

Early Childhood Caries and Primary Caregiver Oral Health Literacy in Western Australia: a Systematic Scoping Review

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Abstract

Background

Early childhood caries disproportionately affects vulnerable groups and remains a leading cause of preventable hospital admissions for Western Australian children. The Western Australia State Oral Health Plan seeks to improve child oral health through universal and targeted health promotion initiatives with primary caregivers. These initiatives require evidence of primary caregiver health literacy and baseline data on Early childhood caries. The objective of this systematic scoping review is to understand current oral health literacy of primary caregivers of children aged 0 to 4 years, identify influential socioecological determinants, and identify data on Early childhood caries in the Western Australian context.

Methods

A systematic scoping review framework identified articles published between 1980 and 2021, using Scopus, PubMed, Medline, CINAHL, PsycINFO, selected article reference lists, and oral health websites. Articles were screened via author consensus, with eight selected.

Results

Data on early childhood caries in Western Australia is limited; the suggested prevalence of 2.9% based on data over 15 years old, however national data suggests an Early childhood caries prevalence of 3.4–8% of children aged 18 months rising sharply by 36 months of age. Fewer than half the primary caregivers reported following evidence-based oral health recommendations for their young children. Engagement with dentists tended to be reactive. Knowledge of dietary and oral hygiene practices were inconsistent and awareness of the Child Dental Benefit Schedule low. Young children's oral health status was clearly associated with socioecological factors including socioeconomic status.

Conclusions

Early childhood caries data and primary care-givers' oral health literacy evidence are unavailable in Western Australia. To realise the Western Australia State Oral Health Plan, research is required to address this knowledge gap.

Background

Child oral health in Australia

Dental caries, colloquially known as tooth decay remains among the most common chronic conditions affecting children globally. Dental caries is largely preventable, however, it disproportionately affects

disadvantaged groups across all age groups ranging from infancy through to the elderly and the widening disparities in oral health has led to dental caries being labelled a 'silent epidemic' (Benjamin, 2010). Early childhood caries (ECC) is a recognised public health concern and is defined as the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries) or filled tooth surfaces in any primary tooth in a child under 71 months of age (Drury et al., 1999). ECC significantly impacts a child's quality of life and untreated caries often results in pain, eating difficulties, development and sleep problems and social embarrassment (Martins-Júnior et al., 2013; Nora et al., 2018). The impact of ECC not only has an impact on the child level but also on the well-being of the child's family and the wider health system and economy (Martins-Júnior et al., 2013). Optimal oral health practices and early intervention have the potential to reduce the incidence of ECC and positively impact both oral and general health throughout the life-course with implications on the wellbeing of the individual and the community (Australian Institute of Health & Welfare [AIHW], 2018).

Dental caries is the most common chronic childhood condition in Australia with almost half of all Australian pre-school children experiencing caries (AIHW, 2020). The prevalence of ECC is notably higher in children from low socio-economic, remote and Indigenous backgrounds (AIHW, 2020). In Western Australia (WA), an analysis of hospital data gathered between 2000 and 2009 found oral health problems, primarily caries, caused the highest rates of acute preventable hospitalisation admissions for children from 0 to 14 years of age (Alsharif et al., 2015). Across these dates 44,000 children were hospitalised, at an estimated cost to families and hospitals of over \$92 million (Alsharif et al., 2015). Emergency dental hospitalisation for relief of dental pain and infection remains a leading cause of potentially preventable hospitalisation in WA with the majority of preschool children requiring treatment under general anaesthesia (Wong et al., 2016). Although associated mortality of general anaesthesia in young children is low, emergency hospitalisation is often emotionally distressing for the child and their parent and carries significant financial costs to public health infrastructure (Rogers et al., 2018a).

Oral health promotion behaviours

Primary caregivers play a pivotal role in their child's health and subsequent behaviours. There is a growing body of evidence that reflects the association between parental oral health literacy and the child's oral health status (Bridges et al., 2014). Primary caregivers' awareness and practice of oral health promoting diets, oral hygiene practices - including brushing teeth - and engagement with preventative dental services provide the foundation for their child's continuing oral health throughout life (Phantumvanit et al., 2018).

A strong link has been established between ECC and frequent sugary food and drink consumption, nocturnal milk bottle use and on demand feeding (Meurman & Pienihäkkinen, 2010; Wigen et al., 2018). Furthermore, irregular brushing habits, not using age-appropriate fluoridated toothpaste and limited access to community water fluoridation and dental care also significantly increase a child's caries risk (Chaffee et al., 2017).

The establishment of a dental home may reduce the prevalence of ECC and improve oral health outcomes among young children; this establishes good preventative practices and enables early detection and intervention to be implemented (Kierce et al., 2016). The Australian guidelines recommend that a child's first dental visit should be scheduled once their first tooth erupts, or by the age of one year (Widmer, 2003).

In Australia, dental fees are not covered by Medicare (the free national universal health care service), and dental health is identified separately from other categories of physical health. As such financial barriers and cost of care have been associated with dental attendance patterns while public dental pathways vary among individual states and territories (Chrisopoulos et al., 2013). In WA, the School Dental Service is available to children aged 5 to 16 years and provides routine dental care including examinations, fillings, extractions, dental cleaning, radiographs and oral hygiene/tooth brushing instruction (Riordan, 1995). The service is staffed primarily by dental therapists who are supervised by dentists with more complex procedures requiring referral to specialist services (Riordan, 1995). However, children under five years of age in WA are not eligible to be seen through the School Dental Service. The Child Dental Benefit Schedule (CDBS) was introduced in 2014 as a supplemental avenue of care for children aged two years to 17 years for families that receive family tax benefits. The CDBS provides up to \$1000 (every 2 years) for basic dental services such as dental examinations, cleaning, fillings, extractions, and x-rays (Putri et al., 2019). However, only 10% of eligible WA families access the benefits of this scheme, compared to around 30% nationally. Moreover, very young children who present with extensive treatment needs requiring treatment under general anaesthesia are not covered by the scheme. While the reasons behind these differences are unclear, they demonstrate a clear inequity of opportunity for WA children.

Primary caregiver oral health literacy

Oral health literacy is defined as the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate oral health decisions (Dickson-Swift et al., 2014). Therefore, improving oral health literacy is central to reducing existing oral health disparities and enabling sustainable outcomes. Although scarce, a few Australian studies offer some evidence on primary caregiver oral health literacy through research into parental oral health practices and knowledge of cariogenic food and drinks.

Conducted in 2018, a national study of 2000 households indicated low levels of oral health literacy among Australian primary caregivers. This study reported 31% of pre-schoolers had never been taken to a dentist, and 39–50% of children aged 0 to 3 years did not have their teeth cleaned at least twice a day (Rhodes, 2018). This is supported by the results of the National Oral Health Study where only 1 in 5 children aged 2–14 years had never consulted a dentist or dental professional (AIHW, 2020). Around 23% of primary caregiver survey participants indicated a belief that dental services were only accessible for treatment rather than prevention purposes and 77% were not aware their child should be taken to a dentist for their first visit by the age of 12 months (Rhodes, 2018). Only 50% of participants were aware that fluoridated tap water was better for their children's teeth than bottled water; a similar percentage were

unaware of the CDBS. Moreover, around 85% did not know the recommended maximum daily intake of free sugars in their children's diet (Rhodes, 2018).

A further study of over 2000 children and primary caregivers in Adelaide, South Australia reported the intake of free sugars among 73% of participants aged 0 to 2 years exceeded WHO recommendations (Devenish et al., 2019). This concerning evidence supports the need for specific research into WA primary caregivers' oral health literacy.

The Australian National Oral Health Plan

The Australian Government recognises the burden of poor oral health among the Australian population and the disparity in prevention and treatment accessibility for those on low income. The National Oral Health Plan 2015–2024 (Australian Government, 2015) outlines national goals to address these issues through: 1) health promotion (evidence based activities that addresses the social determinants affecting oral health), 2) proportionate universalism (universal services with targeted areas for those priority populations at particular disadvantage), and 3) accessible oral health services and better integration of oral and other health services.

Infancy, childhood and adolescence are acknowledged as key life stages in the National Oral Health Plan requiring universal and targeted health promotion input around tooth-friendly diets, brushing and the use tap water, or approved fluoride supplements. The strategic direction of the National plan is aligned with foundation areas, including oral health promotion and improving accessibility of oral health services such as the CDBS. The WA State Oral Health Plan 2016–2020 (WA Department of Health, 2016) reflects the direction of the national plan and sets out objectives to support healthy oral health decisions among priority populations. To achieve optimum oral health outcomes in WA and more broadly in Australia, it is critical to understand primary caregivers' oral health literacy and the associated socioecological determinants.

This paper aims to understand primary caregiver oral health literacy and associated socioeconomic factors within the context of ECC in WA. In order to achieve this, a systematic scoping review was conducted with the following objectives: 1) examine the evidence about current ECC patterns and trends among WA children aged 0 to 4 years, 2) review the evidence about primary caregivers' oral health literacy – their awareness and implementation of positive oral health preventative practices, and 3) the associated socioecological determinants.

Methods

The five-stage systematic scoping review methodological framework described by Arksey and O'Malley (2005) was chosen to guide the systematic scoping review process. The methodology was further checked to ensure it followed the recommendations for a systematic scoping review by Joanna Briggs Institute experts (Peters et al., 2015). Given the scarcity of studies and the heterogeneity of existing studies, a systematic scoping review was deemed to be the most appropriate method to achieve the aim

of this study. The evidence from this review is drawn from qualitative and quantitative research as well as publications by state and national health departments and oral health professional bodies.

Stage one: Identification of research question

As with any review, the first stage is to consider the research question and the aspects that are of particular interest (Arksey & O'Malley, 2005). For this review, the areas of interest were: 1) current ECC patterns and trends among WA children aged 0 to 4 years; 2) primary caregivers' oral health literacy – their awareness and implementation of positive oral health preventative practices, and; 3) associated socioecological factors. From this, the scoping review also sought to identify the gaps in evidence requiring further research.

Stage two: Identifying relevant studies

The main aim of any scoping review is to identify primary studies from a wide range of sources to answer the research question (Arksey & O'Malley, 2005). Our search for literature included using the electronic databases Scopus, PubMed, Medline, CINAHL and PsycINFO and hand searching of article reference lists. Grey literature was also considered. Professional websites such as the Australian Dental Association and national databases such as the Australian Institute of Health and Welfare were also examined.

The articles considered were published between 2010 and 2021 and written in English. The lack of articles specific to WA children meant Australian-wide publications were also considered. Inclusion criteria were: rates of ECC for children aged 0 to 4 years, primary caregiver child oral health awareness and practices of tooth brushing, diet, drinks, dentist attendance and awareness of the CDBS. Publications that delineated this information according to sociological factors were also included for consideration.

Systematic and other forms of literature review were excluded, although articles they reviewed were accessed and considered independently. Boolean logic was used, and search terms included synonyms commonly used in literature (Table 1). Several searches were carried out, using the 'population, interest, outcome' method (Table 2).

Table 1
Search terms

Search term	Synonym and truncation
Oral health	Dental caries, decay, oral care, tooth care, oral hygiene, periodontal disease
Young child	Infant* OR child* OR p*ediatric OR pre-school OR early childhood OR aged 0 to 4 years
Oral health status	Data OR trends OR numbers OR statistics OR monitoring OR records
Caregiver awareness	Health knowledge OR health literacy OR health belief* OR attitude* OR perception
Caregiver behaviour	Health behavio*r OR access OR uptake OR practice OR implementation
Oral health practice	Tooth brushing OR teeth brushing OR infant drinks OR infant diet OR dentist OR Childhood Dental Benefit Scheme
Socio-economic-status	Class OR poverty OR income OR disadvantage

Table 2
Searches using Population Interest Outcome method

Search	Population	Interest 1	Interest 2	Outcome	Outcome
One	Oral health	Young child		Oral health status	
Two	Oral health	Young child	Socio-economic status	Oral health status	
Three	Oral health	Young child		Primary caregiver awareness	Primary caregiver oral health practice
Four	Oral health	Young child	Socio-economic status	Primary caregiver awareness	Primary caregiver oral health practice
Five	Oral health	Young child		Primary caregiver behaviour	Primary caregiver oral health practice
Six	Oral health	Young child	Socio-economic status	Primary caregiver behaviour	Primary caregiver oral health practice

This study aimed to explore oral health literacy among the general Australian population. As such studies focusing on previously identified high risk groups such as children from refugee or Aboriginal or Torres Strait Islander backgrounds were excluded.

Stage three: Study selection

The process of study selection followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) framework (Moher et al., 2009) (Fig. 1). A total of 251 articles were initially identified through electronic databases Scopus (n = 82), PubMed (39), Medline (72), CINAHL (51), PsycINFO (7) based on the terms defined in Stage 1 (Arksey & O'Malley, 2005). Government and oral health organisation websites and the reference lists of the previously identified studies were checked, resulting in 83 further potential articles. Once duplicates were removed the resultant 149 articles were screened through examination of their titles and abstracts. All these articles were checked by the two lead authors (LA and RW) using the predetermined inclusion and exclusion criteria. From this exercise 138 articles were rejected. Three authors (LA, RW and NW) then reviewed the resultant 11 articles and a further 3 were rejected because they were complex sociological or psychological studies or focused on dental treatment

Stage 4: Data charting

In this stage of the process, the selected studies were charted and sorted according to key issues and themes, providing a 'narrative review' (Arksey & O'Malley, 2005) that presents broad information about the study objective, population group, study design/methodology and key findings (Table 3). The eight studies that were included in the final review, reflects the lack of research in this space. Only one was a WA study, three from Victoria and the remaining four had an Australian-wide focus (Alsharif et al., 2014; Gussy et al., 2016; Kilpatrick et al., 2012; Lucas et al., 2011; Putri et al., 2020; Rogers et al., 2018; Stormon et al., 2019; Virgo-Milton et al., 2016). Most studies were quantitative in research design, with three analysing different aspects of data from the National Longitudinal Study of Australian Children (LSAC), a longitudinal cohort health and development study of 10,000 children that commenced in 2003 (Sanson et al., 2002). Most of the findings of interest to our review therefore concerned data collected in 2003 and 2007, when the children in question were aged between 0 and 4 years. Findings were analysed and organised under the themes: ECC trends, primary caregiver awareness and behaviours, and socioecological indicators. The second theme was divided into diet, dental hygiene practices, dental service engagement and awareness of CDBS.

Table 3
Selected articles

Author(s), year published, location.	Objective	Population group	Study design/methodology	Key findings/outcomes
Alsharif et al., (2014) Western Australia.	To understand the differences in dental insurance cover amongst hospitalised Western Australian children aged 0 to 15 years, and associated influencing factors	43, 937 WA children aged 0 to 15 years, hospitalised for an oral-health related condition	Quantitative- data collected from WA Hospital Morbidity Dataset from 1999–2009.	These finding suggest there are other factors other than the cost of dental care, that prevent parents from accessing oral health treatment for their child. Therefore, health promotion is essential in educating parents of the importance of utilising the scheme.
Gussy et al. (2016) Victoria	Identify the 'natural history' of dental caries amongst children aged 0 to 3 years, including risk and protective factors that influence ECC.	Birth cohort study that followed 467 mothers and children at age 1, 6, 12, 18, and 36 months.	Longitudinal study. Quantitative - surveys and oral examinations	Of the 268 children that had a dental assessment at 18 and 36 months- 8% of these children experienced decay, which increased to 23% of children at 36 months. The period between age 18–40 months may be a significant period for the development of dental caries, and the following 18 months a period when this may manifest. Soft drink (but not fruit juice) consumption was associated with lesion development, likely due to the highly acidic nature of carbonated drinks.

Author(s), year published, location.	Objective	Population group	Study design/methodology	Key findings/outcomes
Kilpatrick, et al., (2012) Australia-wide.	<p>Determine differences between parents reported oral health behaviours for Australian children aged 2 to 3 and 6 to 7 years.</p> <p>Examine indicators of social disadvantage that may affect oral health (e.g. low SEP).</p> <p>Identify patterns of oral health inequalities between the two age groups.</p>	<p>4606 children aged 2 to 3 years.</p> <p>4464 children aged 6 to 7 years.</p>	<p>Cross-sectional data from the Longitudinal Study of Australian Children (LSAC).</p> <p>Descriptive, mixed-method, two-stage approach.</p> <p>Interviews and a questionnaire with the child's primary caregiver.</p>	<p>Children aged 2 to 3 years were less likely than older children (aged 6 to 7 years) to brush their teeth twice a day (44% compared to 61%) and to have attended a dental health service in the last 12 months (15% compared to 59%).</p> <p>Only 3% of younger children had parent-reported caries, compared to 67% in the older children.</p> <p>The most socially disadvantaged were associated with higher odds of caries, infrequent toothbrushing and non-use of dental services.</p>

Author(s), year published, location.	Objective	Population group	Study design/methodology	Key findings/outcomes
Lucas et al., (2011) Australia-wide.	To establish differences in child oral health outcomes and behaviours across Australian states and territories, using the cross-sectional data from the LSAC	As Kilpatrick et al.	As Kilpatrick et al.	<p>Almost 90% of Western Australian children aged 2 to 3 years had not accessed dental services, 3 times higher than children in ACT. More than half the WA children (54%) did not brush teeth twice a day and 3% experienced dental caries.</p> <p>In the older WA children (aged 6 to 7 years), access to dental services had increased to 33.3%, brushing teeth twice a day to 30.6%, but dental caries had also increased to 35.5%.</p> <p>Interstate differences may be influenced by variations in state-based oral health services and promotion activities.</p>
Putri et al., (2020) Australia-wide.	To analyse patterns of dental visits under the Child Dental Benefit Schedule (CDBS), the cost of the schedule and utilisation in the first two years of implementation.	This study included 678 000 eligible children for CDBS in 2014 and 567 000 eligible children in the following year.	Retrospective descriptive analyses- data from Medicare between 2014-15	<p>Eligible children aged 2 to 4 years utilised CDBS the least.</p> <p>WA children had the lowest utilisation per eligible child for preventative services under the CDBS in 2014-15. However, WA children had higher utilisation of the School Dental Service compared to other states.</p>

Author(s), year published, location.	Objective	Population group	Study design/methodology	Key findings/outcomes
Rogers et al. (2018) Victoria.	To identify the association between rates of oral health hospitalization amongst Victorian Australian children aged 0 to 4 years and community water fluoridation access, availability of oral health professionals and SES.	1,297 potentially preventable dental hospitalisations amongst 318,997 children aged 0–4 years living in Victoria, Australia	Cross-sectional-quantitative.	<p>Children living in areas with limited access to oral health professionals had 65% higher rates of dental hospitalisation.</p> <p>Children from families of low SES had 57% higher rates of dental hospitalisations.</p> <p>Children living in areas without water fluoridation were on average 59% higher rates of dental hospitalisations.</p> <p>90% of children were hospitalised because of preventable dental caries.</p>
Stormon et al., (2019) Australia-wide.	Investigate community-level constructs (e.g. social, physical and community oral health environment) affecting the oral health of children aged 0 to 4 years.	10,090 children from the LSAC study	<p>Cross-sectional data from children that participated in the Longitudinal Study of Australian Children (LSAC) - quantitative.</p> <p>Used Fisher-Owens et al (2007) conceptual model to guide the investigation of community level predictors of oral health.</p>	<p>Children that were more likely to have caries and dental injury were from low socioeconomic areas, low water fluoridation areas and living in neighbourhoods with poor liveability/facilities.</p> <p>Queensland and Western Australia were the states that had the highest odds of children having dental injury at age 4 years.</p>

Author(s), year published, location.	Objective	Population group	Study design/methodology	Key findings/outcomes
Virgo-Milton et al., (2016) Victoria.	Mother's perceptions, beliefs and behaviours towards child oral health.	32 mothers of children aged 4–12 months.	Qualitative approach to explore the barriers to promoting children's oral health - interviews	Themes: Meaning of oral health; Causes of poor child oral health (unclear understanding of risk factors); Influences on their child's oral health (beliefs, parents own experiences, time, child behaviour); Strategies to overcome barriers to poor oral health (toothbrushing, oral health care); Sources of oral health advice (dental professionals, child health nurses, grandparents).

Stage 5: Collating, summarising and reporting the results

In this stage of the process, the findings from the selected articles are presented. As a scoping review, the findings are discussed as a narrative rather than an assessment of the weight of the evidence (Arksey & O'Malley, 2005). Three themes informed this review: i) early childhood caries among WA children; ii) primary caregiver oral health literacy, and iii) socioecological factors (socioeconomic and environmental determinants).

Stage 6: Consultation stage

Consultation was undertaken at this stage with JP, Specialist Paediatric Dentist and Senior Lecturer in Clinical and Paediatric Dentistry. As a quality improvement initiative, JP was invited to read the selected articles and review draft and provide comments and feedback.

Early childhood caries in WA children

Although several studies have assessed the oral health of school-aged children, only one study with a focus on early childhood caries (ECC) data in WA was identified (Lucas et al., 2011). In this study, 2006 LSAC data revealed ECC among WA children aged 2 to 3 years in the LSAC cohort was 2.9%, slightly lower than the national average of 3.3%. Only ACT and SA had lower reported rates of ECC at 2.5% and

2.7% respectively. Despite this WA had the highest proportion (89.4%) of children that had not accessed dental services in the last 12 months. Although this study uses a sample considered to be representative of the Australian child population, the oral health data obtained was primarily based on parental reporting rather than clinical examination.

The Victorian study conducted by Gussy et al. (2016) provides some evidence of the 'natural history' of caries development among very young Australian children. This cohort study, which followed 467 Victorian children aged 0 to 36 months revealed 8% of participants had caries at the age of 18 months, increasing to 23% by age 36 months. An analysis of national LSAC data by Stormon et al. (2019) and by Kilpatrick et al. (2012) also found ECC increased steeply in children between the age 18 to 36 months. Both studies associated this increase in rates of ECC with changes in the children's diets, the introduction of sugar-sweetened beverages (SSB) and the recommendations for increased regular tooth brushing during this developmental stage not being followed. All three publications concluded that the prime time for oral health promotion and intervention strategies for young children was between the age of 18 and 36 months. The need for early intervention to halt or slow ECC progression is further supported by additional LSAC data stating that rates of ECC among 6 to 7-year-old children was tenfold that of 2 to 3-year-old children (Kilpatrick et al., 2012).

Primary caregiver oral health literacy

The LSAC also provided information on primary caregiver oral health literacy. Kilpatrick and colleagues (2012) revealed that Australia-wide, among the primary caregivers of children aged 2 to 3 years, just 44.4% reported brushing their child's teeth twice a day (increasing to 67% for children aged 6 to 7 years). Only 15.2% of primary care givers had taken their child (aged 2 to 3 years) to a dental health professional in the preceding 12 months, increasing to 59.4% for children aged 6 to 7 years (Kilpatrick et al., 2012). A state by state analysis of tooth brushing behaviour by Lucas et al. (2011) found WA had the highest rate for correct tooth brushing regimes for children aged 6 to 7 years, however, more than half of these children experienced suboptimal toothbrushing at the earlier age of 2 to 3 years.

Analysis of the LSAC by Stormon et al. (2019) found mothers' knowledge on dietary practices was inconsistent: most knew about the cariogenic effect of SSB but few knew about the potential harm associated with night time feeds or the transfer of caries inducing bacteria to their children through poor dental hygiene practices such as kissing children on the lips and sharing feeding utensils.

In Victoria, Virgo-Milton et al. (2016) interviewed the mothers (n = 32) of young children (aged 4 to 12 months) about good oral health, reporting that those with lower oral health literacy may be more likely to delay seeking treatment for their child. Conversely, those who had experienced negative dental experiences during their own childhood, were reported as placing greater impetuous on providing good oral health care for their own children. Australia-wide 2014–2015 Medicare data on children eligible for the CDBS revealed children aged 2 to 4 years were utilising the schedule the least and most primary caregivers who did access the schedule, did so for their children aged 5 to 17 years (Putri et al., 2020).

Furthermore, specific to WA, although 28% of children were eligible for the CDBS only 4% accessed the scheme in 2014, increasing to 6% in 2015.

Socioecological determinants

Kilpatrick et al. (2012) reported that for the Australian children in the LSAC study “marked social disparities in oral health appear as early as 2 years of age and remain evident in school-age children” (p. 38). Social indicators for poorer oral health included rural location, English as an additional language and parental income, employment and housing. The authors recommended targeted oral health promotion interventions as early as possible in the child’s life to mitigate these disparities.

In WA, records of oral health hospital admissions for children aged 0 to 4 years showed 82.7% from the lowest socioeconomic status quintile had no dental insurance, compared to 32% from the highest quintile (Alsharif et al., 2014). Rural location was also associated with higher hospitalisations and lower dental insurance for children under 5 years (Alsharif et al., 2014). The rate of dental insurance for children aged 0 to 4 years in WA decreased by 22% between 2000 and 2009. Lucas et al. (2011) argued that existing child oral health disparities between Australian state or territory of residence, when corrected for individual sociodemographic determinants, were the result of differences in parental understanding of good oral health practices, accessibility of public dental services, the different efforts made between states and territories to promote and support oral health and insufficient engagement with oral health professionals.

Fluoride levels in tap water are a further factor requiring acknowledgement in a discussion on social and environmental determinants of child oral health, as the link between fluoride exposure and dental caries is well established (National Health & Medical Research Council [NHMRC], 2017). Both Rogers et al. (2018) and Stormon et al. (2019) reported that children aged 0 to 4 years children living in areas without water fluoridation had significantly higher rates of dental caries and preventable hospital admissions for oral health issues.

Discussion

Implications for future oral health promotion activities

The findings are interpreted against the systematic scoping review purpose, namely to: 1) examine the evidence about current ECC patterns and trends among WA children aged 0 to 4 years, 2) review the evidence about primary caregivers’ oral health literacy – their awareness and implementation of positive oral health preventative practices, and 3) the associated socioecological determinants.

Gaps in existing data

The WA State Oral Health Plan states that research and evaluation is a key strategy to addressing poor oral health: “A structured and coordinated research and evaluation program is required to inform the development of appropriate, effective and sustainable oral health services” (WA Department of Health,

2016, p. 2). Nevertheless, the findings of this systematic scoping review reveal significant gaps in the data required to achieve this goal for WA's young children. Data regarding early childhood caries in WA children are ostensibly absent. The only figures available come from the 2006 LSAC, that reported 2.9% of WA children aged 2 to 3 years had caries (Lucas et al., 2011). Given these figures are over 15 years old, it is impossible to use them to inform current WA patterns and trends in ECC, and as such it is impossible to develop, implement and evaluate effective and meaningful oral health promotion programs and strategies. Other Australian-wide data that indicate a sharp increase in ECC incidence in children between the ages of 18 months and 36 months suggests oral health promotion strategies are required as early as possible in the child's life.

The oral health literacy of primary caregivers in Australia

It is evident that Australia-wide, many primary caregivers have insufficient levels of oral health literacy to effectively achieve optimum oral health outcomes for their very young children. Primary caregiver's behaviours around their children's toothbrushing is suboptimal (Kilpatrick et al., 2012; Lucas et al., 2011; Rhodes, 2018). Routine dental attendance for prevention and screening is also inadequate, with vital opportunities to improve primary caregiver oral health literacy and curtail the advancement of early childhood caries being lost (Kilpatrick et al., 2012; Lucas et al., 2011). These findings concur with the National Child Oral Health Study 2012–2014 (Do & Spencer, 2016). While the focus of this report focus was children aged 5 to 14 years, it revealed that just 54% of children had visited a dental health professional before the age of 5 years.

A particular primary caregiver oral health behaviour seemingly requiring attention is the practice of sharing utensils and food with children, which exposes them to cariogenic bacteria. Although several studies have attempted to reduce vertical transmission, the colonisation of the oral cavity by cariogenic bacteria is likely inevitable with interventions aiming to prevent vertical transmission making little impact in reducing levels of ECC (Plonka et al., 2012; Wakaguri et al., 2011). Nevertheless, advice and guidance around about bedtime feeding practices detrimental to oral health is needed as part of a holistic oral health plan for young children (Stormon et al., 2019; Virgo-Milton et al., 2016).

Although these Australia-wide studies reported primary caregivers had a better knowledge about the effects of SSB on their children's teeth (Stormon et al., 2019), they also demonstrated that the diets of South Australian children aged 0 to 2 years contained free sugars in excess of WHO recommendations (Devenish et al., 2019) and contrary to the Australian Dietary Guidelines recommendation that SSB should not be provided to children younger than 12 months (NHMRC, 2012). This finding has been echoed in a New South Wales study on child obesity, which found 42.7% of its participant mothers reported they introduced SSB in their child's diet before the age of 12 months (Irvine et al., 2020). Nutrition plays a significant role as the dietary experiences of a child in the first 1000 days of life have a profound impact on eating behaviours and food choices throughout life (Moore et al., 2017), thus healthy food promotion strategies need to incorporate messages about oral health appropriate foods and drinks (Birch & Doub, 2014).

An associated issue that requires consideration in any oral health strategy aimed at young children today is the recent exponential growth of the Australian baby food industry (Euromonitor International, 2020). The market is increasingly flooded with sugar rich infant and toddler products, with the majority of 'pouch foods' increasingly available in the supermarket being predominantly sweet (Moumin et al., 2020). Although these foods were not discussed in the reviewed articles, perhaps because of their recent establishment in the baby and toddler food market, their sugar content is concerning given the well-established links to dental caries (NHMRC, 2012). The smooth texture of these foods also warrant attention as they can encourage persistent and prolonged 'sucking' feeding in which the teeth are bathed for longer periods to this sugar-rich food. One way to reduce the high sugar content in very young children's diets is to provide support and education to primary caregivers around these convenience foods.

Australia-wide evidence of child oral health inequity

This systematic scoping review identified several socioecological factors that contribute to the inequitable incidence of ECC among very young Australian children, including socioeconomic status and geographic location.

The importance of accessible preventative oral health services in reducing ECC is evident from Government data that reveal children living in areas with limited access to oral health professionals have a 65% higher rate of dental hospitalisation (Australian Government, 2015). Several socioecological factors can influence primary caregiver engagement with these services. Family financial status is a strong predictor of dental service accessibility, with the high individual responsibility for the cost of dental treatment (57%) is considerably greater than other health services (11%) (Australian Government, 2015). This reduces dental service accessibility for children in low income families and contributes to the inequitable oral health outcomes across the social divide (Alsharif et al., 2014).

A concerning finding specific to LSES families in WA is the lack of uptake of the CDBS with only 4 to 6% of eligible children accessing the scheme in 2015 (Putri et al., 2020). Again, socioecological factors come into play here; a lack of available dental health professionals in LSES communities, especially rural areas, reduces primary caregiver awareness of the schedule and limits access to local dental services in general (Rogers et al., 2018). The reasons for the lack of uptake of the CDBS may be due to negative parent experiences of dental treatment as a child (Hilton et al., 2007) and parents fear of stigmatisation associated with a perceived 'dental neglect' of their children (Muirhead et al., 2013).

This review also revealed that Australian communities without water fluoridation experience significantly higher rates of dental caries and other oral health associated hospital admissions among young children (Rogers et al., 2018; Stormon et al., 2019). Inadequate tap water fluoridation and the increasing reliance on bottled water among the Australian population (Goldstein Market Intelligence, 2020), may have important implications for child oral health. There is evidence to suggest parents believe bottled water is a healthier option for their children, due to a combination of a general 'mistrust' of tap water and persuasive bottled water marketing campaigns (Ragusa & Crampton, 2016). A combination of public

health policy action plus primary caregiver oral health promotion activities that target the insufficient exposure of young children to fluoride is required.

The need for WA evidence

While the primary caregiver oral health literacy evidence provided by this systematic scoping review is enlightening, most is not WA focused. The early childhood caries statistics are dated, inconsistently recorded and tend to be Australia-wide, parent-reported or from 'other' Australian states. Differences exist between states and territories such as population access to public dental health services and efforts made to promote and support community and family oral health (Lucas et al., 2011). Other important differences include levels of family poverty, rural and remote factors, tap water fluoride levels and the availability. This heterogeneity of socioecological factors and oral health services mean relying on this evidence in planning WA specific interventions is problematic.

Recommendations

It is evident that WA specific research is required to inform universal and targeted intervention strategies that meet the oral health needs of young WA children and their families. Primary caregiver oral health literacy needs to be ascertained, ongoing reliable ECC data need to be gathered and the socioecological factors influencing the two identified.

To achieve the goals and objectives of the WA State Oral Health Plan, policy change is also needed. It can be argued that, to achieve reliable dental caries records for children aged 0 to 4 years, greater access to free public dental services is required, facilitating regular family access to preventative dental services and treatment. The adoption of the WHO recommendation that ECC risk assessments should occur by the time a child is 12 months old and re-evaluated regularly would provide an opportunity for the routine collection of ECC data, which in turn could direct targeted oral health promotion strategies.

At the time of writing this systematic scoping review, the Labour Party manifesto has promised to introduce free dental check-ups for all children aged 6 months to 5 years (WA Labor, 2021). If this eventuates, this may go some way to improve dental service engagement across all social groups and enable more reliable ECC data collection in very young children. This review also argues that further Government action is required in the promotion of the Child Dental Benefit Schedule and the protective benefits conferred by adequate fluoride exposure whether it be through water fluoridation or use of fluoridated toothpaste for young children.

Conclusions

Oral health related childhood preventable hospitalisations and dental general anaesthetic procedures are increasing among Australian children. The WA State Government has indicated a commitment to reducing this oral health burden, proposing the development of a universal and, where indicated, targeted

health promotion approach with children and their families, with a particular focus on the range of socioecological determinants influencing oral health outcomes for the state's children.

At present, health promotion professionals are disadvantaged by the lack of data on ECC and oral health literacy which limit the ability to inform and evaluate future oral health initiatives. Research with WA primary caregivers is urgently required to inform practice and highlight necessary structural and policy factors that currently disadvantage the oral health outcomes for some WA children.

Abbreviation List

AIHW Australian Institute of Health and Welfare

CDBS Child Dental Benefit Schedule

ECC Early childhood caries

LSAC Longitudinal Study of Australian Children

SSB Sugar sweetened beverages

WA Western Australia

Declarations

Ethics approval and consent to participate

Formal ethical approval is not required as no primary data have been collected. As such, there are no patients involved, so the consent of the patient to participate was not required.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this published article. Details of all studies analysed in this scoping review are included in Table 3 in this article.

Competing interests

The authors declare they have no competing interests.

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Authors' contributions

All authors have actively participated in the scoping review and have made a substantial contribution to (1) either conception and design, or acquisition of data, or analysis and interpretation of data; as well as (2) the drafting of the article or its revision; and (3) to the final approval of the version to be published.

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Figures

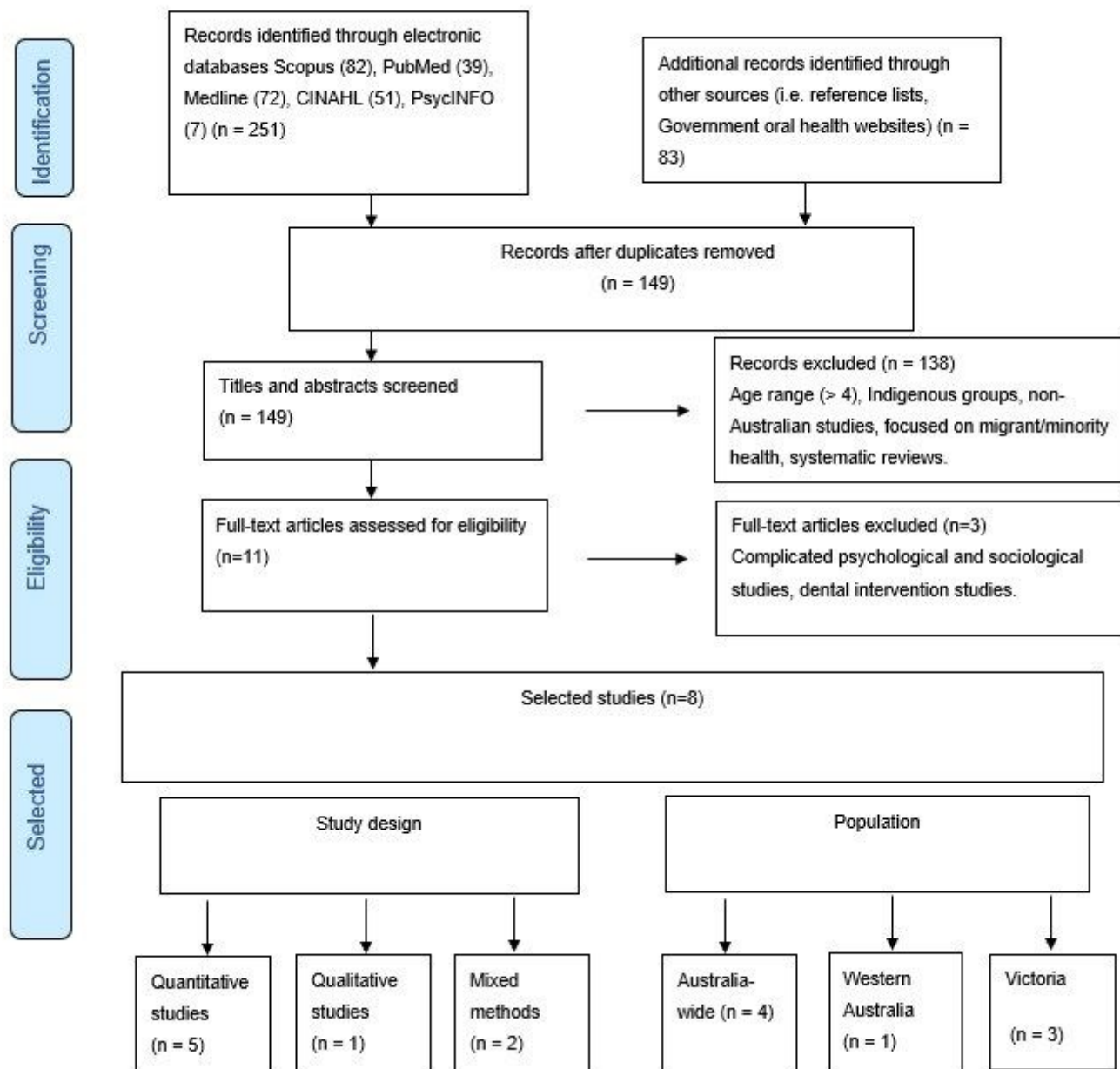


Figure 1

PRISMA chart. Selection of relevant article process