & Bordoni, 2006). Examples of negative attitudes towards oral health include: downplaying the importance of oral health, not visiting the dentist and not brushing teeth regularly. This has been re-emphasised by the Surgeon General of America who stressed that if parents and caregivers are unfamiliar with the importance and care of their child's primary teeth, they are unlikely to promote a good oral health status and to provide the appropriate care that is required to prevent ECC (Vann, Lee, Baker, & Divaris, 2010).

Knowledge of tooth brushing

Previous studies revealed mixed results of parental knowledge about when to begin tooth brushing. Some studies found that the majority of parents knew that they needed to start brushing their preschoolers' teeth when the first tooth erupts (Febres, Echeverri, & Keene, 1997; Gussy, Waters, Riggs, Lo, & Kilpatrick, 2008b). However, another study has found that only one-third of mothers (32%) knew when to commence tooth brushing in their child (Akpabio, Klausner, & Inglehart, 2008). The same study also explored the relationship between parents' own oral health behaviours and knowledge of preschool oral health, and found a strong correlation between the frequency that parents brush and floss their teeth and their knowledge of preschool oral health (Akpabio et al., 2008). These findings highlight the importance of educating parents on when to start brushing their preschoolers' teeth, as well as promoting good oral health behaviours among parents.

Knowledge of regular brushing

A large number of studies found most parents (71% to 100%) knew that regular brushing is important to control for dental plaque (Berkowitz, 2003; Blinkhorn, Wainwright-Stringer, & Holloway, 2001; Mani, John, Ismail, & Ping, 2012; Wierzbicka, Petersen, Szatko, Dybizbanska, & Kalo, 2002). However, in an Australian study only 40% of parents identified "not brushing teeth everyday" as a main risk factor for ECC (Gussy et al., 2008). The differences across countries highlight the importance of obtaining New Zealand data, which we currently do not have, on parental knowledge of preschool oral health.

A study of parents in Malaysia revealed interesting differences between the knowledge of the importance of regular tooth brushing and the likelihood of infants developing tooth decay (Mani et al., 2012). Specifically, the study found nearly 100% agreement rate from parents recognising that regular tooth brushing was important, however only 50% of them knew that preschoolers under the age of two could develop tooth decay. The same study also found that while there was an understanding around the importance of oral hygiene; parents were still found to have poor attitudes and behaviours towards the oral health of their children. The authors of this research indicated that this maybe due to parents not understanding the health impacts that ECC can have on their children (Mani et al., 2012). Similar findings have also been seen in other studies where knowledge has not been translated into good oral health practices (Saied-Moallemi, Virtanen, Ghofranipour, & Murtomaa, 2008; Szatko, Wierzbicka, Dybizbanska, Struzycka, & Iwanicka-Frankowska, 2004). The mis-match between knowledge and behaviours could mean that the importance of good oral health in preschoolers has not been fully communicated to parents (Berkowitz, 2003), or there are significant barriers for parents to implement good oral health practice for their children.

Fluoridated toothpaste

Overall, the use of fluoridated toothpastes to prevent tooth decay was known by a high proportion of mothers, with a range of agreement between studies of 74% to 86% (Baginska & Rodakowska, 2012; Gussy et al., 2008; Mani et al., 2012; Schroth, Brothwell, & Moffatt, 2007; Szatko, Wierzbicka, Dybizbanska, Struzycka, & Iwanicka-Frankowska, 2004). However, a study conducted in Poland found that only 46% of parents knew the importance fluoride had on preventing dental caries (Wierzbicka et al., 2002).

Researchers have also demonstrated that there was a lack of clarity amongst parents as to whether fluoride toothpaste should be used in young children; the amount to be used is also poorly understood. Between 40 and 70% of the parents across various studies knew that a small amount of toothpaste should be used for preschool children (Baginska & Rodakowska, 2012; Blinkhorn et al., 2001; Gussy et al., 2008b; Mani et al., 2012).

Researchers have also documented that parents have a low level of knowledge of when children are capable of brushing their own teeth. In an Australian study by Gussy et al. (2008), 52% of parents believed that by the age of four, children are capable of cleaning their own teeth. Another study, conducted in Poland, found that only one-fifth of parents in their sample knew that they should assist with tooth brushing until their children reach the age of 10 (Baginska & Rodakowska, 2012). While these studies have used different measures, they both indicate that there is a low knowledge level of when children are capable of brushing their own teeth adequately.

Tooth brushing and dental habits

A number of studies have looked at the frequency that tooth brushing occurs among preschoolers. These studies have used different measures, which made comparison of the findings difficult. However, it appears that tooth brushing habits differed across different population groups, for example, a study that looked at the parents enrolled in the Head Start programmes in America found that 65% of parents brushed their children's teeth more than once a day (Vargas, Ronzio, & Hayes, 2003). In another American study, where researchers examined low-income parents of preschool children, parents reported brushing their children's teeth on average nine times a week (Finlayson, Siefert, Ismail, Delva, & Sohn, 2005).

A study from Finland revealed differences in the frequency of tooth brushing by location of residence and by age of the mothers. It was found that while 78% of mothers brushed their preschoolers teeth daily, lower rates of tooth brushing habits were found among mothers who were rurally-based and the younger mothers (Paunio, Rautava, Helenius, & Sillanpää, 1994).

A few other studies reported on the rate of daily tooth brushing among preschoolers. A Malaysian study found that 60% of parents were brushing their preschoolers teeth twice a day, with an additional 27% of parents who were brushing their children's teeth once a day (Mani et al., 2012). Poor tooth brushing habits were reported by a study from Hong Kong, which found that only 42% of children aged between one and three had commenced tooth brushing. Furthermore, among those who had commenced tooth brushing; only 19% of them brushed their teeth twice a day (Chan, Tsai, & King, 2002). About half of them (44%) brushed once a day and the remaining (34%) brushed their teeth irregularly.

Apart from the frequency of tooth brushing, an Australian study also assessed parents' confidence in their ability to brush their children's teeth properly. It was found that while 75% of the parents reported cleaning their children's teeth regularly, only 44% of them reported being confident in their ability (Gussy et al., 2008). Frequency of brushing their children's teeth was significantly related to the degree of confidence that the parents had, with parents who brush their children's teeth more frequently being more confident (Gussy et al., 2008). A similar result was demonstrated in a Malaysian study (Mani et al., 2012).

In addition, a number of studies found that mothers did not know the correct technique for brushing their children's teeth (Blinkhorn et al., 2001; Chan et al., 2002). For example, British researchers found that only 40% of parents stood behind their child when brushing their teeth and only 76% of parents took more than 20 seconds to brush their children's teeth (Blinkhorn et al., 2001). On top of this, 40% of the mothers in this study reported that their children did not let them brush their teeth, and was seen as a further barrier for improving their children's oral health. In a study of parents in Hong Kong, researchers also found that out of the children that had begun tooth brushing, 56% were brushing their teeth without any adult supervision, and toothpaste was only used by approximately half of the children (Chan et al., 2002).

Whilst regular tooth brushing is a common health promotion approach to dental caries, a child having their own toothbrush is a less common health message. It is recommended that children have their own toothbrush in order to avoid having bacteria passed from the mouths of the parent to the child (Harris et al., 2004). There is a lack of research concerning the access and ownership of toothbrushes. However, one study from Brazil found that almost 100% of parents interviewed in the study reported that every member of their family had their own toothbrush (Sakai et al., 2008). The demographics of the participants were not recorded.

Knowledge of dental visits

Of the research reviewed for the purpose of this report, it was evident that parents' knowledge regarding when a child should first visit the dentist varied greatly. A study of preschool parents in Hong Kong showed that 21% of parents thought a dental visit should occur around the age of one, 27% thought a child should be three years of age and 26% thought they would not take their child to the dentist before the age of six, unless a problem arose (Chan et al., 2002). Similarly, an American study found that only 26% of parents were aware of when a child should start visiting the dentist (Akpabio et al., 2008) and a Brazilian study found that only 41% of children had visited the dentist by the age of three (Sakai et al., 2008).

In comparison, a Canadian study found that 74.7% of parents knew that a dental visit should be made before the age of one (Schroth et al., 2007), and a Polish study found that 89.2% of parents surveyed realised that regular dental visits were important for oral health (Baginska & Rodakowska, 2012). In addition, an American study found that children are 3.36 times more likely to visit the dentist if their parents also visited the dentist (Isong et al., 2010).

Parents' perceptions of primary teeth

In some populations, it is commonly believed that primary teeth are not important because they are going to fall out anyway, and therefore, do not need the same kind of care or treatment as permanent teeth, unless they are causing the child pain (Mofidi, Zeldin, & Rozier, 2009). This belief was apparent among some populations, whereas in other studies, parents were aware of the importance of primary teeth. In a study from rural Australia, all parents agreed that their children's teeth were important, with similar results seen in a study from Canada where 96% of parents agreed that primary teeth are important (Gussy et al., 2008; Schroth et al., 2007). However, in Poland, approximately two-thirds of mothers believed care of primary teeth was unnecessary (Szatko et al., 2004) and 17% of mothers from a Hong Kong study believed primary teeth had no function (Chan et al., 2002).

Parents also had negative attitudes and beliefs regarding fillings in primary teeth. Two different studies found that approximately two-thirds of parents believed it was not necessary to fill primary teeth (Chan et al., 2002; Vann et al., 2010). Comparatively, 64% of Malaysian parents knew that filling primary teeth was necessary (Mani et al., 2012). In a British study by Blinkhorn et al. (2001), 47% of mothers in a high-risk population wanted their children's caries filled; however, in a separate British cohort study, it was found that only 6% of parents wanted their children's fillings to be restored.

Parents' opinions on primary teeth are important. Researchers involved in a Canadian study has found that children whose parents believed that primary teeth were important had significantly less tooth decay (Schroth et al., 2007). Similar findings were found in a study from Hong Kong, which demonstrated that parents of children who were caries free were more aware of the oral condition of their children's teeth compared to mothers of children with caries (Chan et al., 2002). Another study also found that caregivers of children with no ECC were more likely to believe that caries could affect a child's health, compared to caregivers whose children had ECC (Schroth et al., 2007). The following section discusses the New Zealand based evidence.

Evidence from New Zealand

A review of the literature has revealed differences in the knowledge levels of preschool oral health and oral hygiene habits across countries. The differences across the countries highlight the importance of obtaining New Zealand data on parental knowledge of preschool oral health and the associated attitudes and behaviours.

Four studies and two Surveys' from New Zealand were identified as having assessed parent's knowledge and practices of preschool oral health in New Zealand. Overall, the findings of these studies indicate a lack of knowledge of preschool oral health. For example, a study by Schluter and colleagues assessed the oral health practices of a group of disadvantaged four-year-old Pacific children and their mothers residing in South Auckland (Schluter, Durward, Cartwright, & Paterson, 2007). The study interviewed 1048

mothers and found that only 47% of their children brushed their teeth one or more times per day, with 47% of mothers reporting that brushing occurred without adult supervision (Schluter et al., 2007). The study also found that 31% of the children were not enrolled in the COHS, and 54% of mothers did not know it was free to enrol their preschooler in the COHS (Schluter et al., 2007). The low enrolment rate was found among this sample of four-year-old children, despite that the MOH recommends that Māori, Pacific and new migrant background children and children living in low decile areas enrol in the COHS by the age of one and children, as-well-as in all other groups should enrol by their third birthday (Ministry of Health, 2008b). In addition, it was also noted that most mothers were not following the recommended dietary habits for their preschooler (Schluter et al., 2007).

Another New Zealand study took place in Dunedin, which aimed at assessing pregnant women's knowledge of preschool oral health (Rothnie et al., 2012). The study surveyed 104 women. A large majority of the respondents were New Zealand European (85%), approximately two-thirds of them were over 30 years old, and 46% were first time mothers. Overall, the results showed that 94% of the women thought oral health in children was very important and 63% knew preventative practices for dental caries in children. Preventative practices most commonly cited were tooth brushing, dietary habits and educating their children. However, the study also identified some knowledge gaps. For example, 25% of the women thought that tooth brushing should begin after two years of age. Furthermore, the majority of women (71%) thought that the first dental appointment should occur after the second birthday, with 25% of the women unsure on how to make a dental appointment for their child. This finding is despite the American Dental Association and the American Academy of Pediatric Dentistry recommendation that a child's first visit to the dentist occurs within six months of the first tooth erupting, however this should be no later than the child's first birthday (Johnson J, 2013).

The study also assessed the respondents' own dental care behaviour. Only one-half of the pregnant women had regular dental attendance themselves. This finding in itself is alarming, as international research has shown that a child's risk of developing caries is higher when mothers have low dental attendance (Honkala & Al-Ansari, 2005). Differences in the knowledge level were seen when comparing socio-economic level, this too was consistent with international literature as women with a lower socio-economic status had a lower level of knowledge of oral health (Rothnie et al., 2012).

This study by Rothnie and colleagues (2008), conducted in New Zealand, also demonstrated that a decreased amount of knowledge was seen in younger mothers and in first time mothers. These results are also similar to international findings (Akpabio et al., 2008; Amin & Harrison, 2009). However, overall the findings indicated that only 43% of mothers felt that they had enough information about their children's dental needs or where to seek dental treatment from when their children were born (Rothnie et al., 2012). The women were asked how they would like to receive information regarding child oral health and over half (57%) of the women said they would prefer to receive the information from Plunket nurses. Women (30%) also opted to receive the information from general practitioners, 21% from dentists, and 18% from midwives (Rothnie et al., 2012).

The third study that has assessed parent's knowledge and practices of preschool oral health in New Zealand focused on pregnant Māori women from Waikato-Tainui (Broughton et al., 2014). The results available to date are the baseline measures from a three-year intervention study that is currently taking place. The study included 222 Māori women, the majority (68%) of whom have a community

services card, which is an indication of having a low socio-economic status (Broughton et al., 2014). The researchers found that 23% of the mothers believed that holes in baby teeth do not matter as they will fall out anyway, 10% of mothers did not think it is important to keep them clean and 7% of the women did not think parents can do much to stop the children from getting holes in their teeth (Broughton et al., 2014). The study also demonstrated that 60% of the women believed that all children eventually get holes in their teeth and 9% of women believing that children do not need their own toothbrush until all their teeth come through. When assessing the mother's dental practices the results showed that only 38% of the mothers regularly visited the dentist; however, 79% thought they needed to see the dentist at the time the interview occurred (Rothnie et al., 2012).

The data available to date around the knowledge and behaviours of New Zealand parents is sparse, and they only focused on specific population groups. Overall, the evidence suggests that there is a need for increasing parents', and pregnant women's knowledge base around preschool oral health. This includes messages around the importance of preserving primary teeth, when to start brushing their children's teeth, and the availability of free dental care services. Knowledge of oral health practices is essential to achieving a healthy oral health status, however, this knowledge does not always mean that these behaviours are put into place; therefore we need to assess the motivators and barriers that parents face to achieve good oral health in preschoolers. The following section will discuss the motivators and barriers to good oral health in preschoolers.

A study conducted in Christchurch used a self-administered oral health literacy questionnaire, which 117 parents of preschoolers completed (Veerasingh & Kirk, 2013). The questions were designed to assess the parents' basic dental knowledge, including oral health promotion, oral health protection, disease prevention, and system navigation. The focus of the questions was around ECC. In the study, 65% of the participants identified as New Zealand European, and two-thirds were between the ages of 30 to 39. No further information was provided on ethnicity. The participants were recruited for the study from two separate preschools at the university campus. This resulted in a high level of university-educated participants (61%) and was therefore a limitation of the study. The results from the study found that 41% of the participants had moderate oral health literacy, with 38% and 21% of participants having poor and good oral health literacy, respectively.

The New Zealand 2013/2014 Health Survey found that children aged one to four years were much less likely to have visited the dentist (59%), in the past 12 months, compared to the average of all children (84%). However, there were no differences by sex, ethnic group, or level of neighbourhood deprivation (Ministry of Health, 2014b).

Data on tooth brushing are available from the 2009 New Zealand Oral Health Survey, which found that children aged two to four had a similar rate of brushing their teeth twice a day (66%) compared to all children aged 2 to 17 (64%). For all children (aged 2 to 17) Māori (52%) had the lowest compliance rate to brushing twice a day, followed by Pacific children (64%), European/Other children (65%), with Asian children having the highest rate of brushing twice a day (72%). The results also showed that the least deprived children had a higher rate (78%) of brushing their teeth twice a day than the most deprived (55%). The survey also assessed the rate of children using fluoride toothpaste twice a day. The results showed that only 15% of two to four-year-olds were using fluoride toothpaste twice a day compared to 43%, which is the average of all children. On average of children aged 2 to 17, Māori (35%) had the lowest use of fluoride toothpaste twice a day, followed by Pacific (41%), European/Other (44%), with

Asian children having the highest use (48%). There were also variations between deprivation levels with the least deprived having a higher rate (51%) of using fluoridated toothpaste than children from the most deprived areas (36%).

The oral health survey also found that overall Pacific children (71%) aged 2 to 17 years had the lowest rate of visiting the dentist in the past year, followed by Māori children (77%), Asian children (80%) and European/Other (83%). When broken down by deprivation those who were in decile 3 (91%) had the highest rate of visiting the dentist in the past year, followed by those in decile 4 (83%), decile 2 (80%), followed by those in least deprived in decile 1 (79%) and those most deprived (decile 5, 72%).

Another New Zealand study was found on the oral health status of five-year-old children (Te Amo, 2007). While it is just outside the scope of this review, the study has been included due to the lack of available evidence that fits into the scope. However, it must be noted that it has a very small sample size (n = 12) and therefore caution must be taken when interpreting the results. The results showed that 75% of the children brush their own teeth, with 50% brushing their teeth once a day, 33% brushing their teeth twice a day, and 17% brushing their teeth a few times a week or less. The children who brush their teeth 'a few times a week or less' identified as Māori and were from decile one schools. The study also found that all but one child (n=11) had visited the COHS as preschoolers, with six children having visited the COHS at age four and three having attended the COHS at age two.

MOTIVATORS AND BARRIERS TO GOOD PRESCHOOL ORAL HEALTH

When developing health promotion initiatives to reduce the prevalence of ECC, it is important to understand the potential motivators and barriers in relation to oral health practices of preschool children. To provide some directions on potential motivators and barriers for parents and caregivers to achieve good oral health in preschoolers, this section drew on the small amount of international and national literature available on this topic.

Motivators

Health benefits

There are many positive health outcomes of good oral health because it affects one's current and future health status (Kawashita et al., 2011). The converse of this is also true as poor oral health in preschoolers has a direct impact on an individual's dental health, and therefore, overall health. The impacts include: impaired ability for a child's to eat, poor sleep as a result of tooth pain, which in turn may also limit the child's ability to learn (Kawashita et al., 2011; Plutzer & Spencer, 2008; Riter et al., 2008). Researchers have also shown that infants with dental caries are shorter on average compared to their caries free counterparts because they grow at a slower rate (Kawashita et al., 2011). Poor oral health during childhood has also been shown to have a direct impact on one's oral health status later in life (Kawashita et al., 2011). Poor oral health has a negative impact on general health conditions such as increasing the risk diabetes, pneumonia, peptic ulcers and cardiovascular disease (Satur et al., 2010). The impact that poor oral health has on the quality of life, nutrition, and social and economic well-being position makes oral health an important determinant of health (Satur et al., 2010). Previous studies had not specifically explored how parents and caregivers would perceive health gain as a motivator for achieving good oral health in their preschoolers.

Appearance

Roberts and Condon (2014) have identified cosmetic appearance and self-esteem as a motivator of good oral health in children. Parents' own experiences of oral health care was reported as an incentive to promote good oral health care for their preschoolers, with many parents not wanting their children to have the same oral health problems that they now have (Roberts & Condon, 2014).

Barriers

Financial cost

International research has consistently identified a lack of dental insurance as a major barrier to achieving a good oral health status in preschoolers (Perez & Amin, 2014; Roberts & Condon, 2014). Many parents and caregivers noted that dental treatment is often too expensive. The consequence of this means the child does not receive dental care, or the dentist is used for treatment purposes rather than as a form of prevention (Perez & Amin, 2014; Roberts & Condon, 2014).

New Zealand has a free dental care policy for children under 18-years-of-age, and therefore, financial cost associated with dental visits should not be a relevant barrier in New Zealand. However, other financial barriers also arose in the literature that could be relevant to New Zealand, including not having access to transportation to dental appointments and a lack of access to sufficient resources, such as toothbrushes and fluoridated toothpaste (Perez & Amin, 2014; Prowse et al., 2014). Currently, there is limited New Zealand data that explores this issue, and research on these matters would be beneficial for policy makers and health promoters as it would provide evidence of potential barriers, which in turn can inform policy direction and programme implementation.

Attitudes

Parents' beliefs and attitudes towards oral health influences how oral health is promoted to their child (Amin & Harrison, 2009; Wong, Perez-Spiess, & Julliard, 2005). A study by Perez and Amin (2014) found that if parents did not place importance on oral health, or more particularly on preschool oral health, it was a significant barrier to a child achieving good oral health. A common belief seen throughout a range of studies is that primary teeth are not important because permanent teeth will soon grow in their place (Perez & Amin, 2014). Parents who placed low importance on preschool oral health often lacked sufficient knowledge to care for their children's teeth in an appropriate manner. Parents lack of knowledge and negative attitude towards preschool oral health has been associated with an increased caries experience in preschoolers (Prowse et al., 2014).

Differing practices and views on oral health, could be related to differences in cultural practices and beliefs, and may contribute to an increased caries risk (Amin & Harrison, 2009; Prowse et al., 2014). Differences could include diet, oral hygiene practices and routines, health beliefs and access to care (Prowse et al., 2014). In some cultures, poor oral health is common and often accompanies the lack of knowledge, lack of access to health care, or not following recommended preventative guidelines (Prowse et al., 2014). In one study, researchers also noted unfavourable attitudes by the parent towards dentists as a barrier to good oral health for their child (Van den Branden et al., 2013). However, another study has found that many parents viewed dentists as a means of oral treatment, rather than as preventative care (Perez & Amin, 2014).

Family factors

Children's lack of cooperation and resistance to tooth brushing has also been identified as a common barrier that parents face when trying to implement good oral health practices according to international studies (Amin & Harrison, 2009; Roberts & Condon, 2014). Children resist tooth brushing due to either wanting independence, for example wanting to brush their own teeth, or not allowing tooth brushing to occur (Amin & Harrison, 2009; Roberts & Condon, 2014). Parents also reported the negative influence siblings can have on oral health promotion in preschoolers, with older siblings often teaching their younger siblings negative behaviours and attitudes towards tooth brushing (Amin & Harrison, 2009).

Mothers' lack of time and availability for oral health practice has also been identified as a key barrier to good oral health (Amin & Harrison, 2009; Perez & Amin, 2014; Roberts & Condon, 2014). Busy households and lifestyles have been identified as key barriers to adequate oral health care in children, or as a reason for parents not making healthier changes and choices that would improve their child's oral health or oral health routine (Amin & Harrison, 2009; Mofidi et al., 2009; Roberts & Condon, 2014). Researchers noted that parents prioritised other tasks such as getting a child ready for school or to bed over tooth brushing, which demonstrates how oral health is viewed in some families (Roberts & Condon, 2014). A study by Daley et al. also noted that the pressures of being a new parent affected the parent's ability to implement healthy oral health routines in older siblings (Daly, Clarke, McEvoy, Periam, & Zoitopoulos, 2010).

Skills and knowledge

Some of the skill-related barriers to good oral health were lack of knowledge around oral health and lack of skills to assist children in tooth brushing, with many parents assuming children could brush their own teeth from the age of three (Amin & Harrison, 2009; Perez & Amin, 2014). Mothers of children who have ECC have been found to have significantly less knowledge about the determinants of ECC compared to mothers of children who have not experienced ECC (Ismail et al., 1997).

The level of skill and knowledge parents had of oral health differed by a range of socio-demographic factors. Specifically, a decreased oral health status was found among families of a low socio-economic status (Amin & Harrison, 2009; Chan et al., 2002b; Colak, Dülgergil, Dalli, & Hamidi, 2013; Ismail et al., 1997; Rothnie et al., 2012; Thomas, Middleton, & Crowther, 2008). Akpabio and colleagues (2008), also found that first time mothers, and young mothers (under the age of 23) on average had a lower knowledge base of preschoolers' oral health compared with mothers that were more experienced and/or older.

Level of education and literacy

Oral health status of preschoolers is associated with parents' education level. A number of studies have found increased number of caries among children whose parents had a lower education level (Chan et al., 2002b; Colak et al., 2013; Ismail et al., 1997; Vann et al., 2010; Wierzbicka et al., 2002). A few studies used parents' literacy level as an independent measure, and found an inverse relationship between the parents' literacy level and their children's oral health status. The association is still statistically significant, even after controlling for socio-economic risk factors (Vann et al; Sanders et al 2009; Yin et al 2009).

Researchers have suggested multiple reasons for the differences observed by parents' education level, including that parents with a lower education level would have less knowledge and skills with which to promote oral health in their preschoolers (Passalacqua et al., 2012; Chan; Williams, 2002), fewer opportunities to be exposed to oral health promotion messages (Passalacqua et al., 2012), and a decreased use of or access to preventive services (Vann et al., 2010).

In contradiction, one study has found that preschoolers from high socio-economic families were more prone to dental problems, if the preschoolers had caregivers, other than the parents, taking care of them (Amin & Harrison, 2009). Low oral health statuses have been reported in these children, as the caregivers may have had a poor knowledge of oral health practices or not deem oral health hygiene important. For these preschoolers, lack of knowledge and skills of their caregivers has a negative impact on their oral health, as well as affecting their overall health.

Evidence from New Zealand

There is a limited amount of New Zealand research which has assessed the motivators or barriers to achieving good oral health in preschoolers. The findings from one small study of five-year-olds in Hamilton indicate that Māori parents are more likely to be unaware of free school dental therapist services (Te Amo, 2007). In addition, the author suggests that distance and lack of adequate transport to dental appointments may prevent Māori children from accessing oral health services, especially in rural communities. Dental practices in rural areas may have limited hours of operation, which could also be seen as a barrier to accessing dental care. Another barrier discussed by Te Amo is that, at all levels, Māori oral health professionals are underrepresented in the workforce. To help close the oral health inequality gap, it could be beneficial to attract more Māori into the dental profession. In a study by Broughton (2000), the author found that Māori parents are more likely to be unaware of which public dental services are available (Broughton, 2000).

ORAL HEALTH PROMOTION INTERVENTIONS

This section describes a range of oral health promotion interventions targeting parents and caregivers of preschoolers. The programmes include the more traditional methods of delivering health messages (eg, face to face, printed leaflets), as well as utilising the more advanced technology. The effectiveness of these programmes was assessed using a range of outcome measures, including amount of caries, Decayed, Missing, Filled teeth (DMFT) score, parental knowledge, tooth brushing behaviour, and uptake of the programme.

Tooth brushing with fluoride toothpaste

Twice daily tooth brushing with fluoride toothpaste is recommended by the New Zealand Ministry of Health as a preventative method for oral health diseases, including for the prevention of ECC in young children (Ministry of Health, 2008a). The regular use of fluoridated toothpaste is the most efficient way to prevent dental caries, including ECC (Huebner & Milgrom, 2014; Marinho et al., 2003).

An intervention study was conducted in England amongst preschoolers aged between 8 and 12-months-of-age from a high oral health risk population in England (Davies et al., 2002). Respondents were

assigned into one of three conditions, where two of them received an intervention and the remaining was a control group. Respondents from the intervention groups received educational leaflets and fluoride toothpaste every 12-weeks until the children were five-and-a-half-years-old. The educational leaflets encouraged parents to use a pea-sized amount of the toothpaste they had just received and to brush their children's teeth twice a day. The intervention groups differed by the strength of fluoride toothpaste they received for free, one with a strength of 1450ppmF (high-strength) and the other group with a fluoride strength of 44ppmF (low strength) (Davies et al., 2002). The children in both test groups received a new toothbrush annually. The control group did not receive a toothbrush or any toothpaste. Over a two-year period, more positive results were observed among participants from the high-strength intervention group. Specifically, the investigators found a significant reduction in the average DMFT among participants in the high-strength intervention group, compared with participants from the control group. It was also found that significantly less caries were seen among participants from the high-strength intervention group compared to participants from the low-strength intervention group (Davies et al., 2002).

Another study, also from England, found a similar positive effect when regular dental products, including a trainer cup, toothpaste, a toothbrush and educational pamphlets on attendance at designated clinics and medical practices, were sent to the parents of infants aged 8 to 32-months-of-age (Davies, Duxbury, Boothman, Davies, & Blinkhorn, 2005). Positive results were seen from the intervention with parents who received regular dental products in the mail, as they were significantly more likely to initiate tooth brushing before 12 months of age, as well as twice daily tooth brushing. However, it needs to be noted that while the results were significant, the overall compliance rate was low, as less than one-half of parents from the intervention implemented the target behaviours (Davies et al., 2005).

A Scottish based intervention study in high-caries-risk children has looked at the effectiveness of receiving a toothbrush and toothpaste as well as supervised tooth brushing in schools. The intervention group is older than our target audience for this literature review, with 5.3 years being the average age of the children in the study, compared to our age range of birth to the age of five (Curnow et al., 2002). However, due to the strong relevance to this literature review, the findings from this study will be included in the review. Each child in the intervention group received supervised tooth brushing on every school day and a toothbrush and toothpaste to take home in an effort to promote tooth brushing in the home. All children were given six-monthly dental examinations, which were completed at the school, over the two-year study period. The results showed a reduced number of caries in newly erupted primary molars in the intervention group compared to the control group (Curnow et al., 2002).

The Childsmile programme

Scotland has a particular focus on improving oral health in children, where they are provided with accessible services which focus on prevention and high quality, effective treatment (Astron, 2005). In 2005, the Childsmile programme was an initiative developed to address oral health in Scottish children, and was made available throughout Scotland (Astron, 2005; NHS Scotland, 2015). Every child is provided with a Dental Pack containing a toothbrush, a tube of 1000ppm fluoride toothpaste and an information leaflet on at least six occasions by the age of five. Children also receive a free-flow feeder cup by one-year-of-age. In addition, every three- and four-year-old child attending nursery has daily supervised tooth brushing. The Childsmile Nursery and Childsmile School programmes also deliver fluoride varnishing for children aged three and upwards who are identified as living in the most deprived areas. A range of health

professionals deliver the Childsmile programme and the dental products are distributed in different ways between each Health Board areas. The professionals include Dental Health Support Workers, Dental Nurses, Dentists, and Dental Hygienists, many of whom are employed by the National Health System (NHS).

However, the programme was only evaluated based on its uptake, where positive results have been seen with an increased yearly uptake of children into the programme and increased numbers of children being enrolled into dental practices (NHS Scotland, 2015).

Oral education for pregnant mothers

Educating and supporting mothers at an early stage of pregnancy can lead to better oral health in children (Plutzer & Spencer, 2008). Australian researchers found that infant oral health education for first time mothers, administered during pregnancy was successful in lowering the rate of ECC (Plutzer & Spencer, 2008). While the overall intervention was successful, supplementary telephone consultations to the intervention group, at 6 and 12- months did not have any additional effect on ECC outcomes. Surprisingly, the findings showed that retention of information was higher among mothers with lower levels of education (Plutzer & Spencer, 2008). The authors thought this may be due to mothers with lower education utilising the education opportunity to extend their knowledge and improve their parenting skills, where mothers with a higher education may feel less need for the support (Plutzer & Spencer, 2008).

A study from Brazil also looked at the effectiveness of dental care and oral health education of primary and permanent teeth in pregnant mothers (Medeiros, Otero, Frencken, Bronkhorst, & Leal, 2015). Whilst pregnant, the mother was given dental treatment and was taught about oral hygiene practices. At three-months-of-age, dental check-ups began for the preschooler and occurred every three months after the initial visit. When necessary the appropriate dental treatment was given. The intervention was successful, with preschoolers in the intervention group having a significantly lower DMFT score (0.25), compared to the control group (4.12) (Medeiros et al., 2015).

Child oral health education for mothers

Preschool oral health promotion and education programmes for parents are the most widely documented form of oral health promotion for preventing ECC. Educating parents and caregivers about oral health is extremely important for improving the oral health status of young children, as parents and caregivers are the primary promoters of oral hygiene practices, and therefore, have a major influence on the oral health status of infants (Ayhan et al., 1996; Hochstetter et al., 2006; Ismail et al., 1997).

Interventions that occur in the early stages of a child's life are best for primary prevention because they optimise the chance of the child staying caries free. In New Zealand, creating interventions for mothers is particularly important because mothers play a key role in the oral health care of their children (Broughton et al., 2014). Dyall (1997) emphasised the key role that Māori women play in their society by shaping the behaviour and values of the next generation (Broughton et al., 2014; Dyall, 1997); however, it is equally important to recognise that in some families, mothers are not the primary or sole caregivers for children. Therefore, ensuring that health promotion messages are relevant to, and understood, by a range of primary caregivers, including Māori mothers who play a significant caretaking and mentoring role to children, may help to reduce the ethnic inequalities in oral health that exist in New Zealand.

Many different types of intervention and messages have been used in various studies to promote preschool children's oral health to parents. These include interventions like text messaging, internet and education; these are discussed in detail below.

Text messaging

One intervention tested the impact of sending mobile phone text messages to mothers everyday for a week (Hashemian, Kritz, Silverstein, & Baker, 2014). The texts provided oral health information for children to parents and reminded them to floss their own teeth. Oral health knowledge and behaviours of mothers in the intervention group significantly increased compared to the mothers in the comparison group, who received no intervention at all. In addition, the intervention group showed a shift in mothers' attitudes towards wanting to improve their child's oral health behaviours.

Web-based

One web-based education programme assessed the effectiveness of an education programme that aimed at improving the primary caregivers' knowledge of oral health and caries transmission in children, along with improving attitudes and behaviours towards their children having good oral health (Albert, Barracks, Bruzelius, & Ward, 2014). The intervention tested parents' knowledge pre- and post- the programme and found significantly increased oral health knowledge; however, due to the recruitment method, the study had a large percentage of insured and college-educated participants, which could have biased the results (Albert et al., 2014).

Video

A Canadian study looked at the long-term effectiveness of an educational video for parents which demonstrated how to care for primary teeth and prevent ECC (Kulkarni, 2013). A follow-up occurred 18 months after the video was shown, where knowledge and children's experience of caries were compared to a group of caregivers who had not been shown the video. The results showed that parents who viewed the video had more knowledge and their children had fewer caries compared with the comparison group (Kulkarni, 2013). Another similar study tested parents' knowledge on infant oral hygiene pre- and post- viewing an educational video (Rothe, Kebriaei, Pitner, Balluff, & Salama, 2010). Parents were shown the video while attending a well-child visit for their child aged between 3 and 12-months-of-age. The results showed a much higher level of knowledge of infant oral hygiene at post-video. A majority of parents reported that the information was helpful and that they were going to change oral health habits at home.

Lectures

In Brazil, an intervention study to increase mothers' knowledge and behaviours relating to oral health was carried out with mothers of preschoolers up to eight months of age (da Silva, N6ia, Gonalves, Pinho, & da Cruz, 2013). The mothers' knowledge was assessed and a preschooler oral health check was conducted at baseline and again at follow-up. Mothers attended educational lectures on preventative oral health care three times over a six-month period. Preschool toothbrushes were also provided to all mothers. After the three educational lectures, individual monthly follow-ups occurred for one year to give the parents specific guidance on oral care for their child and to reinforce the educational messages received earlier. The results from the study were positive, with both an increase in maternal oral health

knowledge and significant improvements in the oral health of the pre-schoolers. In addition, reductions were seen in the amount of caries, plaque and gingival bleeding in the children.

A 24-month intervention study was conducted with parents of preschoolers from a community with a fluoridated water supply in Hong Kong (Jiang, Lo, Chu, & Wong, 2014). The participants were assigned to one of three groups to receive the following; 1) oral health education, 2) oral health education and tooth brushing training, and 3) oral health education, toothbrush training and application of a fluoride varnish every six months. The results showed that there was no difference between the groups in children's caries experience, DMFT scores, or frequency of tooth brushing. This study did not have a control group; therefore the findings could not be used to determine the effectiveness of the oral health education. However, the lack of differences in the outcomes by the interventions they received suggest that, the tooth brushing training and six-monthly application of a fluoride varnish, only received by group two and three, did not produce any additional observable benefit.

An educational intervention was conducted with African preschool parents who had immigrated to Canada (Amin, Nyachhyon, Elyasi, & Al-Nuaimi, 2014). The oral health education programme included videos and 'hands-on' components and was conducted over a four-hour period. Parents' oral health knowledge was compared pre- and post-education programme. The results showed that the intervention was effective in improving parental knowledge, attitudes, and intention to increase the number of dental checkups for their children (Amin et al., 2014); however, the programme did not measure oral health outcomes, or changes in behaviour, over time.

Oral health education for preschoolers

The effectiveness of an oral health education programme for four-year-old children was assessed (Hochstetter et al., 2006). The control group received topical fluoride application every six months, while the experimental group received topical fluoride application every six months, as well as the educational component of the programme which was designed for children, parents and teachers. The outcomes were measured on day eight, at six months and at 12 months. In the children from the experimental group, a significant decrease was seen in both the gingival and plaque index values, and there was no significant increase seen in the level of decay. In comparison, children from the control group had a significant increase in the gingival index, the plaque index, and in decayed surfaces (Hochstetter et al., 2006).

Motivational interviewing

Motivational Interviewing (MI) has proven a successful means of intervention in many different realms of public health (Manchanda, Sampath, & De Sarkar, 2014). The MI approach involves increasing individuals' motivation so that they may design their own strategies to improve their health. MI has increasingly been used as a means to improve individuals' health status, including the oral health of preschoolers.

A series of articles has been produced on the effectiveness of MI counselling compared with oral health education for children aged 6 to 18-months old (Harrison, Benton, Everson-Stewart, & Weinstein, 2007; Weinstein, Harrison, & Benton, 2004, 2006). The oral health education consisted of the parents receiving a pamphlet and also watching a video. The original study found the children whose parents

were in the MI intervention strand had significantly fewer carious surfaces after one year compared with the education group (Weinstein et al., 2004). After two years, the children whose parents had experienced MI had significantly fewer new carious lesions, or decayed or filled teeth compared to the educational group. Harrison et al. also found that at year two, children with parents in the intervention group had approximately a 46% lower rate of DMFT compared to children in the education group (Harrison et al., 2007).

Manchanda and colleagues (2014) compared the oral health status of preschoolers who were in the two intervention groups and the control group. One intervention group received MI, the other intervention group received infant oral health education, and the control group no intervention (Manchanda et al., 2014). The findings showed that participants from the MI group experienced the largest improvement in oral health and achieved the best oral health status, as measured by the number of decayed teeth, compared to the other two groups.

Contradicting these results, a study by Freudenthal and Bowen (2010) also looked at the effectiveness of MI in the effort to change parents' beliefs and improve the care taken in their child's oral health (Freudenthal & Bowen, 2010). Each mother of the intervention group received training on oral health and individualized MI. Two follow up calls were then made to the mother on weeks one and two to see if mothers had any questions or needed any further support. A pre- and post-questionnaire was completed four weeks apart and used the measure Readiness Assessment of Parents Concerning Infant Dental Decay (RAPIDD) (Freudenthal & Bowen, 2010). No significant difference in oral health knowledge or behaviours was observed between the respondents from the intervention and the control groups.

Improving maternal oral health

Evidence from a systematic review concludes that preschoolers were most likely to develop caries if MS bacteria were present at an early stage (Harris et al., 2004). This had led interventions to assess whether improving the mother's oral health status is effective in preventing the transmission of MS from mother to child. Reducing the MS count in preschoolers is an important factor in reducing the prevalence of ECC.

Köhler et al. has conducted a range of studies that aimed to reduce the MS count in first time mothers. The results were positive, with reductions in MS levels seen in both the treated mothers and their children (Köhler & Andreen, 1994; Köhler, Andrén, & Jonsson, 1984; Birgitta Köhler, Bratthall, & Krasse, 1983). One study looked at the MS count as well as ECC prevalence and found a decreased prevalence in ECC in the intervention group compared to the control (Köhler & Andreen, 1994).

A Brazilian study conducted by Zanata and colleagues (2003) intervened with a group of young, pregnant women, who were of low socio-economic status and education level. All participants received a clinical examination, required treatment and educational counselling about diet and hygiene. The intervention group also received antimicrobial solution and topical fluoride. All the participants received repeated treatment interventions at six, 12 and 24 months. The mothers and children were followed for two years after birth. A decrease in caries was seen in the intervention group when the children were two-year-olds, with 15% of the children in the intervention group experiencing caries compared with 33% of children in the control group (Zanata et al., 2003).

A large amount of literature has been found in this area, with the key authors being Köhler and colleagues and Zanata. The results and implications of this research show that focusing on mother's oral health and levels of MS are effective and cannot be ignored; however, a full extensive exploration is beyond the scope of this review given its focus on preschool children.

Chlorhexidine gel application

Application of chlorhexidine gels have been tested as a preventative method for ECC. A study by Wan et al. looked at the use of a weekly chlorhexidine gel application by the parent, with the aim of reducing MS in their children (Wan et al., 2003). The results showed a reduction of MS among both the intervention and control groups; however, the largest reduction in MS levels was seen in those who brushed more regularly using fluoride toothpaste and in those who reduced sweet solid and liquid intake and the frequency of meals (Wan et al., 2003). This study therefore, did not provide evidence for the effectiveness of applying chlorhexidine gels by parents.

Interventions in New Zealand

New Zealand has had very few documented oral health interventions in preschoolers. In the following section oral health interventions for preschoolers that have been conducted in New Zealand are discussed.

Well Child Tamariki Ora (WCTO)

Well Child visits/ Tamariki Ora is a support service programme that is available for high-risk families and whānau with children aged from birth through to five-years-of-age (Plunket, 2015). Eight core contact sessions occur over this five-year period. Oral health education is initiated on the fourth well-child visit when is child five to seven-months-old, the age at which the first teeth start to erupt. On the fifth visit through till the eighth visits, when the child is between nine months old and four-and-a-half-years-of-age, an oral health check, known as 'Lift the Lip', is undertaken (Plunket, 2015). The aim of the Lift the Lip is to improve the oral health status of New Zealand preschool children and to reduce oral health inequalities (Litmus, 2013; Ministry of Health, 2008a). Including oral health checks in the Well Child visit allows children and their families to be provided with broad oral health messages and also increases knowledge and accessibility of the COHS.

An evaluation of the Well Child Oral Health Project in the Taranaki region has found increased enrolments of children under-five in the COHS, increases in the number of children who are caries-free, and an improvement in the DMFT score (Litmus, 2013; Ministry of Health, 2008a). An assessment of the uptake of the oral health component was also included as part of an evaluation for the Well Child programme, and found that the rate of completed Lift the Lip programmes increased between 2005 and 2007 (Litmus, 2013). However, the rates of completion varied by ethnicity, with European children having the highest rate of completion (76%) compared with Māori (62%), Asian (59%) and Pacific (51%) rates (Litmus, 2013). These rates consistently mirrored the completion rates of Plunket and Well Child, as children who are enrolled in these services are administered the Lift the Lip programme. Overall, further research is needed to assess the long-term benefits of the programme in reducing ECC and improving the oral health status of New Zealand children (Litmus, 2013).

Colgate and Plunket

Plunket is New Zealand's principal provider of support services and follow-up care for the development, health and well-being of children under the age of five (Ministry of Health, 2007). In light of this, Plunket has partnered with Colgate in an effort to start good oral hygiene habits. Since 2007, every new Plunket baby has received a free set of toothbrush and toothpaste, along with oral health education, at their Core-4 visit; this is when the child is between five and seven-months-of-age. In areas suffering particular hardship, tooth brushes are often provided to other children in the family at the preschoolers Core-4 visit. Since 2007, over 200,000 toothbrushes and toothpastes have been provided to children. No evaluation has been done on the effectiveness of this programme.

Keep me Smiling

'Keep me Smiling' is a Hawkes Bay oral health project for preschoolers (New Zealand Dental Association, 2015). The aim of the project is to ensure that all preschoolers in the Hawkes Bay region were enrolled in the COHS and to educate parents in how to care for their children's teeth and check for signs of decay. At the child's 15-month immunisation visit, the practice nurse educates the parent on oral hygiene, gives the child a free toothbrush and toothpaste and invites the parent to pre-enroll their child in the COHS. Children older than 15 months who have not registered with the COHS also receive the oral health intervention. When the child visits the dental service, the practice nurse is notified, which helps to ensure that children are more likely to continue regular visits to the dentist. The programme has been running since 2005 and has continued to be implemented in the community. Findings from the evaluations have shown an increased number of children enrolled and seen by a dental therapist before they start school.

Toothbrush kit distribution

For six years, the Nelson Marlborough Public Health Units funded toothbrush kits, which contained a toothbrush, toothpaste and oral health information resources (New Zealand Dental Association, 2015). The toothbrush kits were distributed by GP Practice Nurses to parents of infants at their five-month immunisation. Overall, the programme was successful with evidence from the positive feedback received from parents showing an increased awareness of the importance of oral health care and increased oral health care overall.

Current interventions

A study currently being undertaken in New Zealand assessing the impact of an intervention with 222 pregnant Māori women who live in the Waikato-Tainui area (Broughton et al., 2013). The study assesses the oral health knowledge base of the women during their pregnancy. The intervention is implemented for the first three years of the child's life and includes dental care to mothers during pregnancy, application of topical fluoride to the child's teeth, anticipatory guidance for the mother and MI at 6, 12 and 18 months after the child is born (Broughton et al., 2013). Clinical and self-reported data are when the child is aged 24 and 36 months. The findings of this study will provide important information and guidance into future oral health promotion programmes. This concludes the presentation of the results of this review; the following section provides a summary to this report.

SUMMARY

This review has summarised and synthesised the literature on parents and caregivers' knowledge and associated attitudes and behaviours relating to preschool oral health, as well as the characteristics and impacts of various preschool oral health promotion initiatives. The review has also described WHO, American Academy of Paediatric Dentistry, and New Zealand Ministry of Health's policies and strategic directions towards improving preschool oral health.

The importance of maintaining good oral health, throughout the life course, has been documented in the literature (Kawashita et al., 2011; Satur et al., 2010). However, previous studies have demonstrated that preschoolers in New Zealand have poor oral health status, and there are inequalities that exist between different socio-economic and ethnic groups. The most recent data available from the Ministry of Health indicate that approximately 50% of New Zealand's five-year-old children are caries free (Ministry of Health, 2011). Furthermore, results from the 2009 Oral Health Survey found that a notable proportion of preschool children do not have good oral health habits, as only 66% of two to four-year-old children brush their teeth at least twice a day and 15% using fluoridated toothpaste.

Oral health promotion initiatives are needed in New Zealand to improve parents and caregivers' knowledge about preschool oral health, and enable them to assist and support their preschoolers developing good oral health habits. In addition, further oral health research needs to be conducted in New Zealand to identify the relevant motivators and barriers for parents and caregivers to achieve good oral health in their preschoolers.

KNOWLEDGE

Overall, the international evidence indicates that parents have a low level of knowledge of hygiene and care needed for preschooler's teeth to ensure good oral health and to reduce the risk of ECC. There was a general lack of knowledge of when to begin brushing the children's teeth and when the child's first visit to the dentist should occur. The studies also demonstrated that there was confusion around when children are capable of brushing their own teeth and whether fluoridated toothpaste should be used. Also, many parents did not realise how important children's teeth are (particular primary teeth) and what impact not caring for the teeth could have on the child's current and future health status.

The small amount of evidence that is available about the knowledge of New Zealand parents and caregivers shows similar trends to the knowledge base seen overseas.

RISK FACTORS

Three main risk factors were identified in the literature for poor oral health status, and these were the parents' education level, the socio-economic status of the family and the level of knowledge the mother has on oral health. The evidence demonstrates that the education status of parents is inversely associated with poor oral health in children, with an increased number of ECC seen and a higher mean number of DMFT. Children from low socio-economic families, on average also have a poorer oral health

status compared with children of a higher socio-economic status. Children of young (under the age of 23-years), or first time mothers, have worse oral health status than those whose mothers are older or more experienced, as the latter are thought to have a higher knowledge base.

Reducing disparity in oral health status has been identified as a priority by the WHO, and is also a priority for the New Zealand Ministry of Health. It is therefore, important to implement oral health promotion initiatives that would reduce the gap. While some of the risk factors identified above are not modifiable, oral health status of these preschoolers could still be improved by targeting the initiatives to families that are more 'at risk'.

INTERVENTIONS

Numerous oral health interventions in preschoolers have been undertaken internationally. This review identifies educating mothers and caregivers on preschool oral health as the main approach to improve the oral health status of preschoolers and prevent ECC. While positive improvements were seen in preschoolers' oral health with education programmes, this review demonstrates that education should not be the only preventative strategy used. The most successful interventions were those that incorporated more than one preventative strategy, such as giving away a toothbrush and toothpaste coupled with oral health education. While no studies involving motivational interviews for parents and in interventions that improve parent's oral health have been conducted in New Zealand, internationally positive results have been demonstrated. Further research needs to be conducted in New Zealand to assess the effectiveness of specific strategies and preventive methods.

It is also noted, that preschool oral health interventions are typically designed for parents, and in many cases, focused solely on mothers. It is important to recognise that while parents play an important role in their children's oral health, other people could also influence the children's oral health status and habit such as their regular caregivers (such as grandparents, uncles/aunts, nannies), other significant adults, and siblings. Among Māori families, women could be particularly influential in shaping children's behaviour (Dyall, 1997).

GAPS IN THE LITERATURE

To date, there are very few New Zealand studies that have investigated parents and caregivers' knowledge of preschool oral health and the associated attitudes and behaviours; therefore, this literature review has drawn heavily upon the international literature. Acknowledging the unique ethnic and cultural diversity among the New Zealand populations, further research with parents and caregivers in New Zealand is needed.

A large number of studies have assessed the knowledge level of parents on preschool oral health, exploring the relationship between parental knowledge level and preschoolers' oral health status. While parental knowledge level is generally associated with preschoolers' oral health status, some studies have found that good knowledge base does not necessarily translate into good practice. This finding is consistent with most behaviour change models, which emphasise the importance of addressing multiple factors that influence behaviour (Hollister & Anema, 2004). This includes individual factors (knowledge,

self-efficacy), contextual factors (home environment), and other external factors (cost). The importance of having a multi-faceted intervention is evidenced in the literature (Davies et al., 2002), which shows that interventions that have multiple components, instead of solely focusing on parental education, achieve the best outcome.

There is an obvious information gap around motivators and barriers for achieving good preschool oral health. The current literature goes some way to providing information on potential motivators and barriers for parents, or caregivers, in implementing effective protective behaviours on behalf of their preschoolers; however, none of the studies had tested these assumptions with parents and caregivers or to identify practical steps in enabling good oral health care for their preschoolers. In addition, a number of intervention studies undertaken in New Zealand focused on very specific population groups (Broughton et al., 2014; Rothnie et al., 2012; Schluter et al., 2007). While these studies provide insights into how to improve preschool oral health among priority groups, the findings may not be generalised to the general population or other priority groups.

CONCLUSIONS

Improving the oral health status of preschool children in New Zealand is a significant challenge. This narrative literature review presents the available evidence that investigates ways to improve preschool oral health at a population level. This review indicates that oral health promotion programmes aimed at parents, and caregivers, of preschool children may improve the health of the overall population in New Zealand. However, additional research is needed to understand the type of health promotion programmes that would be meaningful for parents, and caregivers, of preschoolers.

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APPENDIX A DEFINITION OF TERMS

Dental caries – signs and symptoms of decaying or crumbling of the teeth, which are metabolic events that occur in the dental plaque of infected teeth.

DMFT – “decayed (D), missing (M), and filled (F) teeth (T)” is a index that is well established as the key measure of caries experience in dental epidemiology (Lo, 2015).

Early childhood caries (ECC)– occur in children aged between 12 and 30 months. Caries in young children have a different formation pattern than in older children. The pattern of dental caries has been labelled various terms, including “bottle caries”, “nursing caries” and “baby bottle tooth decay” (Kawashita et al., 2011). However, the term “early childhood caries (ECC)” is the recommended term used to describe caries in infants and preschool children (Kawashita et al., 2011).

Free flow feeder – is the same as a training cup which is used to transition away from a bottle, or as an alternate feeding apparatus for young children

Mutans Streptococci (MS) – is often found in the human oral cavity and significantly contributes to tooth decay.

Permanent teeth – Once having lost the primary teeth, permanent teeth grow in their place. By the age of 12 most children have lost all of their primary teeth and have a majority of their permanent teeth. This is approximately 32 teeth.

Preschoolers – infants and children from birth until five years of age

Primary teeth – also known as baby teeth, erupt into the mouth at approximately six-months of age. Children grow about 20 teeth, which they begin to lose between the ages of about 6 and 11 years. Children lose their primary teeth and gain their permanent teeth.

APPENDIX B 2009 CHILD ORAL HEALTH SURVEY FINDINGS

Table 2 Ministry of Health 2009 Oral Health Survey Results, children aged 2 -4 years

Indicator	2-4 year olds
Mean number of primary teeth	19.5
Mean number of sound primary teeth	18.8
Prevalence of having caries-free primary teeth	79.70%
Prevalence of untreated coronal decay on one or more primary teeth	14.90%
Mean number of primary teeth with untreated coronal decay	0.4
Mean number of filled primary teeth	0.3
Prevalence of missing one or more primary teeth due to decay	1.40%
Mean number of primary teeth missing due to dental decay	0
Mean dmft score (in primary teeth)	0.8
Prevalence of having caries-free teeth (all primary and permanent)	79.70%
Prevalence of untreated coronal decay on one or more primary or permanent teeth	14.90%
Prevalence of brushing teeth at least twice a day	65.60%
Prevalence of brushing teeth at least twice daily with fluoride toothpaste of 1000ppm or greater	15.30%
Prevalence of having visited a dental professional in the last year	59.70%
Prevalence of having parent-rated fair or poor oral health	4.90%
Prevalence of wellbeing reported to have been affected a lot or very much by condition of teeth, lips, jaws and mouth	6.60%
Prevalence of having experienced toothache (sometimes, often or always) in the last year	1.40%
Prevalence of having taken time off school or normal activities in the past year because of problems with teeth or mouth	7.50%
Prevalence of caregiver having taken time off school or normal activities in the past year because of problems with child's teeth or mouth	5.80%

A Literature Review on Oral Health in Preschoolers

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