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A review of dental caries in adolescents, risk factors and preventive strategies

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Abstract

Background and objective: The adolescent stage is critical because of the increase in influences from peers and media and exposure to unhealthy food environments and aggressive marketing. This necessitates the need for dentists, dental and oral health therapists, hygienists, and others to engage with adolescents early for establishing good life-long oral health habits. A review of New Zealand school Year 8 children's and adolescents' dental caries experience shows improvements over recent years for Māori, Pacific, and non-Māori and non-Pacific children. However, large ethnic inequalities persist, with no sign of the gaps closing. The objective of this paper was to examine risk factors associated with dental caries in New Zealand adolescents, identify current strategies to improve caries experience, and make recommendations for further improvement.

Methods: Electronic databases and electronic and hand-searches of reference lists of articles, reports, and textbooks used were identified, and findings were organised into common themes.

Findings: Seven themes have updated: past caries experience and current caries activity; dietary habits; oral hygiene habits; exposure to fluoride; access to dental services; oral health literacy; and socioeconomic background of adolescents and parents/caregivers. Each of these themes is described in detail. For various reasons, adolescents are susceptible to higher dental caries experience.

Conclusion: While dental practitioners and others engage with adolescents early and provide appropriate preventive practices, additional effective strategies proposed are needed to further improve the overall caries experience among New Zealand adolescents and to reduce ethnic inequalities.

Introduction

Dental caries is a major public health problem globally and is the most widespread non-communicable disease (World Health Organization, 2017a). In 2015, 7.8% of the global child population (573 million children) had untreated dental caries. The prevalence of untreated caries in deciduous and permanent teeth peaks at ages 1-4 years and 15-19 years, respectively (The Lancet Child Adolescent Health, 2019). Impacts of dental caries include debilitating pain, infection, tooth loss, difficulty with eating and speaking, poor school performances or absences, and limit social interactions. It is a mostly preventable disease, but its treatment is costly.

New Zealand children from birth to until their 18th birthday are eligible to receive free publicly funded oral health services. Children from birth to school Year 8 (age 12-13 years) receive oral health services provided by Community Oral Health Services (COHS) run by New Zealand's 20 District Health Boards (DHBs). Those in school Year 9 (age 13-14 years) to age 17 years, whether studying or not, are eligible to receive regular free dental care under the Adolescent Oral Health Services (AOHS) scheme provided by dentists, COHS, or Māori health service providers who are contracted by the DHBs to provide such services (Ministry of Health, 2015a).

Dental caries experience

In New Zealand, data on prevalence and severity of dental caries for school Year 8 children are collected annually by the Ministry of Health. Analysis of the Ministry data on the percentage of Year 8 children with no caries (Figure 1) and an average number of permanent teeth with decay, missing due to decay and with fillings (DMFT) (Figure 2) in children examined between 2009 and 2018 showed a sustained improvement (Ministry of Health, 2020). Although wide disparities in caries experience between Māori, Pacific, and non-Māori/non-Pacific (predominantly New Zealand European) children still exist, with no sign of the gap closing, caries experience has declined for all ethnic groups.

In 2018, (Table 1) nearly 44% of Māori and 45% of Pacific had caries experience, compared with 29% of non-Māori/non-Pacific children. Of those with caries, Māori, Pacific, and non-Māori/non-Pacific children had an average of 2.5, 2.4, and 2.0 teeth affected by caries, respectively. These 2018 data (Table 2) also revealed significant variation between DHBs: with 51% of Year 8 children in Northland, and ≤30% of children in five DHBs (Waitemata, Waikato, MidCentral, Capital Coast, and Wairarapa) experiencing dental caries. These variations likely reflect differing social determinant exposures, such as reticulated water fluoridation and socio-economic position.

Compared with the caries experience among Year 8 children in 1988 (Hunter et al, 1992), there had been a significant improvement in 2018 with caries-free rates increasing from 28.5% to 66.2% and a decline in mean DMFT from 2.4 to 0.7. International reports of 12-year-olds during the period 2000 to 2010 (Bernabé et al, 2014) showed the mean DMFT range between 2.9 in the

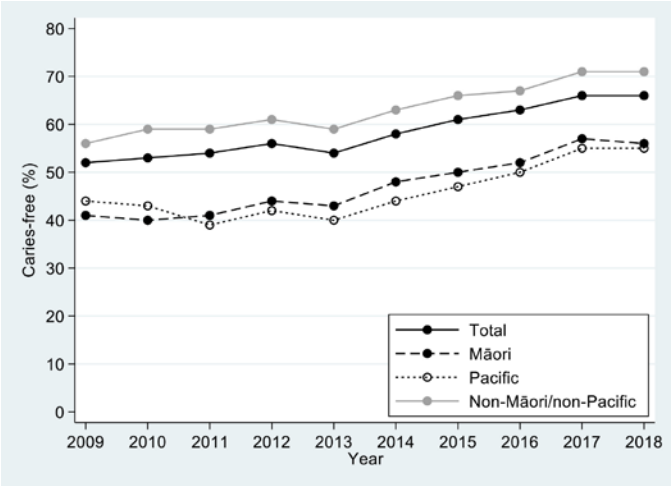

Figure 1: Percentage of examined school Year 8 children in New Zealand who had no obvious caries experience (caries-free) between 2009 and 2018, overall and by major ethnic groups (Ministry of Health, 2020).

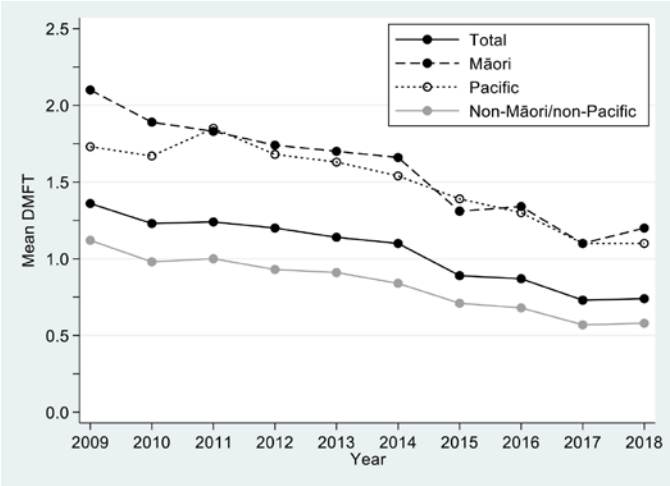

Figure 2: Mean number of Decayed, Missing due to decay, and Filled permanent teeth (DMFT) of examined school Year 8 children in New Zealand between 2009 and 2018, overall and by major ethnic groups (Ministry of Health, 2020).

Table 1: Dental caries experience of Year 8 children in 2018 by ethnicity (Ministry of Health, 2020).

Ethnicity	Percentage of children with caries experience	Mean DMFT of children with caries experience
Māori	44%	2.5
Pacific	45%	2.4
Non-Māori/non-Pacific	29%	2.0

Table 2: Dental caries experience of Year 8 children in 2018 (Ministry of Health, 2020).

DHB	% of children with caries experience
Northland	51%
Waitemata	30%
Auckland	32%
Counties Manukau	37%
Waikato	27%
Lakes	40%
Bay of Plenty	44%
Tairawhiti	36%
Taranaki	33%
Hawkes Bay	32%
MidCentral	29%
Whanganui	36%
Hutt Valley	33%
Capital & Coast	28%
Wairarapa	25%
Nelson Marlborough	34%
West Coast	42%
Canterbury	35%
South Canterbury	38%
Southern	35%
New Zealand	34%

Czech Republic and 0.3 in Tanzania. Within Australia, Canada, Denmark, United Kingdom (UK), United States of America (USA), and New Zealand the mean DMFT ranged between 0.9 in Australia and 1.2 in New Zealand.

New Zealand dental caries prevalence data among adolescents are not routinely collected and less comprehensive. From the 1976, National Adult Dental Survey (Cutress et al, 1979), the mean DMFT scores among those aged 15-19 years was 13.4, and six years later in the 1982 survey (Cutress et al, 1983) mean DMFT declined to 8.5. The National Oral Health Survey in 2009 (Ministry of Health, 2010a) showed that 44.7% of those aged 12-17 years were caries-free and the average DMFT was 1.9. A secondary analysis of adolescent data from the 2009 survey (Fogarty, 2017) reported greater caries experience in 12-14 and 15-17-year-old Māori and Pacific adolescents than in their Asians peers. Published reports available between 2000 and 2010 of adolescents aged 15 years (Bernabé et al, 2014) showed a wide variation, ranging between mean DMFT of 5 in the Czech Republic and 2 in the UK. The mean DMFT in Australia, Denmark, USA were 2.1, 2.2, and 2.4, respectively. The unavailability of recent New Zealand data on mean DMFT among 15-year-olds makes the comparison with other countries impossible. Collection of annual data on the prevalence and severity of dental caries in adolescents under New Zealand public-funded oral health system is necessary to check on the progress and to take appropriate actions if needed.

Aim

Health behaviours may change throughout a person's life, but the childhood to adolescence stage is critical because influences from peers and media increase, while those from parents and other family members decrease. The behaviours and lifestyles learned or adopted during adolescence be possible to influence oral health both in the present and in the future. This review examines

factors associated with dental caries in New Zealand adolescents, identifies current strategies to improve caries experience, and makes recommendations for further improvement.

Methods

Dental caries risk factors identified to reflect risks pertinent to the New Zealand population include socioeconomic deprivation, suboptimal fluoride exposure, ethnicity, poor oral hygiene, prolonged bottle feeding, poor family dental health, enamel defects, eating disorders, irregular dental care, high sugar diet, high carbohydrate diet (in people with complex medical conditions), active orthodontic treatment, and low salivary flow (New Zealand Guidelines Group, 2009). In this review, risk factors relevant to New Zealand adolescents have been updated. The literature search used electronic databases including PubMed, Google, Cochrane Library, New Zealand Ministry of Health, Ministry of Youth Affairs, New Zealand Health Promotion and World Health Organization (WHO), and selected textbooks. Articles used in this review were identified using the following keywords: 'adolescence', 'adolescent oral health services', 'dental caries', 'prevalence and severity of dental caries in school Year 8 children', 'risk factors of caries', 'assessment of caries risk', 'past caries and current caries activity', 'utilisation rates of adolescents', 'prevalence of dental caries among adolescents', 'oral hygiene', 'manual tooth brushing', 'dental flossing', 'dietary habits', 'sugar-sweetened drinks', 'access to dental care', 'oral health literacy', 'water fluoridation', 'use of toothpaste', and 'socioeconomic factors and dental caries'. Secondary electronic and hand-searches resulted from reference articles and related sources.

Findings

Set against the New Zealand adolescents current backdrop of caries experience, risk factors which need to be addressed by dental practitioners, the Government, the Ministry, and DHBs have updated: past caries and current caries activity; dietary habits; oral hygiene habits; fluoride exposure; access to dental services; oral health literacy; and socioeconomic background of adolescents and parents/caregivers. Each of these themes is described below.

Past caries and current caries activity

A systematic review (Mejàre et al, 2014) showed that baseline caries experience is the most powerful and accurate single predictor of caries activity in all age groups. In New Zealand, caries experience of school Year 8 children is generally the caries experience (excluding pre-cavitated lesions) of adolescents in Year 9 classes when seen for the first time in AOHS. However, although efforts are made by COHS to ensure that all Year 8 students are seen and treatments completed before the transfer to AOHS, it does not happen with all. This is either due to the shortage of dental staff, particularly dental and oral health therapists in COHS, or Year 8 students' absences or cancellation of appointments.

In AOHS, after comprehensive examination and caries activity noted, Year 9 adolescents are provided with appropriate oral health messages and applications of fluoride varnish and fissure sealant. All other required treatments are completed and follow-up recall appointments are made after 12 months. From then on adolescents receive regular care every 12 months until their 18th birthday. Regular attendances at dental clinics have proved to be important for the control of caries, with preventive actions or clinical repair of the damage (Reifur et al, 2017).

COHS continue to contact all those Year 8 students who were missed out on examinations and treatments before the transfer and advise them to see the dental practitioners under the AOHS scheme soon in the next calendar year. Regional adolescent oral health coordinators following up with these children ensure they are seen in AOHS within an acceptable time frame. Oral health therapists' work programme needs to be developed with Health Workforce New Zealand to estimate the number of therapists needed to provide regular dental care to all enrolled children and to ensure all Year 8 children are examined and treated before leaving COHS.

Dietary habits

Excessive sugars and their frequency are the main causes of dental caries (Moynihan et al, 2004). Sugar-sweetened beverages are a major source of sugar, and their consumption is increasing in most countries especially among children and adolescents (World Health Organization, 2017a). Exposure to unhealthy food environments and aggressive marketing of unhealthy foods encourage children and adolescents to consume greater amounts of cheap, high-energy nutrient-poor foods and drinks that are high in sugar.

A Wellington study on Year 8 children using Kid'sCam (Signal, et al, 2017) showed that on average, children were exposed to marketing of sugary drinks, fast food, confectionery, and snack foods more than twice their average exposure to healthy food marketing. Analysis of data from Youth '07, a nationally representative survey of the health and wellbeing of New Zealand youth, including 8,697 students aged 13 to 17 years (Sundborn et al, 2014), revealed that 29% were categorised as high consumers of soft drinks (four times a week), 45.4% were moderate consumers (one to three times a week), and 25.6% were low consumers (had not consumed soft drinks in the past week). There were strong ethnic differences in consumption, with nearly half of the Pacific children (48.8%) being high consumers, while it was lower among Māori (39.1%), Asians (24.5%), and New Zealand European (22.9%) children. There was also a strong relationship with deprivation, the most deprived groups being the highest consumers.

Fifty-eight percent of children who reported that soft drinks were 'usually' available at home were in the high consumption group, compared to 15.1% of children who reported that these drinks were never available at home. These findings suggest that, in conjunction with minimising the availability of soft drinks in schools,

reducing the availability of soft drinks in the home would greatly reduce the consumption of soft drinks among New Zealand children and adolescents. The Ministry of Health recommends water and unflavoured milk and the eating of fresh fruit (Ministry of Health, 2012a). Dentists, dental and oral health therapists, and hygienists need to continue providing adolescents and their parents/ caregivers comprehensive information about the risks of intake of sugary drinks.

To mitigate the risk, mandatory regulation of marketing sugary drinks to children and adolescents particularly at sports and other events needs to be introduced. The Government requiring the beverage industry to introduce a sugar icon on the packaging of all sugary drinks to indicate the amount of sugar in each product in teaspoons would make the adolescents and parents/ caregivers aware of the sugar content of various drinks. The WHO recommends taxation of sugar-sweetened beverages and foods with high free sugar content to discourage the consumption of these foods and beverages, particularly in children and adolescents (World Health Organization, 2017b). National campaigns on introducing excise tax on sugary drinks need to be strengthened. Several countries such as Hungary, France, California in the USA, Mexico, and Belgium have already introduced such a tax. The UK has differential rates of tax according to how much sugar the drink contains, rather than a flat rate like Mexico.

Oral hygiene habits

Long-term exposure to plaque can lead to the demineralization and destruction of the teeth through caries. The Dunedin Multidisciplinary Health and Development study (Broadbent et al, 2011) collecting dental plaque data occurred at ages 5, 9, 15, 18, 26, and 32 years, showed across the long term, participants in the high- plaque-trajectory group were more likely to experience caries, periodontal disease and subsequent tooth loss than were those in the low- or medium-plaque-trajectory groups, and they experienced all those conditions with greater severity.

The Ministry of Health recommends that adolescents brush their teeth twice a day, with the use of a pea-sized portion of fluoride toothpaste of 1000 ppm or greater (New Zealand Guidelines Group, 2009). In 2019, the prevalence of brushing at least twice daily among 12-17-year-olds was 59%, and 57.1% brushed their teeth at least twice daily with fluoride toothpaste (Ministry of Health, 2010a). With over 40% not meeting recommendations for toothbrushing and the use of fluoride toothpaste, there is a need for improvement in brushing habits. The powered toothbrushes reduce plaque and gingivitis more than manual toothbrushing in the short and long terms (Yaacob et al, 2014). The efficacy of a brushing episode relies on the dedication of the user of the toothbrush and adherence to oral hygiene instructions. The dental practitioner can thus recommend effective brushing with a manual or powered toothbrush twice daily using a fluoridated toothpaste.

Using floss or interdental brushes in addition to toothbrushing may reduce gingivitis or plaque, or both, more than toothbrushing alone. Flossing is still important, but the quality of the available studies is poor. A 2015 meta-review by Sälzer and colleagues found that the majority of available studies failed to demonstrate that flossing is generally effective in plaque removal. Similarly, Ng et al (2019) concluded that the use of floss may not be beneficial if not effectively performed. In New Zealand, dental practitioners continue to advise adolescents on the effective use of dental floss. To mitigate the risk of the effects of poor oral hygiene, free toothbrushes and toothpaste need to be provided to families from deprived backgrounds living in non-fluoridated areas of New Zealand, funded either by the Ministry or DHBs, to enhance brushing habits of all family members, including adolescents.

Exposure to fluoride

Fluoride protects teeth against the progression of dental caries by reducing demineralisation and promoting remineralisation. Slightly more than half the New Zealand population has access to a fluoridated water supply. Water fluoridation is a proven public health measure; efforts need to be made to extend water fluoridation to all other areas in New Zealand where there is a reticulated water supply (Office of the Prime Minister's Chief Science Advisor and Royal Society of New Zealand, 2014). Legislative changes to decision-making on the fluoridation of drinking-water supplies are currently before the New Zealand Parliament. If enacted, the Bill gives DHBs the authority to fluoridate water supplies in their areas.

Twice daily brushing with at least 1000 ppm fluoride toothpaste is recommended (New Zealand Guidelines Group, 2009). A recent study showed (Hobbs et al, 2020) overall, 6.8% of adults and 6.4% of children use non-fluoride toothpaste in New Zealand. Timing of periodic dental examinations, advice to maintain personal oral hygiene through daily toothbrushing, with fluoride toothpaste, and professionally-applied treatments such as fluoride varnish based on the individual patient's caries-risk assessment are provided by dental practitioners.

The New Zealand Parliament should enact the Bill to provide DHBs the power to direct on water fluoridation. Providing free toothpaste and brushes at no cost to deprived families in non-fluoridated areas with the assistance of non-governmental organisations (e.g. toothpaste companies) or funded either by DHBs or the Ministry, needs to be considered. Dental practitioners and others need to continue advising the general public on the benefits of fluoride toothpaste and lobby for a high excise tax on non-fluoride toothpaste in New Zealand.

Access to dental services (Utilisation)

Regular dental visits are important for better oral health. A New Zealand study (Thomson et al, 2010) involving participants at ages 15, 18, 26, and 32 years showed that at any given age, among those who usually visited for a check-up, and had made a dental visit during the

previous 12 months, fewer had teeth missing due to caries, and they had lower mean DS and DMFS scores. The longer routine attendance was maintained, the stronger the effect.

The Ministry has established a national target of 85% utilisation for adolescents. In 2018, 71.4% of eligible adolescents in New Zealand made dental visits under the AOHS scheme. Analysis of the data revealed important differences among DHBs; less than 53% in Northland and Tairawhiti and around 80% in Auckland, MidCentral, South Canterbury, and Nelson Marlborough DHBs. These variations reflect the geographic spread of the areas, the number of contracted dental practitioners, and ethnic population compositions.

Data sourced from Senior Portfolio Manager Oral Health, Ministry of Health shows disparities in utilisation rates between ethnic groups in 2018; with Māori having the lowest (46%) and non-Māori/non-Pacific the highest (76%). Utilisation rate for the Pacific was 74%. Reasons for adolescents not regularly attending dental services are varied. In a survey conducted among Southland students in school Years 12 and 13 (aged 16-20 years), 56.3% of the reasons were related to attitudes with perceived lack of importance or necessity, 20.8% due to anxiety or fear about dental care, and 22.3% because of costs (Murray et al, 2015). Data collected through focus groups in Pacific adolescents aged 13-18 years in Christchurch and Dunedin (France et al, 2017) showed that factors enabling access to public-funded dental services included: awareness of the cosmetic and functional importance of teeth; positive perceptions of dental practitioners; supportive and comfortable dental environments; culturally sensitive and Pacific Island dentists. Barriers identified included: negative perceptions of dentists; loss of structured support for dental attendance during adolescence; a mismatch between parents' and/or caregivers' guidance and behaviour around oral health care; and uncomfortable, unsupportive and uninformative dental environments. Other barriers identified by Pacific adolescents were (Smith et al, 2018) lack of structured dental appointments, prior negative clinic experiences, feelings of embarrassment or awkwardness, perceived costs, and less emphasis placed on individual oral health in collective Pacific cultures.

In some parts of New Zealand (e.g., Auckland), mobile adolescent dental services visit schools at regular intervals, enabling more adolescents to make regular dental visits. With the mobile clinic visits, barriers such as distance, difficulty with transport, and appointments at inconvenient times are removed; influences from other adolescent friends at school promotes more adolescents visiting the clinic. The presence of clinics on the school premises reminds adolescents of dental visits without the need to remember to make dental appointments.

To improve utilisation, activities such as effective transfer of children at the end of school Year 8 by COHS to dentists in the AOHS scheme; increasing the number of dentists in the scheme; ensuring dentists cover the entire geographic DHB areas, and follow-up of enrolment in AOHS and promotion of service need be continued. Some innovative approaches are required for the conventional dental practice setting to be viewed by adolescents as an inviting, respectful, and shame-free environment. After-hours and Saturday dental appointments and use of mobile dental clinics in remote areas, if not occurring already, need to be implemented. Strengthening the training of oral health personnel on cultural sensitivity and community-orientation is important to enhance cultural acceptance by adolescents. Cultural competencies are to be developed to guide health personnel on these issues (Public Health Advisory Committee, 2003). Racial and ethnic diversity among dental practitioners is associated with improved access to care for minority patients (Smedley et al, 2004; Sullivan, 2004). The number of individuals entering the dental profession needs to reflect New Zealand Māori and Pacific ethnic diversity.

Adolescents who leave school after age 16 years are often difficult to reach unless concerted efforts are made both by those adolescents and dental practitioners. Liaising with general medical practitioners, social workers, Māori providers, and community health workers will assist in contacting these adolescents and/or their families. An integrated information system developed and implemented nation-wide would ensure a smooth transfer of detailed information across services and providers and thus assist with contacting these adolescents. Equity in accessing adolescent oral health services by different ethnic communities must be addressed. The lowest rates of utilisation (45% in 2017 and 46% in 2018) by Māori adolescents require more innovative actions such as promoting more Māori dental practitioners to join the AOHS scheme and using mobile dental clinics in areas where there are Māori adolescents either studying or working.

The New Zealand Government's Youth Development Strategy Aotearoa relates to those within the 12-24-year age group (Ministry of Youth Affairs, 2002). Adolescent oral health services making links with youth services would promote better utilisation of the services and oral health outcomes. Integration would enhance different youth services or agencies available in New Zealand to know what oral health services can offer and how to access such services. There is a need to strengthen efforts in contacting secondary schools, particularly in highly deprived areas, and inclusion reminders in the school newsletters on the availability of free dental services and the importance of regular dental visits.

Oral Health Literacy

Health literacy in dentistry 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' (U.S. Department of Health and Human Services, 2000). The findings of a Ministry report (Ministry of Health, 2010b) show that the majority of New Zealanders are limited in their ability to obtain, process, and understand basic health information and services to make informed and appropriate health decisions. This Ministry's report further shows that Māori have much poorer health

literacy skills than non-Māori, regardless of gender, age, level of education, labour-force status, household income, or rural/urban location, and this is likely to harm their health status. Lower health literacy is associated with poorer health and poorer use of health care services (Berkman et al, 2011).

Studies on oral health literacy in New Zealand are limited. A Christchurch study on oral health literacy of parents of pre-schoolers (Veerasamy et al, 2013) found 41% of participants had a moderate level of oral health literacy and 37.6% and 21.4% of participants were recognised as having poor and good oral health literacy respectively. The findings included associations between parents' oral health literacy and socio-demographic characteristics such as ethnicity, education, and family income.

Poor oral health literacy is associated with missed dental appointments (Baskaradoss, 2016; Holtzman et al, 2014). A Brazilian study showed that adolescents aged 15-19 years with poorer oral health literacy had more teeth with cavitated lesions independently of their socioeconomic status (SES) (Dutra et al, 2019). To maintain better oral health and to receive treatment one must be able to understand, interpret, and act on health information whether it is communicated verbally or in written form. This is a two-way process: while one needs an adequate level of oral health literacy, complex and complicated verbal or printed information (consent forms, information sheets, brochures) full of jargon and technical and unfamiliar words erect barriers for the individuals to understand and to act accordingly. Verbal instruction given hurriedly makes it difficult for the patients to grasp all that information, causing a significant barrier to better oral health. Dental practitioners do not routinely check whether their patients have understood the information and patients are unwilling to reveal that they have trouble in understanding – many feel reluctant, particularly in some cultures, to ask questions. In many cases, patients "don't know what they don't know" and the dental practitioners must check with patients whether they have understood the information.

Jargon-free communication, use of adolescent-friendly visual materials including pictures or videos to clarify concepts, providing a few key messages at each visit, maintaining eye contact while speaking, and confirmation of comprehension via the 'show-me' or 'teach-back' method, would improve understanding. Strengthened communication components particularly on oral hygiene and dietary education, with dental practitioners using plain-language approaches and not relying solely on print materials, would enable adolescents' better understanding. The Ministry has published a guide on developing health education resources in New Zealand (Ministry of Health, 2012b) and this guide would be useful for developing oral health education resources as well. An oral health literacy project undertaken in the Counties Manukau area identified a few key oral health-literacy approaches which include professional development for the workforce, clarification of patient referral pathways and follow-up, and oral health messages for different audiences (Counties Manukau Health, 2014). The Ministry has developed a guide for health literacy review and how to build a health literate organisation covering the health system, health organisations, health workforce, and individuals (Ministry of Health, 2015b). To mitigate this risk and to increase adolescents' active participation, adolescent-appropriate oral health literacy messages and professional development for oral health professionals regarding approaches that build health literacy need to continue to be developed.

Socioeconomic factors

Social inequalities in oral health have been well documented. The national oral health surveys (Cutress et al, 1979; Hunter et al, 1992; Ministry of Health, 2010a) and regional or area-based studies (Brown et al, 1992; Treasure et al, 1994) in New Zealand have confirmed the existence of inequalities in dental caries experience and tooth loss related to SES. The Dunedin Multidisciplinary Health and Development Study has followed a cohort of New Zealanders from birth to adulthood. Observations of their oral health status at ages 5 years (Evans et al, 1984) and 26 years (Thomson et al, 2004) have shown clear SES differences in dental caries experience. A study (Thomson et al, 2000) at the ages of 18 and 26 years showed that socioeconomic inequalities in tooth loss appear to begin early in life. A 2016 report (Broadbent et al, 2016) showed that parents' SES and beliefs about how to keep teeth healthy strongly influenced their children's beliefs and health behaviours growing up. These factors were also associated with substantial differences in untreated tooth decay and tooth loss by the time their children reached their 30s.

In 2018, 23% of New Zealand dependents aged 0-17 years were living in households with disposable income less than 50% of the median after-housing costs, and 6% of children were living in households experiencing severe material hardship (Duncanson et al, 2019). Using the measure of less than 60% of the median income, 34% of Māori, 28% of Pacific people, and 16% of European/Pakeha people had household incomes below this threshold in 2011 to 2013 (Perry, 2014). Making improvements in the SES of communities is beyond the domain of oral health services.

The Public Health Report England in 2014 revealed that children living in the most deprived areas had the greatest benefits from water fluoridation. A study in Wellington and Christchurch children reported that the differences in caries experience were greater for children of low SES with water fluoridation (Lee et al, 2004). To mitigate this risk, adopting public health measures such as extending water fluoridation to more areas with reticulated water supply, increasing tax on sugar-sweetened beverages, and regulating advertisements on these beverages during sports events will enhance the reduction of overall caries levels and inequalities among different socioeconomic groups. Providing free toothpaste and brushes to high-deprived families, in addition to educating and motivating them on regular oral hygiene habits, will encourage children and adolescents to meet toothbrushing recommendations.

Recommendations

The following recommendations are made to further improve adolescents' oral health and to reduce regular reduce inequalities. Some of these recommendations are already employed.

To the Government, the Ministry of Health, DHBs, Universities, and the Public Health Workforce.

1. Data on caries experience in adolescents
   - Examine options and introduce means of collecting annual data on the prevalence and severity of dental caries in adolescents who are seen and treated under New Zealand's publicly-funded service.
2. Continuity of care
   - Adolescent oral health coordinators follow those Year 8 children missed out on examination and treatments before leaving COHS.
   - Develop oral health therapists' work programme with Health Workforce New Zealand to ensure the availability of adequate numbers to meet the demand.
3. Dietary habits
   - Introduce mandatory regulation of marketing sugary drinks to children and adolescents, particularly at sports and other events.
   - Introduce legislation for the beverages industry to include a sugar icon, health warning, and sugar content on the packaging and labels of sugary drinks.
   - Introduce an excise tax on sugary drinks.
4. Oral hygiene habits
   - Distribute fluoride toothpaste and toothbrushes free to deprived families living in non-fluoridated areas, the programme to be funded either by DHBs or the Ministry.
5. Fluoride exposure
   - Parliament enacts the Bill providing DHBs the power to direct on water fluoridation.
   - Increase excise tax on non-fluoride toothpaste.
6. Access to dental services (Utilisation)
   - Increase the number of dental practitioners providing dental care under the AOHS scheme to cover the entire area of each DHB.
   - Ensure dental settings are welcoming and are adolescent-friendly.
   - Strengthen the training of oral health personnel on cultural sensitivity and community orientation.
   - Encourage and support more Māori and Pacific students to enter the dental profession.
   - Continue to target secondary schools, notably in deprived areas, with reminders in school newsletters and by other means on the availability of free dental services and the importance of regular visits.
   - Target Māori adolescents and ensure high utilisation by increasing Māori dental practitioners and use mobile dental clinics to make it easier for them to attend.
   - Target adolescents above age 16 years who are not at school and make contact with them by liaising with other health providers.
   - Integrate adolescent oral health into existing youth health programmes in New Zealand and collaborate with other public health programmes. Make links with other government departments, notably Education and Social Welfare, to avoid duplication and confusion.
   - Develop and implement a national integrated information system to ensure a smooth transfer of detailed information across services and providers to assist with contacting these adolescents.
7. Oral health literacy
   - Continue to develop adolescent-appropriate oral health literacy messages using plain-language approaches.
8. Socioeconomic status
   - Regional adolescent oral health co-ordinators around New Zealand continue to ensure that adolescents in highly deprived areas receive dental care.

To dentists, dental and oral health therapists and dental hygienists

1. Ensure the clinic environment is supportive and comfortable for adolescents.
2. Be aware of cultural differences and be sensitive.
3. Be aware of different levels of oral health literacy among adolescents and their parents/caregivers and use simple language when providing dental advice.
4. Provide after-hours and Saturday appointments.
5. Continue advising adolescents and parents/caregivers on the importance of oral health and twice-daily brushing with fluoride toothpaste and flossing.
6. Continue discussions on the importance of reducing the amount and frequency of intake of drinks and food with high sugar content.
7. Follow those adolescents who missed their dental appointments and liaise with other agencies to trace those who didn't attend the dental clinic for more than 18 months.
8. Lobby for an excise tax increase on non-fluoride toothpaste.

Conclusion

Focussing on the oral health of adolescents and behaviours provides an opportunity for dentists, dental and oral health therapists, hygienists, and others for setting up good oral health habits for life. By continuing the current strategies and adopting new strategies recommended would improve the current dental caries experience of adolescents and address inequalities in New Zealand's different ethnic communities.

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