

An Investigation into Parents' Awareness of Effects of Commercial Fruit Beverages on Their Children's Teeth

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the requirements for the degree of Master of Public Health**

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Attestation of Authorship

“I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.”

Prathibha Sural

Signature: _____

Date: _____

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Ethics Approval

This study was approved by Auckland University of Technology Ethics Committee (AUTEC) on 30 January 2015. AUTEC Reference number 14/388.

This study was also approved by Plunket Ethics Committee on 15 March 2015.

Abstract

Good dental health is essential to overall health and has strong linkage with people's self-esteem, employability and quality of life. Poor dental health can be a major burden to individuals, families and nations. Good dental habits practiced during childhood have long-term benefits later in life. Dental caries and tooth erosion are common public health problems affecting children. These can be attributed to increased amount and frequency of intake of sugar and low pH foods. Many studies worldwide and in New Zealand highlight tooth wear in children, which can in part be attributed to frequent consumption of fruit juices. Both natural and added sugars in home-made or commercial fruit beverages can affect dental health, however, commercial fruit beverages are more easily accessible and storable than home-made beverages, so are more frequently consumed. This quantitative study assessed parents' knowledge of effects of commercial fruit beverages (any store-bought drink that contained 5% or more fruit) on their children's teeth.

This study used a mixed-mode, anonymous survey for data collection using online and paper questionnaires. Questions were focused on participants' knowledge, awareness and practices towards their children's consumption of fruit beverages in relation to controlling early childhood caries and erosion. Parents/guardians of children aged between 1-10 years and living in the Auckland region were invited to participate in the survey. Participants' oral health literacy level was assessed through label-reading of their preferred brand and sub-brand; the factors that influence the choice of the juice were also identified.

Since most of the participants in the present study were European women aged above thirty and from higher socioeconomic background, the results indicate that the oral health awareness in this group is reasonable. Price and availability of the beverage and child's liking for its sweet taste were the important considerations for choosing a brand. A majority of the respondents agreed that the availability of store-bought drinks increase

the amount and frequency of fruit beverage consumption in children. There was a modest correlation between awareness level and the ethnicity, age, education and family income of the respondents, however there was no significant association between the awareness level and number of children the respondents had.

Understanding of the difference between fruit juice and a fruit drink was considerably low among the respondents. This might be compounded by the unclear labelling of the beverages. Accordingly, there is a need to improve oral health literacy of parents and caregivers in addition to developing standards for more explicit labelling. Advocacy actions should also take the erosive potential of fruit beverages into account in addition to their sugar contents.

Chapter 1: Introduction

Introduction

A healthy set of teeth with strong supporting structures is important at every stage of life for chewing food, speaking and for aesthetics purpose. Oral health status also affects the physical and psychological well being of individuals and influences how they grow, socialise, and their perception of social well-being. A systematic review by Moynihan and Kelly (2014) indicates that even mild dental problems commonly affecting young children can have significant effects on dental health throughout the life-course. Poor dental health and untreated dental conditions can have a significant impact on quality of life. As stated in the *World Oral Health Report 2003* (Petersen), “the four most prominent non-communicable diseases (NCDs) - cardiovascular diseases, diabetes, cancer and chronic obstructive pulmonary diseases - share common risk factors with oral diseases, preventable risk factors that are related to lifestyle” (p. 9). For example, poor dietary practices play a significant role in development of these diseases. They also influence the development of tooth decay (FDI World Dental Federation, 2014); hence, improving oral health by curbing these risk factors can also lead to prevention of many comorbid disorders.

Oral health was one of the thirteen population health objectives in the New Zealand Health Strategy published in 2000. It is also one of the twelve priorities for Māori health (Ministry of Health, 2006). The New Zealand health sector has obligations to Māori through the Treaty of Waitangi, as declared in the New Zealand Public Health and Disability Act 2000 and a number of key health policy documents including the recent New Zealand Health Strategy (Ministry of Health, 2016b). In its vision statement of oral health strategy the Ministry of Health (2006) has outlined the seven key action areas on oral health policy. The key elements of this vision include improving oral health of young people and reducing oral health inequalities. While still embracing the principles of the previous health strategy, the new health strategy developed in 2016 emphasises

improving health literacy of people as a means to achieve ‘people-powered health’ by 2026 (Ministry of Health). Oral health literacy is the “degree to which individuals have the capacity to obtain, process and understand basic oral health information and services needed to make appropriate health decisions, a definition consistent with that of general health literacy” (Sabbahi, Lawrence, Limeback, & Rootman, 2009, p. 452).

Dental caries, commonly known as 'tooth decay', has long been considered one of the most widespread non-communicable diseases in the world (FDI World Dental Federation, 2014). According to the *2009 New Zealand Oral Health Survey* (Ministry of Health, 2010), dental caries is the most prevalent, preventable, chronic and irreversible disease in New Zealand. Although tooth decay can occur at any age, early childhood caries (ECC) is a condition seen in young children which affects multiple teeth in a very short time (Manton & Hayes-Cameron, 2013).

Dental erosion is a type of tooth wear which is caused by increased acid level in saliva. This condition has become a recognised problem in children in recent years (Fung & Brearley Messer, 2013; Kassebaum et al., 2015; Noble, 2006). Fung and Brearley Messer (2013) have identified a strong correlation between frequent consumption of drinks containing fruit and these two common dental problems. This study explored the knowledge of parents about the risk factors present in fruit beverages sold in the market and their effects on children’s teeth. It also examined the oral health literacy levels of the parents regarding the difference between fruit juice and fruit drink and correlated their awareness with their choice of the beverage by label reading.

Research questions

This research was carried out with an aim of investigating the awareness level of parents and guardians regarding the effects of commercial fruit beverages on their children’s teeth.

Secondary research questions are:

- Does the awareness level vary according to education levels, age groups, ethnicity and socioeconomic status of parents?
- What are the factors that influence their selection of fruit beverages?

Research process

This was a quantitative study that used a cross-sectional anonymous survey to obtain information from participants. Parents and grandparents who were primary caregivers of children aged between 1-10 years were invited to take part in an anonymous survey. In order to include participants from different socioeconomic backgrounds and education levels, both online and paper questionnaires were used for data collection. The raw data collected was entered into an SPSS database and analysed using univariate and bivariate analyses to check the overall awareness level and the differences in awareness across different independent variables.

Key assumptions

It should be explicitly noted that this research was done with a number of key assumptions. Made mainly on the basis of a literature review by the Health Promotion Agency (Health Promotion Agency, 2015), these assumptions are: (a) that children's health is a priority; (b) that dental caries and erosion are important childhood oral health problems in New Zealand; (c) people's dietary practices could be one of the major risk factors of dental caries and erosion; (d) people do not have sufficient health literacy levels to understand the influence of consumption of fruit beverages in causation of common dental problems; (e) nutritional labelling and health choice symbols are important indicators at the point of sale to guide consumer decision making; and (f) choosing commercial fruit beverages for the study will help to develop better standards for its marketing strategies.

Researcher Positioning

I am a dentist graduated from India with eight years' experience in clinical dentistry. While working as a tutor in the Department of Paediatric Dentistry in India I developed a special interest in child dental care. After my arrival in New Zealand I completed a Postgraduate Diploma in Public Health. While working as a research assistant for two projects at University of Auckland, I worked as a dental assistant and administrator of a private mobile school dental service that offers free dental care to adolescents. After learning that even developed countries like New Zealand are not immune to childhood dental problems, I chose to work as a temporary dental assistant in different suburbs of Auckland in order to learn more about private and public health systems in New Zealand. I have recently become a mother, which has heightened my interest in child health.

Thesis organisation

This thesis is presented to the readers under following sections:

Chapter One – Introduction

Introduces my topic and research question, why it is significant and the structure of my thesis.

Chapter Two – Background of Dental Caries and Erosion

Examines dental caries, ECC and erosion, their risk factors and protective factors. The epidemiology and burden of diseases are discussed in this section. The chapter also explores how dental diseases in childhood can cause later dental-related harm.

Chapter Three – Commercial Fruit Beverages and Their Health Effects

Begins with the description of different types of commercial fruit beverages and discussion of the health impacts of fruit beverages. This chapter also examines the

overall consumption of fruit-based drinks among children of New Zealand.

Chapter Four – Parental Perspectives

Provides an overview of children's ways of learning and how their parents and grandparents (apart from the health system) play a role in learning good dental habits. The oral health knowledge of parents across the globe as well as in New Zealand is critically analysed in this chapter.

Chapter Five – Research Methods

Research methodology, study design and ethical issues involved in this study are described.

Chapter Six – Analysis

Analysis of the results in relation to the research questions and objectives of the study are illustrated.

Chapter Seven – Discussion

The findings of this research and their implications are discussed in relation to the research objectives and existing literature. Strengths and limitations of this study are also listed.

Chapter Eight – Conclusion and Recommendations

Summarises the conclusion of the study followed by recommendations to augment oral health policy initiatives and educational programmes to improve oral health literacy of parents and caregivers and future research.

Chapter 2: Background of Dental Caries and Erosion

Introduction

Oral health is strongly linked with general wellbeing and is associated with positive development of individuals, communities and nations. However, this association is not well acknowledged (FDI World Dental Federation, 2014). The reasons for overlooking this correlation are the chronic nature of dental diseases, a gap in understanding of their pathogenesis and inadequate promotion and advocacy about oral health in the political arena (FDI World Dental Federation, 2014). This chapter gives an understanding of the causes, clinical features and complications of dental caries and dental erosion with an overview of burden of the diseases in New Zealand both at individual and community levels.

Dental caries

Dental caries or tooth decay is the prime cause for tooth loss in both children (Beighton & Bartlett, 2006). As Figure 1 illustrates, it is a multifactorial disease which is caused by interaction of the bacteria in the presence of fermentable carbohydrates over time. The community of oral bacteria is harboured in the biofilm, called ‘dental plaque’, present on the tooth surface. The carbohydrates are fermented by the bacteria, producing organic acids which can dissolve the minerals on the tooth surface they come in contact with. Most of the oral microorganisms remain active only in acidic medium (Beighton & Bartlett, 2006).

Alternatively, saliva protects the oral environment from the progressive destruction through buffering actions, lavage of acids and antimicrobial properties (Rugg-Gunn & Nunn, 1999). As the saliva adjusts the oral pH to the normal level, minerals move back onto the surface of the tooth—thus reversing the caries process. This demineralisation and remineralisation takes place continuously at microscopic level. The development of

clinical decay occurs only when there is a shift in the balance towards more demineralisation with too little time for remineralisation (Lee & Lee, 2006).

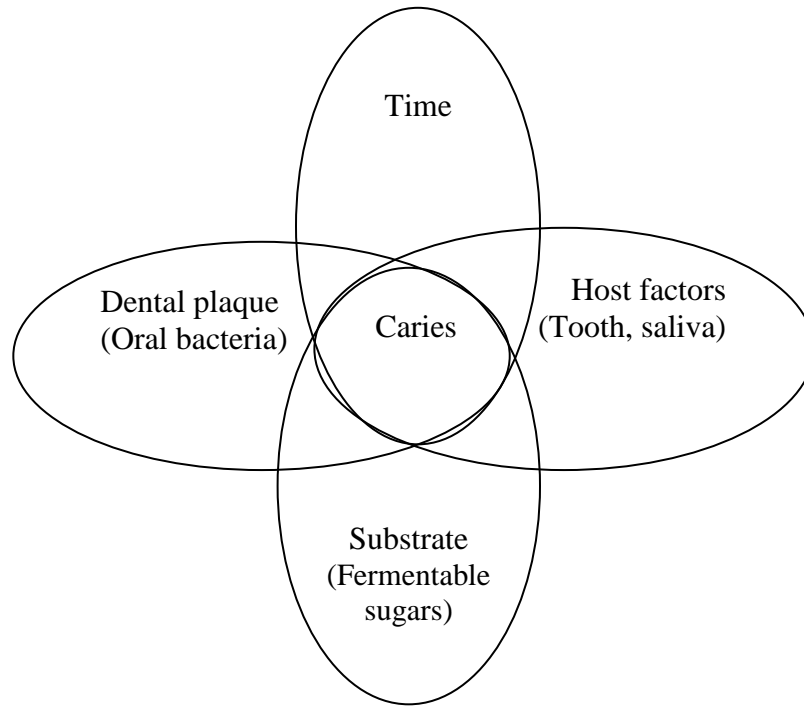


Figure 1. Schematic diagram of factors involved in the pathogenesis of dental caries. Reprinted with permission from “Dental Caries and Pulpitis” by D. Beighton, and D. Bartlett, 2006, in R. Ireland (Ed.), Clinical Textbook of Dental Hygiene and Therapy, p. 75. Copyright 2006 by Blackwell Munksgaard.

Sugars and tooth decay

In relation to tooth decay, sugars are broadly classified into two groups: intrinsic and extrinsic sugars. Intrinsic sugars are those naturally present inside fresh fruit and vegetables, whereas extrinsic sugars are usually present outside the cellular structure of plants. These extrinsic sugars are further divided into 'milk sugars' and 'non-milk extrinsic sugars' (NMES). Intrinsic sugars are considered less cariogenic because they are present inside the cell structure; they are not fully released into the mouth during mastication. On the contrary, NMES have the potential to cause dental decay. Potentially more cariogenic NMES are sucrose, glucose, maltose and fructose. Sugar

added to food and drinks and sugars naturally present in fruit juices, syrup and honey both fall under NMES (Noble, 2006).

Sugars naturally present in dairy products are called lactose, or milk sugar. Lactose is known to be a low cariogenic sugar and is considered safer for dental health. Furthermore, cow's milk (when no sugar is added) is cariostatic in nature due to the presence of calcium phosphate and casein, making it a dentally safer drink (Moynihan, 2002). Experiments on animals have shown that milk may have protective action against caries. In a study on rats from which the salivary glands were deliberately removed in order to make them caries-prone, lactose had the lowest cariogenicity when compared to other sugars (Bowen, Pearson, VanWuyckhuyse, & Tabak, 1991). Bowen et al. concluded that unsweetened cow's milk can be given as a beverage to prevent tooth decay, particularly in children with reduced saliva and at night when salivary flow is naturally low. A recent systematic review by Aarthi, Muthu, and Sujatha (2013) also upholds this claim, while in a Saudi Arabian study (Alshehri & Alshehri, 2015), preschoolers who slept with a milk-filled bottle in their mouth had highest prevalence of caries. The Saudi Arabian study does not specify whether the milk given in the bottle was sweetened or unsweetened. It did, however, find a positive correlation between high caries prevalence and consumption of sweetened milk beverages in general.

Quantity versus frequency of acid attack: Stephan curve

The strength of evidence for association of dental caries and the amount of sugar consumption over frequency of consumption has always been a subject of debate (Moynihan, 2002). Manton and Hayes-Cameron (2013) and Caswell (2009) argue that the frequency of sugar consumption is more detrimental in terms of dental decay than one time consumption of significant amounts of sugar. As explained by the Stephan curve (Figure 2), any single fermentable carbohydrate in the diet reduces the pH of the oral environment rapidly from its resting state of 7.0 to below 5.5, which is the threshold at which enamel begins to dissolve. Reduction of pH is more if the food consumed is more acidic. Ions present in saliva help to buffer the plaque acids, thus controlling the

process of demineralisation. Remineralisation can take place only when the plaque pH rises above 5.5. But, if the challenge is too frequent then the plaque pH will remain continuously under the critical pH with longer period of acidic condition, increasing the likelihood of developing caries (Lee & Lee, 2006). In this regard, fruit beverages are an important source of sugar and acidic content.

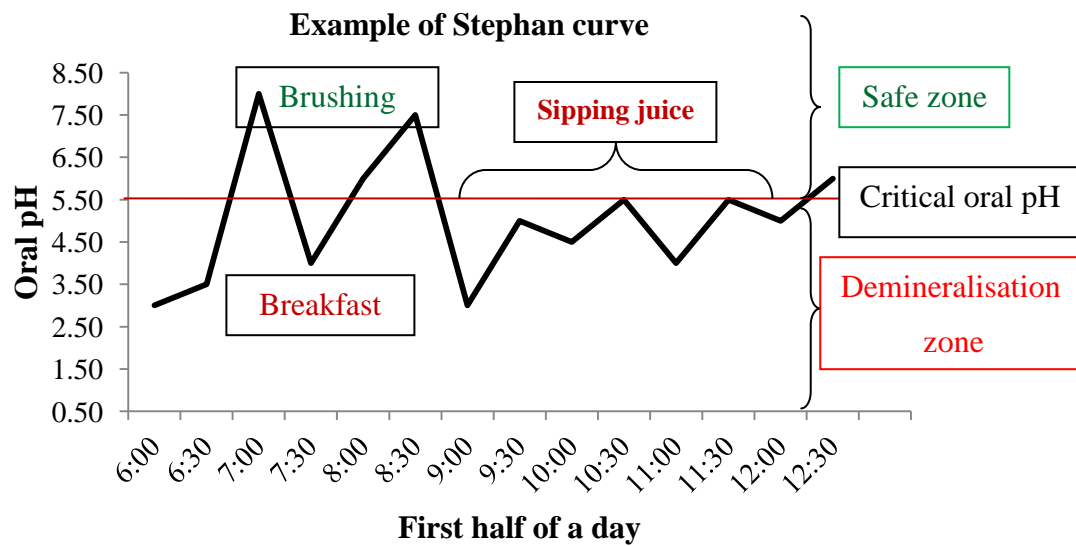


Figure 2. An example of oral pH changes demonstrated using a Stephan curve. Reprinted with permission from “Paediatric dentistry” by S. M. G. Lee and G. T. R. Lee, 2006, in R. Ireland (Ed.), *Clinical Textbook of Dental Hygiene and Therapy*, p. 286. Copyright 2006 by Blackwell Munksgaard.

Early childhood caries

Early childhood caries is a specific form of tooth decay affecting milk teeth of infants and toddlers. According to Bach & Manton: "ECC is classified as the presence of one or more decayed, missing (due to caries) or filled teeth in a child under the age of 72 months" (2014, p. 169). Major causative factors of ECC are sticky sweets, reduced saliva and sweet liquids given in feeding or sipper bottles. When the child is bottle-fed on demand and often falls asleep with the bottle in his/her mouth, it leads to constant bathing of the teeth (Manton & Hayes-Cameron, 2013). Although upper front teeth are most susceptible, ECC can form on other teeth (Health Promotion Agency, 2015).

All children are prone to ECC. It is more prevalent in disadvantaged populations such as children with poor socioeconomic status, from an ethnic minority, malnutrition, abnormal development of tooth and poor health practices or whose parents—particularly mothers—have low literacy levels or any condition that leads to poor dietary choices (Çolak, Dülgergil, Dalli, & Hamidi, 2013).

Natural sugar alternatives

In recent years a plant called 'stevia', a Paraguayan shrub, is competing against sugar and other artificial sweeteners. It belongs to the Asteraceae family and is used either as a crude extract or in a highly purified form, though the latter is gaining popularity in a wide number of countries (Urban, Carakostas, & Taylor, 2015).

There is evidence to show the benefits of stevia on general health as well in controlling diabetes, hypertension, weight control and many other health problems. It has also demonstrated the ability to reduce the craving for sweet foods (Goyal & Goyal, 2010). According to the review by Goyal & Goyal, an experiment conducted on rats in 1992 did not show a potential to increase the risk of developing tooth decay. A study by de Slavutzky (2010) demonstrated the dental benefits of stevia. All cases in the study demonstrated significantly lower amounts of plaque following rinsing with stevia when compared to a sucrose rinse. The plaque deposit following the sucrose rinse was more gelatinous in appearance whereas the plaque after using stevia rinse appeared like “ground flour”, which was easy to remove (p. 214). The results of this study, however, should be considered carefully because it used a small sample of eight volunteers.

The Ministry of Primary Industries of New Zealand first approved the commercial use of stevia in 2008. In 2012 Frucor Beverages launched ‘Just Juice with stevia’ as an alternative to sugar, a product claiming to contain 50% less sugar. While it has helped to increase the popularity of stevia, people are sceptical about its safety. There have also been reports of hypersensitivity to stevia in different parts of the world, including New Zealand (Crispe, 2014; Euromonitor International, 2014). A recent review by Urban et

al. (2015) concluded that there is no potential danger in consuming the purified form of this sweetener. They argue that the cases reported in the literature were possibly due to the consumption of stevia in its crude form and that stevia can induce an allergic reaction in individuals who are also allergic to other plants in the Asteraceae family. As a result there have been calls for more obvious labelling of products containing stevia, using methods such as having pictures of the stevia leaf on the pack as a standard (Crispe, 2014; Euromonitor International, 2014). My study attempted to obtain parents' opinions of stevia and as such it may help in understanding the general perception of New Zealanders towards this sweetener.

Epidemiology of ECC

Despite the major emphasis placed on controlling the disease at the global level, ECC has been a major problem in developed countries, whereas in developing countries it is at epidemic proportion (Çolak et al., 2013). A comprehensive review and other studies from the late 1990s indicate ECC prevalence of 1-12% in developed countries and around 70% in developing countries (Çolak et al., 2013; Health Promotion Agency, 2015). In New Zealand, despite several scientific advances in clinical dentistry and public health interventions since the 1920s (Jones, 1984), the *2009 New Zealand Oral Health Survey* shows that only 51% of 5-year-old children of New Zealand are free from dental caries (Ministry of Health, 2010). Furthermore, there is significant disparity in oral health across ethnicity, education level, socioeconomic status, geographic deprivation and other factors. Approximately 48% of Māori children and 47% of Pacific children were caries-free when compared to their Asian (66%) and European/other (62%) counterparts (Ministry of Health, 2010).

The *2002 National Children's Nutrition Survey* and *2006/07 New Zealand Health Survey* also highlight the oral health disparity in Māori and Pacific children (Ministry of Health, 2003, 2008a). The school dental data showed caries prevalence of approximately 50% in 5-year-olds with a majority being Māori and Pacific children; moreover, there has been no significant reduction in prevalence and severity of ECC in the past decade

(Bach & Manton, 2014). Dental emergencies are identified as a primary cause of hospital admission of young children (particularly in 3- to 4-year-olds) in many District Health Boards in New Zealand (Whyman, Mahoney, Morrison, & Stanley, 2014). According to Bach and Manton (2014), between 2000 and 2009, 7.3% of all hospital admissions for children aged between 29 days to 14 years was for dental emergencies. These emergencies are mainly caused by dental caries.

Dental erosion

Dental erosion is the physical result of the chronic chemical dissolution of the tooth surface (Noble, 2006). It is defined as the "physical result of a pathological, chronic, localised, painless (initially) loss of dental hard tissue which is chemically etched away from the tooth surface by acid and/or chelation without bacterial involvement" (Rugg-Gunn & Nunn, 1999, p. 64).

The areas affected and the clinical picture of erosion and dental caries are very different. While caries develop beneath dental plaque and areas that are difficult to clean (pits and fissures, proximal surfaces between teeth), erosion develops in areas that are devoid of plaque but exposed to acid (such as palatal and buccal surfaces of all teeth and occlusal cusp tips of posterior teeth) (Rugg-Gunn & Nunn, 1999). Erosion may present itself in different forms, such as change in the cutting edge of front teeth, yellowish tint due to exposure of underlying yellow dentin as the white enamel cover is dissolved, broad rounded shiny concavity and dental fillings that appear to be rising above the tooth surface as the surrounding tooth substance dissolves (Noble, 2006).

The tooth has its nerves and blood vessels in the innermost layer (called 'pulp'). However, some nerve endings extend into the outer layer or dentin, making it hypersensitive to cold and acidic pH; for that reason, the outside of the crown of the tooth is insulated by highly calcified enamel. Enamel is lost by continuous exposure to acid which later exposes the nerve endings in the dentin to the oral environment. While dental erosion is initially symptomless, exposure of dentin can be extremely sensitive

and annoying. It should be noted that even though the body can produce 'reparative dentin' to make up for the lost dentin, loss of enamel is permanent (Noble, 2006).

There are a number of causes for dental erosion. It can be caused by intrinsic factors like vomiting, gastric reflux, anorexia and bulimia or by extrinsic causes such as acidic diet, medicine and environmental factors. Fruits and fruit juices naturally contain acids such as phosphoric, citric, tartaric, acetic, malic and carbonic acids (Moynihan, 2002). Ascorbic acid—which has been identified as potentially erosive—is added in significant quantities to some commercial food and drinks (Noble, 2006). If the nutrition label indicates the presence of any of these acids then the product is likely to be highly erosive. When the tooth surface is flushed with acidic liquids it erodes the whole surface of the tooth by demineralisation (Rugg-Gunn & Nunn, 1999). Erosion resulting from intrinsic factors is outside the scope of this research.

According to K. Ayers, Drummond, Thomson, and Kieser (2002), tooth wear progresses faster in primary teeth than in permanent teeth owing to the thinner dentin and enamel and greater solubility of enamel in primary teeth. While caries invades only one tooth at a time, erosion can affect all teeth (permanent and primary) all at the same time, causing irreversible dissolution of the tooth to varying degrees (Noble, 2006). Furthermore, when the dental hard tissue is softened by the acids it is more susceptible to other forms of tooth wear, such as attrition (resulting from tooth-against-tooth friction) and abrasion (resulting from mechanical rubbing of hard foreign substance) also (Rugg-Gunn & Nunn, 1999).

Epidemiology of dental erosion

As estimated by Black in 1908, the prevalence of chemical tooth wear was less than 0.1% (as cited in Gambon, Brand, & Veerman, 2012). It was once seen mainly as part of aging but has more recently become a common problem in children (Fung & Brearley Messer, 2013; Noble, 2006).

Taji and Seow (2010), in a comprehensive review of dental erosion, observed the wider variation in the prevalence from 13% to 82% in 5- to 12-year-old subjects. The results of this review, however, are predominantly based on the studies from the United States of America, Europe, Saudi Arabia, China and Brazil. The researchers also noted that the prevalence of erosion recorded in Australian schoolchildren was 78% and 25% in primary and permanent teeth respectively, and there was a notable association with caries. A similar study in Australian primary school children highlights the prevalence of tooth wear and its significant association with drinking fruit juice (Fung & Brearley Messer, 2013). The wide ranging values appear to be due to inherently different sample populations, study design and scoring criteria used. There is also controversy over classification of erosion used in the studies and presence of various confounding risk factors.

Epidemiological studies indicate that in contrast to dental caries, higher socioeconomic status and education level of the parents can be risk factors for erosion (Gambon et al., 2012; Millward, Shaw, & Smith, 1993). As Gambon et al. argue, tooth wear is seen more frequently in males than females because boys need more sourness and sweetness to perceive the taste. They prefer stronger flavours in comparison to girls. In a Brazilian study, school boys from the higher income families and those who had parents with higher education levels showed higher prevalence of tooth wear than female students from similar background (Mangueira, Sampaio, & Oliveira, 2009).

Prevalence in New Zealand

Dental erosion in young people was included in the national surveys of United Kingdom as early as the early 1990's and in the National Oral Health Survey in Iceland (as cited in Arnadottir et al., 2010; Nunn, Gordon, Morris, & Walker, 2003), but prevalence of dental erosion is not included in any regular New Zealand national survey. In their review, Taji and Seow (2010) found only one eligible study from New Zealand, conducted by K. Ayers et al. (2002), which reported 82% of tooth wear (inclusive of erosion and other forms of tooth wear) in 5- to 8-year-old subjects.

Childhood dental problems: A cycle of events

ECC is a virulent form of caries, characterised by decay in multiple teeth that can progress quickly. Children presenting with dental caries in their primary teeth are also prone to decay in their permanent teeth; poor oral health in childhood often persist to adulthood. Primary teeth play an important role in chewing, speech, aesthetics, maintenance of an intact dental arch and reserve space for the future permanent successors. While ECC is often involved with pain, infection, chewing problems and malnutrition, early loss of primary teeth can affect speech articulation, dietary practices and development of the jaw. The sequelae of the dental caries (including ECC) ranges from painless lesion (incipient) to life threatening conditions such as sepsis of oral cavity (Finucane, 2012). Although no cases of death of children due to dental infections have been recently reported in New Zealand, there have been a few cases documented in the United States (Finucane, 2012). The mortality and morbidity pyramid in Figure 3 outlines the human and economic costs of ECC.

Permanent teeth begin to erupt from the age of six years, hence between 6-14 years-old is called the 'mixed dentition period'. If affected primary teeth are left untreated during this period, the chance of spreading the decay to permanent teeth increases (Finucane, 2012). Premature loss of deciduous teeth has been shown to contribute to jaw discrepancy, crowding and malocclusion, malnutrition, small stature, poor general health and quality of life, behavioural problems and poor school performance (Finucane, 2012; Health Promotion Agency, 2015). In Thailand, dental problems resulted in a staggering loss of 1900 school hours per 1000 children in 2008 (FDI World Dental Federation, 2014). It should be noted that the patients who are negatively influenced by their bad dental experiences in childhood are more likely to delay dental treatment for their children in the future (Smith & Freeman, 2010).

Initial dental defects can be restored with little pain and discomfort, whereas the pulpal infections require more complex treatments such as pulpectomy (surgical removal of pulp) and tooth extraction; such treatments in children are usually performed under

general anaesthesia (Finucane, 2012). These complex procedures may increase levels of dental fear.

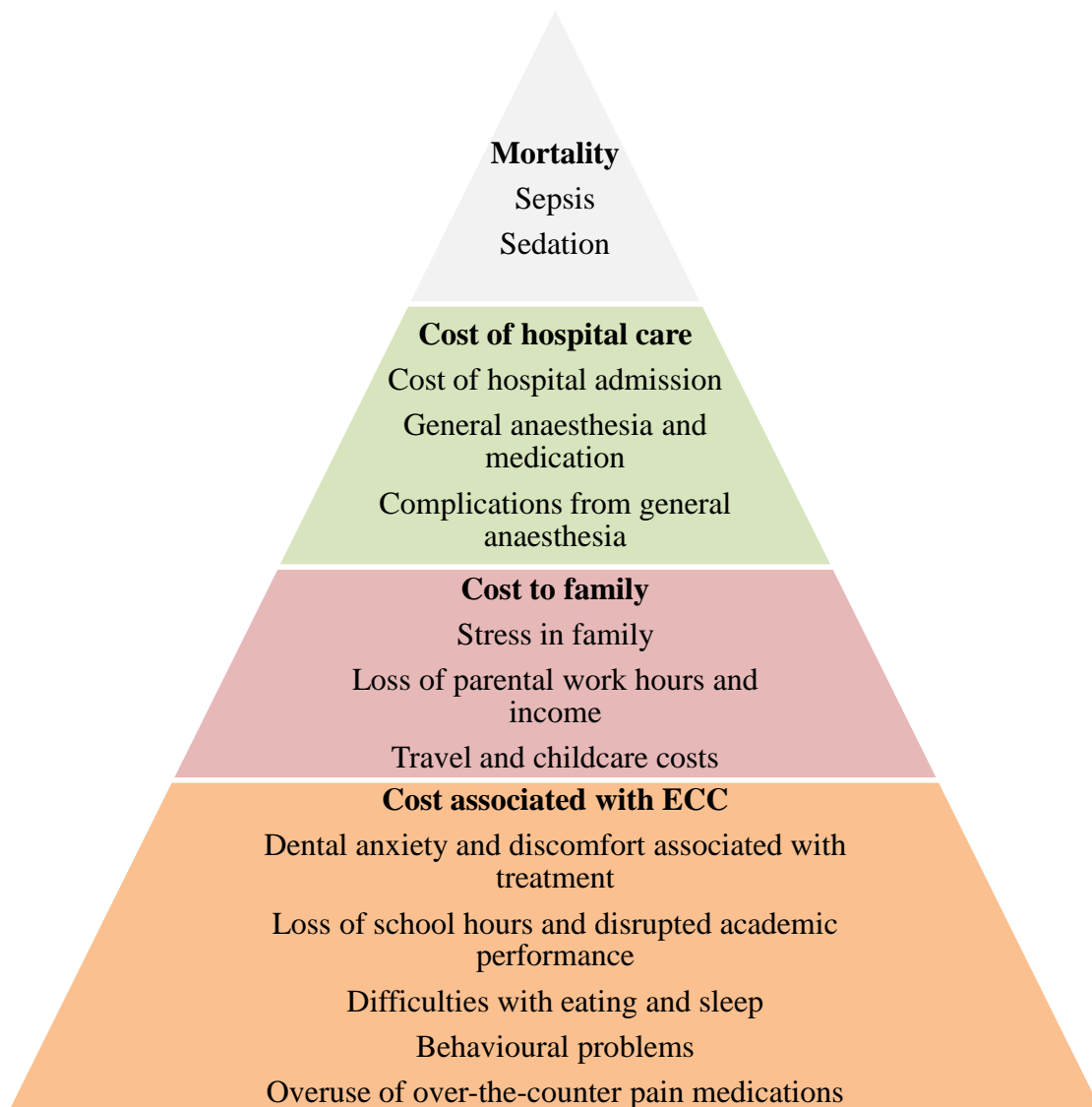


Figure 3. Morbidity and mortality pyramid for ECC. Reprinted with permission from “Beyond the Dmft: The Human and Economic Cost of Early Childhood Caries” by P.S. Casamassimo, S. Thikkurissy, B.L. Edelstein, E. Maiorini, 2009, The Journal of American Dental Association, 140(6), p. 654. Copyright 2009 by the American Dental Association.

According to Sundborn, Beaglehole, and Thornley (2014, July 23), in 2009, 5050 seven-year-old or younger children had to undergo multiple tooth removal under general

anaesthesia. Most of the cases were due to a high-sugar diet. The total cost of these treatments accounted for more than \$20 million—which was borne by the taxpayers. Apart from the expense of curative treatment, there is a huge indirect cost to parents, children and the community. A study by Anderson, Drummond, and Thomson (2004) identified that out of 95 parents, 66 of them had to arrange time off work on the day of their child's dental treatment under general anaesthesia. Almost half of them reported lost income for the day. Even though this study has demonstrated an improvement in children's quality of life following treatment under general anaesthesia, increasing number of treatments requiring general anaesthesia also increases the waiting time for the child—causing further disruption.

Preventive measures

Most of the risk factors of ECC and tooth wear can be prevented through plaque control, diet control, community water fluoridation and regular visits to the dental clinic (Health Promotion Agency, 2015). Therefore, dental public health initiatives should include these measures.

Plaque control

Plaque control is one of the most efficient methods in caries prevention. Tooth brushing with fluoridated toothpaste, mouth rinsing and flossing are common methods of plaque control (Manton & Hayes-Cameron, 2013). Tooth brushing commenced before twelve months of age is associated with lower caries experience (Health Promotion Agency, 2015). In young children, brushing teeth twice daily is recommended for controlling formation of plaque and controlling caries process (Manton & Hayes-Cameron, 2013). Owing to their lack of self-motivation and limited dexterity to brush their teeth effectively, plaque control in young children depends on parents' dental awareness and motivation to brush their children's teeth (Bach & Manton, 2014; Lee & Lee, 2006). In New Zealand only 66% of the parents with children aged 2- to 4-years-old brushed their children's teeth twice a day (Health Promotion Agency, 2015). There is evidence that

children of lower socioeconomic families begin tooth brushing at later ages and that they are more likely to seek dental care only for symptomatic problems. Parents who have higher oral health literacy are more likely to commence tooth brushing of their pre-schooler children earlier than those who lack oral health knowledge (Bach & Manton, 2014).

Diet control

A systematic review commissioned by the World Health Organization suggests that restricting total sugar intakes to less than 5% of total energy consumption can minimise the lifetime risk of tooth decay. This review included data published since 1950 addressing sugar consumption and dental caries (Moynihan & Kelly, 2014). Alternatively, controlling the frequency of sugar intake, avoiding 'grazing' between meals, restricting sweet foods to mealtimes and leaving a gap of at least two hours between every intake allows sufficient time for remineralisation and reduces caries risk (Manton & Hayes-Cameron, 2013; Noble, 2006). Evidence shows that consumption of sugar among New Zealand children is on the rise, particularly through beverages (Bach & Manton, 2014). Reports show that soft drinks featured six times among the top 30 selling products and fruit juices made up 20% of sales (Bach & Manton, 2014). Further discussion on purchase and intakes of fruit-based beverages is available in Chapter Three.

Community water fluoridation

Fluoride offers dental benefits through increasing resistance to demineralisation by forming firmly bound fluoroapatite crystals into the dental tissue and through interfering with the bacterial activities by increasing the pH of the plaque (Blinkhorn & Mekertichian, 2013). Fluoride can be delivered through adding it to the community water supply, toothpastes, rinses, gels, salt and fluoride-releasing restorative materials (Manton & Hayes-Cameron, 2013).

While most dentists support community water fluoridation in New Zealand there are campaigns against it too, with differences in knowledge and beliefs among people, particularly across different ethnic groups (Fluoride Action Network NZ Inc, n.d.; Grant, Dawson, & Thomson, 2013). Any dose higher than one part per million given through water fluoridation at the time of the development of the tooth can cause mottling of enamel, a condition called 'fluorosis' (McDonagh et al., 2000). Since mineralisation of all the developing teeth usually occurs in the first five years of age, exposure to excess fluoride during this period is problematic. The systematic review by McDonagh et al. shows that fluoridated water supply is associated with reduction in the number of teeth affected by caries. At the same time, it underscores dose-dependent increase in dental fluorosis.

Reports in New Zealand show lower caries prevalence in under-5-year-olds who have access to fluoridated water supply than those with no access to community water fluoridation (Ministry of Health, 2006), yet only 60% of the population have access to fluoridated drinking water (Ministry of Health, 2016a). Instead of solely relying on fluoride to prevent caries, other methods like diet control and good oral hygiene practices should be promoted simultaneously.

Utilisation of oral health services

Regular dental check-ups ensure prevention and early intervention of dental problems through appropriate oral health education, professional plaque removal and application of restorative materials (Lee & Lee, 2006). Children and adolescents in New Zealand are entitled to free dental care until their eighteenth birthday. Dental service providers are contracted with the Ministry of Health to receive a standard package for a prescribed list of curative and preventive treatments per annum per enrolled patient, which is much less than the fee-for-service price (Mathu-Muju, Friedman, & Nash, 2013; Ministry of Health, 2011). Unattractive remuneration and occupational stress have led to job dissatisfaction among dental therapists, resulting in a shortage of workforce (K. Ayers, Meldrum, Thomson, & Newton, 2006; K. M. S. Ayers, 2009). This in turn may put

pressure on available providers to see many patients in a short time with little space to give complete oral health education to every patient. The Ministry guidelines for dental providers use a high-risk individual approach to identify candidates for caries prevention and early intervention (Ministry of Health, 2011); however, caries development is dynamic and can occur and progress in individuals of lower risk groups too (Selwitz, Ismail, & Pitts, 2007).

According to the *2009 New Zealand Oral Health Survey*, only 72% of 2- to 17-year-old children living in the most deprived areas (decile 5) accessed the dental service in the past year, whereas for decile 3 areas the rate was 91%. When broken down by ethnicity, Pacific and Māori children had lower rates (71% and 77% respectively) when compared to Asian (80%) and European/other children (83%) (Ministry of Health, 2010).

In another study, 54% of the mothers of pre-schoolers from the Pacific population did not know that enrolling their children in the Community Oral Health Service was free (Health Promotion Agency, 2015). Only 59% of 1- to 4-year-old children had visited the dental service provider when compared to older children for the past 12 months in 2013-14 (Ministry of Health, 2014). However another survey by the Ministry of Health (2015) shows a marginal increase of 3% of service utilisation in 2014-15.

Some of the community-level barriers identified that impede the use of dental service in New Zealand are: a lack of adequate transport, limited opening hours of operation in rural areas, Māori oral health professionals being underrepresented in the workforce and not knowing what types of dental service are available for free. Some individual and family factors noted are: (a) no perceived need; (b) lack of awareness about importance of primary teeth; (c) influence of cultural beliefs and practices; (d) people's attitudes towards dental service providers; and (e) utilising dental services for treatment rather than for preventive care (Health Promotion Agency, 2015).

Plunket nurses are the first port of call for receiving health advice and support for many families with infants and preschool children (Drummond, Clarke, Maxwell-McRae,

Konthasinghe, & Thomson, 2002). In 1992 Plunket developed an oral health training module for their nurses, after recognising the role Plunket nurses had in providing relevant advice and information to parents of small children. The evaluation of effectiveness of this module, carried out five years after its introduction, has shown that this model was moderately successful in providing nurses with basic knowledge of oral health and ability to make appropriate referrals. According to the report of this study however, competency of the nurses was assessed mainly on their knowledge of dental caries and its relation to sugar intakes and oral hygiene, with little focus on acidic foods (particularly fruit juice) and their role in erosion. It appears from this evaluation that there is a need for continuous updating of the information used in the module, along with its systemic evaluation (Drummond et al., 2002). Plunket has been working in liaison with Colgate and the New Zealand Dental Association (NZDA) since February 2015 to control ECC and to encourage enrolment with the Community Oral Health Service. This further highlights the need for widening Plunket nurses' current knowledge of oral care for young children (Riches, 2015).

Summary

Dental caries and dental erosion are two common dental problems in children. Dental caries is caused by demineralisation of tooth structure due to the activity of the oral bacteria in the acidic medium by fermenting the sugars in the diet. Dental erosion is caused by washing of the acidic liquids, leading to slow dissolution of hard structures of teeth. Studies have shown that NMES in the diet increases the risk for caries and acidic diet leads to erosion, while milk sugar has protective effects. Frequency of acid attack with insufficient time for buffering action further increases the chances of progression of cavity formation and erosion. Data shows that childhood dental diseases have been a huge burden on the New Zealand economy. Untreated childhood dental problems can be very serious, with temporary and permanent complications. The preventive strategies used for caries prevention can be challenging to apply in children.

Chapter 3: Fruit Beverages and Their Health Effects

Introduction

The nutrients in fruit are vital for maintenance of health. Fruit and vegetables consumed sufficiently on a daily basis could help prevent many major non-communicable diseases and certain cancers (World Health Organization, 2003). For pre-schoolers and schoolchildren, the Ministry of Health (2012) recommends at least two servings of fruits along with two and three servings of vegetables respectively for these age groups. Fruit juices are more appealing to some busy individuals who want to get their recommended fruit servings. Availability of several types of fruit beverages in the market with different combinations of fruit makes it more attractive and convenient to prefer commercial fruit beverages.

Description of fruit beverages

The New Zealand Juice and Beverage Association (NZJBA) (2013, p. 1) defines juice as "that product made from the liquid portion obtained from the edible part of the fruit or vegetable". While the definitions of different fruit beverages vary across countries, the Food and Agriculture Organization of the United Nations (FAO) (2001) provides some common juice designations, which are outlined in Table 1.

Fruit juice

Fresh juices typically do not undergo any heating process. Some types of juice, such as juice concentrate, are processed by evaporating the water content of the juice. After the concentrate is transported to its destination the same amount of water is then added to reconstitute to 100% juice. Some fruit beverages are heat-treated at up to 90⁰C for about 10-20 seconds to make them sterile; they are then vacuum-packed in sterilised containers so they can be stored without refrigeration for 6-9 months (when the seal

remains unopened). Similarly, short-life products are pasteurised at a lower temperature (70 - 75°C) for 10 - 20 seconds but have a shorter shelf life of 2 - 6 weeks (Caswell, 2009).

Table 1.

Some common juice definitions.

Term	Criteria
Pure juice 100%	All juice
Fresh squeezed	Unpasteurised (very short shelf life)
Not from concentrate	Single strength (pasteurised after extraction)
From concentrate	Made from concentrate
Fresh frozen	Unpasteurised
Juice blend	A mixture of pure juices
Puree	Contains pulp (higher viscosity than juice)
Nectar	Pulpy or clear (20 - 50% juice and added sugar)
Juice drink	Contains 10 - 20% juice
Juice extract	Fruit extracted by water and then concentrated
Natural flavoured	Usually less than 1% juice

NOTE: Only common terms of fruit beverages are included. Reprinted with permission from “Principles and Practices of Small and Medium-scale Fruit Juice Processing” by R.P. Bates, J.R. Morris and P. G. Crandall, 2001, p. 11. Copyright 2001 by the Food & Agriculture Organization.

There is an assumption by consumers that freshly squeezed juice products are healthier than 'from concentrate' varieties (Caswell, 2009). Evidence shows that both varieties have similar sugar and fibre contents providing similar energy levels. More research is needed to examine if there is any difference between these two varieties in terms of nutritional benefits such as phytochemicals and antioxidant properties.

Fruit smoothies

In the United Kingdom, commercial fruit smoothies typically contain 80 grams of fruit with 150 ml of fruit juice for every serving of 250 ml. The Department of Health considers one typical serving of fruit smoothie to be two servings of fresh fruit, because fruit smoothies contain more crushed fruit when compared to any other fruit beverage (Caswell, 2009). According to NZJBA (2013), there are generally two types of fruit smoothies with the following designations:

- i) Fruit smoothies are thick, fruit containing drinks often sweetened with fruit puree rather than fruit juice. Tiwary, Ward & Jackson (1997) claim that fruit smoothies have higher soluble fibre content than that in juice, over half of which is pectin, thus helping in increasing short-term satiety.
- ii) Traditional smoothies are blends of fruit juice or fruit puree, usually with ice cream or milk.

The present study included only bottled fruit smoothies commonly sold in shops and supermarkets (for example, Homegrown Raw Fruit Smoothie and Charlie's Honest Smoothie) because although both types of smoothies are available in the market, there is too much variation in the fruit content, nutritional values and health effects of freshly made traditional smoothies. Also, freshly made traditional smoothies at cafes and restaurants do not provide the convenience of label-reading.

Fruit drinks (Juice drinks)

Different countries define fruit drinks in different ways as well. According to Caswell (2009), fruit drink is a fruit beverage which contains anything less than 100% pure fruit juice. They can also be purchased as ready-to-drink beverages or squash or cordials that require dilution prior to consumption (Caswell, 2009). NZJBA (2013) does not give an upper limit for the fruit content of fruit drinks but it must contain a minimum of 5% of fruit. According to NZJBA (2013), juice drinks and fruit drinks are synonymous.

In addition to the definitions of fruit juice, fruit drink and fruit smoothies, NZJBA (2013) has given description of cordials, fruit syrups, nectars, crushies, quenchers and more. These drinks are not legally defined in New Zealand. According to New Zealand guidelines, different types of fruit beverages have fruit content ranging between 5 and 100%. To avoid ambiguity the term ‘fruit beverage’ was used for this research as a collective term to refer to any drink that has fruit content of 5% or more.

Impact of fruit beverages on general health

Fruit-based drinks are undoubtedly a great way to reap the benefits of fruit for those who struggle to eat it (for example, babies and toothless individuals or children who do not like eating fruit at all). But fruit beverages cannot be a substitute for fresh fruits for several reasons.

Fruit beverages provide very little dietary fibre. Dietary fibre is a part of plant food which cannot be digested by our digestive system. It is present in fruits, vegetables, cereals and legumes. It helps in cholesterol reduction, normal bowel function and other essential health functions (Caswell, 2009). Reference value for dietary fibre for 1- to 3-year-olds and 4- to 8-year-olds are 14 grams and 18 grams respectively (National Health and Medical Research Council, 2006). Squeezing the juice out of fruit removes the dietary fibre naturally found in fruits (Caswell, 2009). Therefore, according to the Ministry of Health (2012), it only contributes up to one serving of fruit while additional servings of fruit should come from fresh, frozen or canned fruits, irrespective of the type and amount of juice consumed.

Two studies (one with children and one with adults) have shown that drinking moderate amounts of fruit juice on a daily basis can be considered as a “marker of healthier dietary habits” (Caswell, 2009, p. 282). The study groups in these studies were associated with consumption of healthier food in general with fewer intakes of junk foods. These studies do not, however, provide any details about association with socioeconomic factors and other confounders that may have influenced this habit.

Furthermore, a study by Dennison, Rockwell, and Baker (1997) has proven that drinking fruit juice which far exceeds the recommended amount has also been associated with short stature and increased risk of obesity among pre-schoolers. Although a review by O'Neil and Nicklas (2008) concluded that drinking moderate amounts of 100% fruit juice can be an important source of vitamin C, folic acid, potassium and some antioxidants for children and adolescents, it acknowledges the low fibre content in 100% juice varieties as well. One of the ways that the relationship between obesity and fruit juices has been explained is by Benelam (2009), using 'liquid calories' theory. This theory states that energy derived from energy-dense liquid is less satiating than solid food that provides the same amount of energy; it increases the chances of consumption of more energy than needed. This may lead to frequent juice consumption causing tooth problems.

Effects on dental health

Some fruits have fibrous texture and on chewing them they act as natural abrasives, eliminating plaque from teeth and gums. Chewing also stimulates salivary flow, accelerating the cleansing action (Glosman, 2011, July/August). Even though fruit is packed with natural sugars and many studies have shown that fruit is acidogenic, along with other epidemiological studies the *Dietary Sugars and Human Disease report 1989* concluded that these intrinsic sugars are negligible causes of tooth decay (Great Britain Panel on Dietary Sugars, Acheson, & Great Britain Department of Health and Social Security, 1989; Moynihan, 2002). In contrast, fruit juice contains NMES, which is produced by the release of natural sugars from the whole fruit as a result of the juicing process (Caswell, 2009). As estimated by Moynihan (2002), NMES content in an unsweetened fruit beverage may be equivalent to that of a standard soft drink.

Most of the fruit juices reduce the pH of saliva to below 5.5. In support of this, all fruit juices used in one study reduced the pH of the saliva to different values. Some of the readings were well below the critical pH within a minute of consumption and it took at least thirty minutes to recover to normal levels (Saha, Gudamarlahally, Shivkumar, &

Pal, 2011). This drop in pH was higher in commercial fruit juices. The result of a recent study on the effects of fruit smoothies on enamel erosion is also formidable (Tahmassebi, Kandiah, & Sukeri, 2014). Tahmassebi et al. argue that while pH is only a measure of the strength of acid, titratable acidity (TA) measures the time needed for an alkali to neutralise the acid present in the medium. Although fruit juices are made of weak acids, their TA is much higher. In support of this argument the smoothies used in their study had slightly higher pH than Diet Coke. Their TA however was 3.5-4 times more than Diet Coke. This means fruit juices require more time to neutralise by saliva.

There has been contretemps regarding whether to use pH or TA for measuring the erosive potential of a drink. In this regard, Jensdottir, Holbrook, Nauntofte, Buchwald, and Bardow (2006) suggest using pH as a guide to predict the erosive potential within the first few minutes (initial erosive potential), while the TA can be used to identify the erosive challenge for longer period of exposure. They also state that a drink with a high initial erosive potential is well defended by the salivary proteins than those with higher TA. In their experiment, although cola drinks showed lower pH and higher initial erosive potential than orange juices used in the study, salivary proteins showed significant protection against erosive potential of cola drinks while no protection was obtained for orange juices. Physical characteristics of the drink (such as high viscosity) and drinking juice from a sipper bottle while sleeping tend to keep the acid in contact with the teeth for longer period thus resulting in slow oral clearance (Jensdottir et al., 2006).

Furthermore, two different experiments in India and Saudi Arabia have demonstrated macerating effects of fruit juices on restorative materials, jeopardising the longevity of dental fillings as well (Fatima, Abidi, Qazi, & Jat, 2013; Maganur, Prabhakar, Satish, Namineni, & Kurthukoti, 2013). Both studies depicted changes, to different degrees, in the surface hardness, micro leakage and decomposition of resin content of commonly used, tooth-coloured filling materials. These studies show that fruit beverages are detrimental to dental health in several ways.

Besides all this, we should not overlook the significant impact the commercial fruit beverages have on the environment. As Caswell (2009) argues, production, pasteurisation, cold storage and transport of fruit beverages all contribute to increased carbon dioxide emissions. Increasing consumer demand for freshness, variety of flavours and freshness puts further pressure on beverage industries to cause damage to the environment.

Fruit-based drinks consumption in New Zealand

Following increasing awareness of the effects of fizzy drinks on health, there is a shift in the consumer demand towards fruit-containing drinks. According to the Euromonitor International (2014), New Zealanders prefer fruit-based drinks to other sugar-sweetened beverages for their children. Sale of fruit-based beverages is on the rise. In 2014, Frucor Beverages held 57% value share of the market (including fruit-based drinks and soft drinks) while Fresh Up showed sales of NZ\$20 million (Euromonitor International, 2014). As stated by D'Costa (2013, February 20), the per capita juice consumption in New Zealand is around twenty-five litres per year, making New Zealand the tenth highest juice-consuming country in the world. According to the latest reports of Statista (2016), juices accounted for 17% of market share and are still only second to cola carbonates (the highest selling soft drinks).

In the study carried out by K. Ayers et al. (2002), tooth wear was less common in children who were weaned after twelve months than those weaned before twelve months. In this study, even though there was no statistically significant relationship between extent of tooth wear and the dietary risk factors examined, greater wearing of molars was seen in children who drank from a feeding cup or bottle for more than six months. A possible explanation to this is the liquids fed to babies after weaning comprise drinks other than milk (K. Ayers et al., 2002). Food and Nutrition Guidelines by the Ministry of Health (2012) do not recommend giving any fruit beverage or sugary drinks to children. If consumed, it suggests restricting the consumption only to one small serving occasionally (less than once per week). But in the study by Ayers et al.,

fruit-based drinks accounted for over 40% of the daily consumption of the dietary risk factors for erosion among the participants. According to *New Zealand Children's Food and Drinks Survey 2007* (National Research Bureau, 2008), fruit juice is second only to tap water in the most consumed beverages by children aged 5-16 years.

Consumption of sugary drinks and juices by Māori and Pacific children is much higher than children of other ethnic groups (Ministry of Health, 2012). However, even in privileged ethnic groups like New Zealand European, fruit beverage intake by pre-schoolers has notably surpassed the Ministry's recommendation. A study by Theodore et al. (2006) depicts that around 30% of New Zealand European pre-schoolers drank more than one serving of fruit juice per day. In addition to this, 71% of the pre-schoolers consumed at least one serving of juice per week and 50% of them drank at least one serving of milkshake and flavoured milk per week. Here it should be noted that adding milk to fruit beverages adjusts the pH of the drink to some extent, but if the drink contains added sugar it may still be detrimental to teeth (Noble, 2006). None of the studies discussed in this thesis state whether the beverages consumed by the children were home-made or store-bought or demonstrate the differences in their impact.

Recommendations for amount and frequency of fruit beverage consumption

Fortunately there are some ways to reap the nutritional benefits of fruit beverages and avoid its ill effects on teeth. Consuming fruit beverages only during meals, drinking water or plain milk at other times and rinsing mouth after juice consumption can aid in fewer acid attacks and give sufficient time for acid clearance and buffering capacity of saliva (Lee & Lee, 2006).

Diluting the juice with water helps to adjust the pH of the drink to some extent and adding milk adds some benefits of its low cariogenicity discussed earlier. Even Frucor, a leading brand selling fruit-based drinks in New Zealand, advises its consumers to dilute one part of juice with three parts of water for children aged 1-2 years. For 2- to 5-year-

olds, its recommendation is to dilute one part of juice with one part of water and to restrict consumption only during meals rather than in between. Only those over 6 years of age should drink undiluted juice; that too should only be one serving per day, taken with meals (Fruco, 2016). The advice mentioned above is included in the oral health education given by dental providers during dental appointments (Lee & Lee, 2006). However, little is known about to what extent the parents are aware of these recommendations and how much are they motivated to follow these guidelines.

Summary

Different types of fruit beverages contain different percentage of fruits in them, but they cannot be consumed as an alternative for fresh or canned fruits due to their low fibre content and difference in nutrition levels. Literature shows various health impacts of overconsumption of fruit beverages, particularly in children. Detrimental effects of fruit-based drinks on teeth and the dental fillings are also highlighted. Fruit-containing drinks are becoming more popular among young New Zealanders, with increasing sales of ready-made fruit beverages. Following the Ministry's guideline for consumption of fruit beverages, restricting the consumption to meal times and diluting the drinks with water or milk are some recommendations made in order to minimise the dental impacts of these beverages on children. But there is very little information available about awareness, knowledge and practice of these recommendations among parents and primary caregivers of New Zealand.

Chapter 4: Parental Perspectives

Introduction

Parenting, as defined by Savage, Fisher, and Birch (2007), “involves the task of care and feeding one’s children” (p. 8). Every word spoken and every activity of the parents has an influence on their children. They are the ultimate role models. Savage et al. (2007) argue that since food scarcity has always been one of the major perceived environmental threats to well-being of children, the traditional child feeding practices include feeding frequently in response to demand or distress. However, the major threats to child health in this contemporary world are posed by too much food. It is pertinent to shift the focus to these threats (Savage et al., 2007). This chapter discusses the influence of parents and caregivers on the oral health behaviours of their children; it also provides the rationale for this study.

Children's way of knowing

According to Sheiham and Bönecker (2006), there are basically two types of health behaviours: health-related and health-directed. They state that the health-related behaviours are needed to maintain health but are not carried out mainly for health reasons. For example, most people brush their teeth as part of body hygiene, feel and freshness, which in turn helps in maintaining dental health. These habits are typically learned at a very young age from their parents, friends or significant individuals. On the other hand, health-directed behaviours are usually carried out when the individual is concerned about health or when there is a threat to health. In this regard, brushing in the morning can be health-related and bed-time brushing can be health-directed. Individuals show different levels of readiness to follow health-directed behaviours. Dietary habits of parents and the education given by dental professionals need to be more health-related

to be religiously followed by children (Sheiham & Bönecker, 2006). The same concept can be applied for fruit juice consumption.

Parental influence

For at least the first few years, parents select the foods of the children's diet which may later serve as models of eating patterns and health behaviours in children (Savage et al., 2007). Simultaneously, children rely mainly on their primary caregivers in receiving home dental care and to access professional dental services. As previously discussed, oral hygiene habits and poor oral health knowledge of parents, along with their readiness to seek dental advice, has strong influence on children's oral health behaviour. In support of this, a meta-analysis has also confirmed the association between parental and child dental anxiety, particularly in those 8 years old or younger (Themessl-Huber, Freeman, Humphris, Macgillivray, & Terzi, 2010). A study in the United States showed a strong correlation of impact of parental influences in the aetiology of ECC (Weatherwax, Bray, Williams, & Gadbury-Amyot, 2014).

In an Australian study (Plutzer & Spencer, 2008), oral health education administered during pregnancy for first-time-mothers was helpful in reducing the rate of ECC in their children. Interestingly, telephone consultation at six and twelve months showed that the retention of information was greater among mothers with low literacy levels. From this study it appears that the mothers with lower levels of education were more interested than mothers with higher education to extend their knowledge and parenting skills when there was an opportunity to learn.

Evidence from New Zealand

The Health Promotion Agency (2015) recently conducted a literature review on oral health in pre-schoolers. The review confirms the limited availability of New Zealand data on overall oral health knowledge, awareness and practices of parents. In this regard, only three completed studies and two surveys were identified. One study (Schluter,

Durward, Cartwright, & Paterson, 2007) included Pacific pre-schoolers and mothers. This study finds a lack of understanding of good oral health practices in children along with mothers' negligent attitude towards primary teeth.

Overall oral health literacy levels of parents were assessed in a Christchurch study (Veerasamy, 2010). Despite 61% of the participants included in this research having university-level education, only 21 % of participants showed good oral health literacy level, while 41% and 38% of participants had moderate and poor oral health literacy respectively.

A study (Rothnie, Walsh, Wang, Morgaine, & Drummond, 2012) carried out in Dunedin on expectant mothers' knowledge of child oral health care illustrated that a substantial number of pregnant women had insufficient knowledge about providing appropriate oral health care to their future children despite the available information. In this study more than half of the participants were not first-time mothers. Although 98% of the participants believed oral healthcare was important for their child, they were uncertain about appropriate home oral health care methods—particularly younger mothers, first-time mothers and those from low socioeconomic groups. It should be noted that the review by the Health Promotion Agency excluded studies which focused on dietary factors alone.

According to the *2007 New Zealand Children's Food and Drinks Survey* (National Research Bureau, 2008), a majority (85%) of parents and caregivers reported that fruit juice was available in their home and when it was available, 93% of them noticed that their child drank fruit juice. Other juice (juice-from-concentrate, powder and cordials) were also available in 56% of homes. Around nine out of ten parents and caregivers from these homes said that their child drank it when it was available, while 23% of them said that their child drank daily or more often. When broken down by age groups, 21% of parents and caregivers of children aged between 8-12 years and one quarter of parents and caregivers of children aged between 5-7 years said that their children drank fruit juice daily or more often when available. The percentage for other juice consumption

was 23% and 19% for 8- to 12-year-olds and 5- to 7-year-olds respectively. Availability and reported child consumption of fruit juice was more common in the homes of Asians and Europeans/other when compared to Māori and Pacific homes. In contrast, availability and frequency of consumption of other juice by children was higher in Māori and Pacific peoples than Asian and European/other groups.

Around 42% of parents and caregivers regularly monitored their children's food and drink intakes when they were away from home whereas 14% of parents never monitored. Around six out of ten parents and caregivers kept a watch on their children's food and drinks consumption between meals at home, one in ten did this rarely and one in ten never monitored their children's between-meals food habits (National Research Bureau, 2008)

Rationale of the study

There are many school-based nutritional health programmes at local and national levels. Initiatives such as 'Fuelled4life', 'traffic light system', 'water-only schools' are some examples. Fuelled4life is a programme managed by the Heart Foundation and it is based on the Food and Nutrition Guidelines of Ministry of Health. This initiative offers food and beverage suggestions to the people involved in selecting food and beverages mainly in schools and preschools. Food companies can register their products with Fuelled4life if the items meet the nutrition criteria of the 'Food & Beverage Classification System' (Heart Foundation, 2012).

The traffic light system is a food and beverage classification system using green, amber and red colours. Green is for healthy options (including water and unsweetened milk), amber for drinks that can be consumed in moderation (including fruit juices up to 250 ml and fruit drinks up to 350 ml) and red is for options that are unsuitable for regular consumption (drinks that are high in calorie but low in nutritional value, including those with bigger pack sizes). Beverages that are in the red category are not to be sold in school premises (Waitemata District Health Board, n.d.).

Ministries of Health and Education are encouraging schools to sign up to the 'water-only' policy by becoming free of sugary drinks. This policy does support consumption of plain milk. By 2015, 10% of schools in New Zealand were water-only ("2016: The year of the water-only school?," 2016, March 21).

Apart from the studies and surveys discussed in this thesis, there is very little known in New Zealand about the understanding of parents and guardians of dental impacts of fruit beverages and their responsibility in controlling the problem. Since both home-made and commercial juices contain NMES and low pH, they can affect dental health, yet, raising awareness about commercial fruit beverages specifically can be a prudent course of action; 'market fruit beverages' are more easily accessible and storable than making fresh juice every time, so are more frequently consumed. Additionally, commercial fruit juices may contain considerable amounts of added sugar, even if the label says 'contains no added sugar' (Ministry of Health, 2012). The Food Standards Australia New Zealand (2012) states,

The amount of sugars in the nutrition information panel will include naturally occurring sugars, such as those found in fruit, as well as added sugar. Note the products with 'no added sugar' nutrition claims may contain high levels of natural sugars. (para. 13)

The NZJBA (2013) states that juices that claim to be pure can legally have up to 4% of added sugar.

Rationale for label reading

Guiding individuals in self-management facilitates improvement in their health knowledge, thus helping them to follow health instructions more precisely (Coulter, Parsons, & Askham, 2008). Improving oral health literacy is a very effective measure to help individuals make healthier choices and is important for informed decision-making regarding their children's health (Ministry of Health, 2008b). This in turn may reduce the fiscal burden on the government caused by poor dental health of children of New Zealand.

Commercial fruit beverages allow assessment of nutritional quality through label-reading. Literature shows a gap in knowledge about whether parents and caregivers of New Zealand have sufficient awareness of the dental effects of these products. Label reading might help to examine the discrepancy between parents' self-reporting of their knowledge of health effects of fruit beverages and their actual shopping-practice. A study by University of Minnesota researchers compared self-reporting of label-reading behaviours of consumers with their actual behaviours with the help of a robust computerised eye-tracking device. While 24% of the respondents claimed that they almost always looked at the sugar content of the products, the eye-tracking device recorded only 1% of the respondents actually doing that (Graham & Jeffery, 2011). Collecting information about parents' choice of brand and sub-brand of beverages could be a simpler and more cost effective method to compare this discrepancy. Data from this study might also help to understand the factors that influence parents' choice of type and brand of fruit beverages.

Summary

Parents select the foods for their children, which may later serve as models of their eating patterns. Health-related behaviours of parents are often religiously followed by children. There is evidence to show that understanding the parental perspectives and factors influencing the selection of fruit beverages are important for more precise oral health promotion. Although all fruit beverages have damaging effect on teeth to some degree, commercial fruit beverages are sold in different forms with different proportions of natural and added sugars. They also tend to increase the frequency of consumption, thus are more destructive to teeth.

Chapter 5: Methods

Introduction

This study utilised a quantitative descriptive format to explore the awareness level of parents and caregivers about dental effects of commercial fruit beverages. This chapter gives an outline of materials and methods used to achieve the study objectives. It includes the study design, sampling method and data collection process involved. Ethical and recruitment issues specific to this study are also discussed.

Study Setting

The study was carried out in the Auckland region, including all twenty-one local board areas of the Auckland Council (Figure 4). This region was selected because 34% (approximately 1.5 million) of the population of New Zealand reside in Auckland region. Auckland is also home to a more culturally diverse population than other regions of the country. According to the 2013 Census, Europeans made up almost 60% of the population while 11% were identified as Māori, 15% as Pacific people, and Asians made up almost a quarter of the total population (Auckland Council, 2014). It should be noted that the rates of all ethnic populations do not add up to 100% as the Census allowed the respondents to identify themselves with more than one ethnicity.

Study Design

The study was designed to assess the awareness of parents and caregivers regarding dental effects of commercial fruit beverages on their children's teeth. Consequently, knowledge was selected as an independent variable while an effect of fruit beverages on children's dental health was a dependent variable. In this regard a cross sectional approach was considered appropriate for identifying descriptive information about the knowledge of the participants (Gordis, 2009). This study did not involve testing the

association between knowledge of participants and dental health of their children. New information obtained from this study may be later used to hypothesise for further research and as such is an exploratory study. A survey questionnaire was used as an instrument in this design.

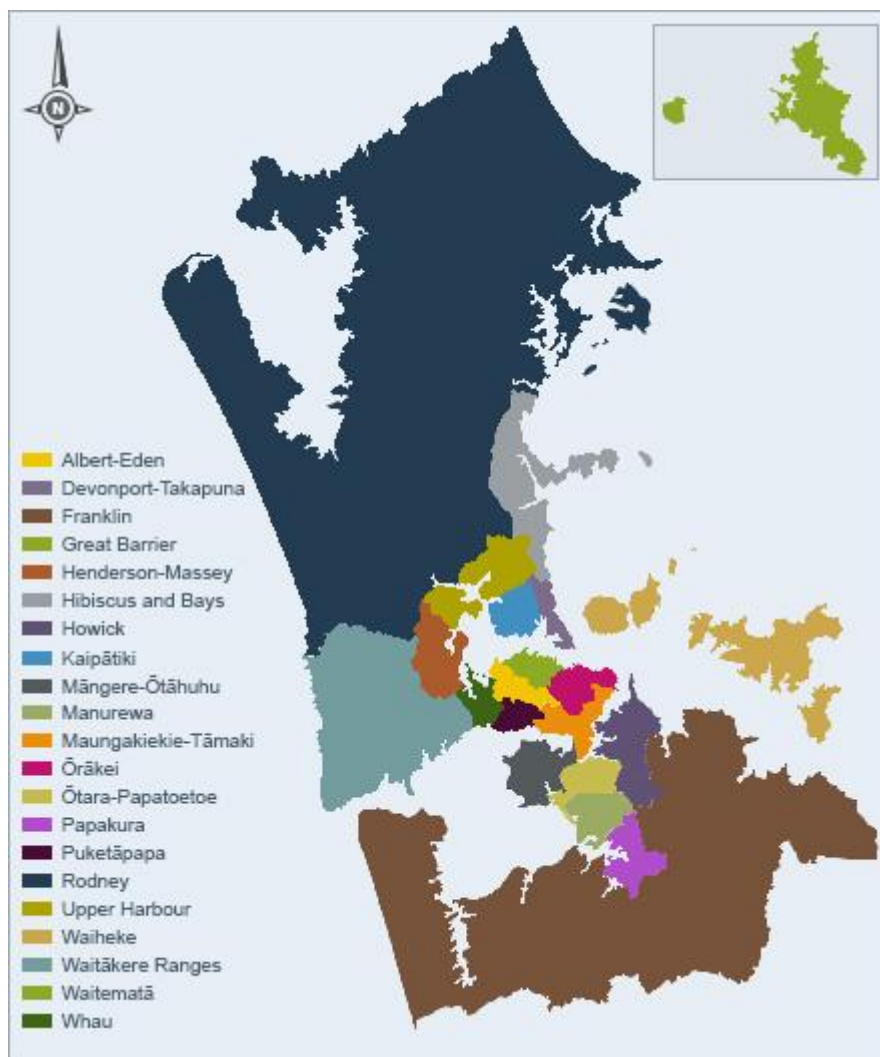


Figure 4. A map showing the twenty-one local boards of Auckland region. Retrieved July 15, 2016, from http://www.aucklandcouncil.govt.nz/EN/AboutCouncil/RepresentativesBodies/LocalBoards/Pages/home.aspx?utm_source=shorturl&utm_medium=print&utm_campaign=Local%2BBoards Copyright 2016 by Auckland Council. Reprinted with permission.

Study Population

The study participants were parents and caregivers of children aged between 1-10 years and residing in the Auckland region. Caregivers may be grandparents or guardians, which was made explicit on the participant information sheet (Appendix A). Considering the susceptibility of the primary teeth to erosion and the challenge of controlling cavities in young children, this age group was targeted. Infants under twelve months of age were excluded from the study. The reason is that usually the first tooth starts to erupt only after the age of 6-7 months (Phillips, 2006). Between 6-12 months is also the age range when many parents consider weaning their infants from breastfeeding and begin to introduce other liquids (K. Ayers et al., 2002). Therefore, infants under 12-months of age are less likely to have major dental impacts caused by fruit beverages. Similarly, children older than 10 years of age were not included in the research because they are less influenced by their parents' dietary choices than their younger counterparts (Lee & Lee, 2006). They have better dexterity and motivation to brush their teeth and the capability to understand health messages. Using fluoride toothpaste is also safer in this age group (Lee & Lee, 2006).

Participants included in the study were required to have basic English reading and writing skills. Those with insufficient English fluency might have had to rely on others to read and understand the participant information sheet and to answer the questionnaire, which could have led to privacy and response issues.

Sampling method

Sample size

The sample size for this study was selected with an aim of detecting statistically significant findings that are generalisable to the population of Auckland. Since the study population for this research was parents and caregivers of children aged 1-10 years, an approximate total number of eligible respondents was calculated using the data from

2013 New Zealand Census (Statistics New Zealand, 2014). According to the Census, the total number of families (including couples, single parents and grandparents in parental roles) with at least one child aged between 0-9 years living in the Auckland region was approximately 126,495, so the population size used to calculate sample size was 130,000. Rothnie et al. (2012) used similar research methodology to assess the oral health knowledge in pregnant women of Dunedin. In this study 325 questionnaires were handed out, with a 30% (104) response rate. Therefore, this response rate was considered as the expected frequency. For a study with the population size of 130,000 and expected frequency of 30%, a sample size of 322 subjects was needed to estimate the awareness level with 95% confidence interval (CI) and 5% desired margin of error. The sample size calculation was validated using 'EPI Info' software developed by the Centers for Disease Control and Prevention (Mobile application software/2015). After adjusting for unusable questionnaires the sample size was increased to 500.

Recruitment

A self-selection sampling method was chosen to ensure randomness to the sample (Engel, Jann, Lynn, Scherpenzeel, & Sturgis, 2015). As shown in Figure 5, the sampling frame consisted of lists of Plunket clinics, primary schools and early childhood education centres (ECE Centres) in the Auckland region. Information about Plunket clinics was collected from Plunket's Clinical Services Managers. Contact details and service details of primary schools and ECE centres were obtained from 'Education Counts', an online directory sponsored by the Ministry of Education (Education Counts, 2015). The coordinators of these educational institutions were contacted and sought permission to include the parents of their students in the survey. To those who agreed, a common tailored email was sent. The email had all the information about the study with a link to the online survey. This email was then forwarded by the coordinators to the parents and caregivers. Parent-Teacher Associations (PTAs) of many schools were also approached with a request to send the email invitation to its parent members as a group email.

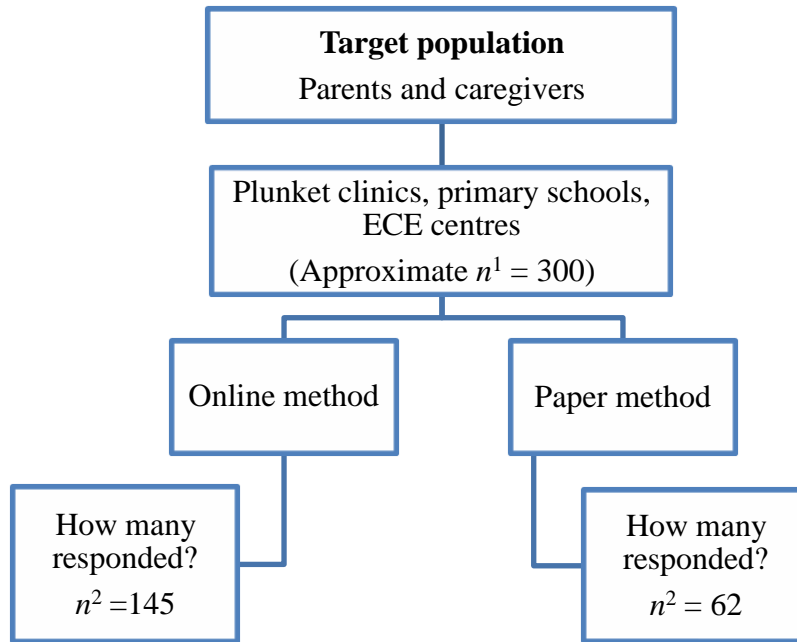


Figure 5. Flowchart of selection of participants. n^1 = number of institutions approached; n^2 = number of responses.

Advertisements (Appendix B) sharing necessary information about the study with a link to the online survey were put up on the walls of Plunket clinics. The advertisements had vertical tear-off tabs with the survey link. Plunket care providers also handed out the participant information sheets to eligible parents and caregivers.

Control of bias

For the purpose of controlling selection bias the survey was conducted anonymously. As Aldridge and Levine (2001) argue, people are more sceptical about how the information revealed by them could be used. In this regard, guaranteed anonymity might give more assurance to the participants to be more truthful than they would be in a face-to-face method (Aldridge & Levine, 2001). No face-to-face contact with the participants was made. No contact information of any participant was shared with the research team. The anonymity of the survey was also anticipated to minimise interviewer bias as the research team could not identify the respondent. A self-administered questionnaire was

used for data collection. As suggested by Engel et al. (2015), self-administered modes are likely to yield more honest responses, particularly in studies involving self-reporting of behaviours, thus minimising response bias.

Control of coverage issues

Some studies favour the internet-based survey for its advantage of reaching a large population in short time. It is also more cost effective than other methods (Engel et al., 2015). In contrast, some studies also focus on reduced representativeness of participants who take part in online surveys, owing to coverage and selection bias (Khazaal et al., 2014). Traditional paper-and-pen method helps to include people with less computer literacy or those who have limited access to the internet (Engel et al., 2015). In a study by Mayr et al. (2012) there was a significant demographic variation between respondents who preferred web-based surveys and those who preferred paper-and-pen method. Since one of the objectives of this study was to compare the differences in awareness levels across age, education levels and socioeconomic status of parents of various ethnic groups, both written and online questionnaires were used. Mixed mode designs help in improving response rate, reduce under-coverage issues and avoid social desirability bias (Engel et al., 2015).

Due to the anonymous nature of the survey, the research team was unable to directly approach eligible parents and caregivers to encourage them to complete the survey. The participants were approached from all wards of the Auckland region. Efforts were also made to encourage parents of Waiheke and Great Barrier Islands to take part in the survey. Māori-based educational institutions were contacted with the email invitation to encourage Māori participation. Similar attempts were also made for other ethnicities in order to draw a representative sample. The coordinators of most of the Māori and Pacific peoples' schools and preschools contacted said that their clients had a low level of computer literacy so preferred paper questionnaires. However, despite the frequent reminders by the school staff, Māori and Pacific participants were less keen to return the completed questionnaire.

Instrument

Questionnaire design

Questions used in the survey questionnaire (Appendix C) were formatted in simple English in order to be easily understood by a person with a secondary school education. The questionnaire began with a question about how many of the respondents' children were under ten years of age; information about their age and gender were also sought. The purpose of this question was to examine the association between the awareness levels of the participants and number of children they had. This question was placed in the beginning of the questionnaire to confirm that the respondents had children in this age group before they proceeded to answer other questions. Options were given up to five children, with an assumption that participants were less likely to have more than five children aged less than ten years.

Other items in the questionnaire were categorised into three sections: (1) Section A: Products and influence; (2) Section B: Knowledge, activities and information source; and (3) Section C: Demographic information. The questionnaire was comprised predominantly of closed-ended questions in order to make it easy for the participants to understand and choose appropriate options; however, four closed-ended questions had the 'other- please specify' option where the respondents could bring up any options other than listed. Three questions were left open-ended to encourage free expression of the subjects' own knowledge and/or feelings/practices. Four of the closed-ended questions used had five-point Likert scales with "agree", "strongly agree", "neither agree nor disagree", "disagree" and "strongly disagree" options. Two questions used ordinal scales from one to five to rank the dental harmfulness and preventive activities related to fruit juice consumption.

Questions about demographic information

The demographic section was placed near the end of the survey in order to avoid survey fatigue. Demographic information included gender, age group, ethnicity, education level

and annual household income of the participant. Education level and household income were used as the indicators of socioeconomic status of the participants.

Information about age of respondents in years was sought by using five groups with the class interval of five years from '24 or less' to '45-49'. After that, a class interval of ten years was used for 50-59 with an assumption that few respondents in this age group have children aged less than 10 years. The ethnicity question, as used in the New Zealand Census 2006, gave multiple options to participants based on their cultural affiliation rather than their race or citizenship (Statistics New Zealand, n.d.). The options given were: New Zealand European, Māori, Samoan, Cook Island Māori, Tongan, Niuean, Chinese, Indian, European and Other. For education, options given were: secondary school, diploma, technical college, university graduate, postgraduate and other. Information about annual household income was sought using the following income bands: \$30,000 or less, \$30,001–50,000, \$50,001–70,000, \$70,001–100,000, \$100,000 or more and not stated. The suburb where the participant lived was asked using an open-ended question to ensure that the study included participants from all wards of the Auckland region.

Questions about product and influence

The questionnaire had a section related to average purchase of fruit beverages in household shopping and average consumption by children. Respondents were requested to name the brand and fruit content of the beverage they chose for their child and factors that influenced their choice. This aspect was considered important in order to understand the discrepancy between what is known and what is feasible when parents make these choices. The common brands and types of beverage preferred by the respondents were later compared through label-reading.

This part also focused on assessing participants' knowledge of difference in fruit content and sugar levels in different types of fruit beverages available in the market. Other questions included were about the opinion of respondents regarding presence of stevia in

the child's drink, reasons behind giving fruit beverage to children and the anticipated impact of availability of commercial fruit beverages on the amount and frequency of their children's consumption.

Questions about knowledge, activities and information source

The section about knowledge, activities and information source included questions to assess respondents' perception and knowledge about the dental effects of store-bought fruit beverages on their children. It covered regular practices in amount, frequency and type of fruit beverage consumed, and precautionary measures followed to prevent common dental problems caused by these beverages. The source of information obtained in the past year by the respondents about their child's oral health was also collected.

Questionnaire validation

This research was undertaken as part of a Master of Public Health programme. Therefore, the questionnaire used for this study was not formally validated due to time constraints. The demographic information obtained through the questionnaire was, however, based on the standard definitions used in the New Zealand Census 2006. Questions related to amount and frequency of fruit beverage consumption in children were adapted from the food frequency diary used in *2002 National Children's Nutrition Survey* (Ministry of Health, 2003). Questions related to purchase and factors influencing purchase of fruit beverage were adapted from a small marketing research project conducted by students of the Institute for Integrated Learning in Management–Graduate School of Management in India (Bardhan, Jha, Jaiswal, & Alam, n.d.). Other questions were developed specifically for this study considering their face validity. The questionnaire was peer-reviewed by the staff of the Oral Health Department of Auckland University of Technology (AUT).

Pilot testing

Pilot study assessments were utilised for proper planning and execution of the main study and also to finalise the *pro forma* to be used for collection of data. The questionnaire was pilot tested with fifteen participants to confirm that the questions were comprehensible and acceptable to potential participants. Before carrying out the pilot survey, only parents and guardians were included in the survey. After the pilot testing, grandparents were also included in the inclusion criteria. Age group '60 and over' was also added in the demographics section with an assumption that most of the grandparents will be in this age group. No other major changes were required for the questionnaire, however some ethical issues identified in the participant information sheet were rectified.

Data collection

The survey for this study was accessible between May and July 2015. Label-reading of the market fruit beverages was done in April 2016.

Ethics approval

The study proposal was first approved by Auckland University of Technology Ethics Committee (AUTEC) on 30 January 2015 (Reference number: 14/388). Since Plunket was also involved in recruitment, ethical approval was secured from Plunket Ethics Committee as well on 15 March 2015.

Informed consent

Both online and paper questionnaires included a participant information sheet at the beginning, which explained the details and rationale of this study. Responding to the survey questionnaire was considered as consent to participation, which was made explicit in the participant information sheet provided.

Online approach

For the online survey, SurveyMonkey online survey software was used because this was more familiar among potential participants than other survey software packages considered. Evidence shows that people tend to respond better to survey invitations from familiar sources than those that come from unknown or less familiar sources (Fowler Jr, 2013).

Offline approach

While the administrators of many ECE centres agreed to advertise the online version, there were a few institutions where the coordinators notified that their clients had limited access to the internet due to their lack of computer literacy and availability of a computer and/or internet. In such cases, a bundle of paper questionnaires was sent to the school staff to distribute among the parents. Paper copies of the questionnaire were given to participants who preferred the conventional paper-and-pen method. The staff of the institutions took responsibility for reminding the parents to complete the survey and to return the paper copies. The filled paper questionnaires returned to the staff were collected from the schools and ECE centres.

Label reading procedure

In order to assess the understanding of oral health literacy level of the participants, they were requested to name the brand and fruit type of the store-bought beverage their child drank often. If there was no specific choice they were also given an option to tick 'No specific choice'. Popular brands and fruit types among the participants were then studied for their fruit and sugar contents.

The ingredients lists of the beverages were examined for percentage of juice from fruits and vegetables and presence of added sugar. Hidden added sugars with alternative names (such as sucrose, glucose and cane juice solids) were also spotted. The nutritional panel of the beverage was studied as per the labelling guidelines from the Food

Standards Australia New Zealand (2012). The Food Standards Australia New Zealand specifies that any type of added sugar or alternative sweetener present in the drink must be declared in the ingredient list. However, it does not mandate the companies to declare the amount of added sugar or sweeteners present in the drink. In the nutrition panel the amount of sugar depicted includes natural sugars, such as those found in fruits and vegetables and also added sugars. Since both natural sugars and added sugars present in fruit beverages are equally detrimental to teeth, this component was considered. For the convenience of comparison with similar products, amount of total sugars per 250 ml of fruit beverage was used for analysis.

Label reading was however only a minor component of this research because there are several brands and combinations of fruit types available in the market; not many participants are expected to remember or stick to a specific brand or type of fruit beverage. Moreover, evidence supports that frequently consumed sugar is more detrimental in terms of dental decay than the total amount of sugar consumed at any one time (Caswell, 2009). But this component of study was anticipated to provide an insight into the level of awareness of the parents and other factors that influence their choice.

Data entry, data cleaning and reclassification

Online responses from SurveyMonkey were directly downloaded from the website as an MS-Excel file. Paper responses were manually entered into the file. Later it was imported into SPSS software package for analysis. Data cleaning was done using logical checks such as removal of unusable questionnaires and ensuring that the age of the children of all respondents was listed in descending order.

Reclassification of demographic variables

Even though attempts were made to include all ethnic populations of New Zealand, obtaining a representative sample for all ethnic groups was not possible. Participants from some ethnic groups were too few to do further analysis. Therefore, for ethnicity results the respondents were regrouped into two major groups: ‘Europeans’ and

‘Others’. Europeans and New Zealand Europeans were included in the European group. All other ethnic populations were re-classified into the ‘Others’ group due to their small numbers when considered individually. This classification was made only to make the labels of variables more meaningful statistically; future studies with larger participant bases will be able to explore ethnicity variables with wider breadth and depth.

Similar issues were encountered for age, education level and household income. For age of respondents, participants were regrouped into three intervals: under 30 years, 30-39 years and 40 years and older. For education level, the respondents who had studied up to secondary school, diploma or technical college were merged into a diploma/technical college group due to their small number when considered separately. The number of participants with university graduate degrees and postgraduate education was however analysed without any modification. For annual household income, the respondents were reclassified into three major groups: those who earn up to \$70,000, whose earnings are above \$70,000 and not stated. Cut-off income level of \$70,000 was chosen as it was close to the median household income of Aucklanders as stated in 2013 Census, which is \$76,500 (Auckland Council, 2014).

Re-classification in Section A of the questionnaire

Initially five options were given for the question regarding amounts of fruit beverage bought in a week. However, for analysis purpose the options were regrouped into three groups: ‘half litre or less’, ‘one litre’ and ‘two litres or more’. For the question regarding children’s beverage consumption on typical weekends and weekdays, the five options given were regrouped into three options: ‘never’, ‘once a day’ and ‘twice a day or more’. Due to few responses in some groups, the five options given for the question regarding how often they put a juice box in their child’s school lunch box were re-classified into two groups: “never” and “once a week or more”.

Section A of the questionnaire was comprised of some questions that had 5-point Likert scales with “strongly disagree”, “disagree”, “neither agree nor disagree”, “agree” and

“strongly agree” options. At the time of analysis, due to the small number of responses, these variables were collapsed into 3-point scales with “disagree”, “neither agree nor disagree” and “agree” options.

In section B, the questions regarding dental harmfulness of natural and added sugars present in fruit beverages were planned to be asked separately, but due to a typing error both questions were merged in the paper questionnaire. Therefore, only online responses ($n = 144$) were considered for this aspect. These responses were also regrouped into 3-point Likert scale for data analysis.

Data analysis

Since this was exploratory research, descriptive statistics were used to describe the main features of the data, mainly focusing on univariate analysis expressed as frequency, percentages and means. This research also involved a small component of bivariate analysis to compare the independent variables with various covariates. A chi-square test for independence was used to assess the association between demographic variables of the respondents with certain responses related to knowledge and practices related to child’s fruit juice consumption. This test was considered because the responses were categorical variables which were expressed in percentages (Daniel & Cross, 2013). Non-parametric tests were used for some responses that had extreme outliers. The Mann-Whitney U test was used to compare the means of the scores between two independent ethnic groups—Europeans and others—with practices related to child’s fruit juice consumption. This test was considered as it met the criteria for comparing the association of the mean score of activities related to fruit juice between two groups (Daniel & Cross, 2013). The Kruskal-Wallis H test was used to compare mean ranks of two or more categories of independent variables with ordinal dependent variables (knowledge about dental harmfulness of juice consumption and preventive activities) (Daniel & Cross, 2013).

Summary

This chapter outlined the methodology used for this study. Participants for this study were recruited through a self-selection method from Plunket clinics, ECE centres and primary schools. Nutrition panels of the favoured fruit beverages selected were studied for fruit and sugar content. Data analysis on SPSS was done using descriptive statistics, chi-square tests and non-parametric tests. The findings of this study are discussed in the following chapter.

Chapter 6: Results

Introduction

The findings of this study are presented in this chapter. It begins with characteristics of the sample obtained, a demographic profile of the participants and the number of children they had. It also details the average purchase frequency and consumption of fruit beverages and the factors influencing the purchase. It is followed by parental knowledge and preventative activities related to children's fruit beverage consumption and sources for child oral health information. Findings about the association between parental awareness level and their gender, age, socio-economic status, ethnicity and number of children are also presented. The chapter also includes the results of label-reading of fruit beverages chosen by respondents for their children.

Sample characteristics

A total of 207 respondents took part in the survey. Out of those, 145 (70%) respondents completed the online survey while 62 (30%) respondents used the paper-and-pen method. One response in the online survey was unusable with less than 10% of the required information supplied. Hence, 206 responses were ultimately considered for analysis. Less than 10% of respondents failed to respond to some of the questions. Since the study is exploratory, the results are presented with an assumption that the data missing at random (MAR) would not have a significant effect on the statistical power (McKnight, McKnight, Sidani, & Figueredo, 2007).

Demographic profile of participants

Ninety percent of the respondents in this study were females. Nearly half of the respondents were in the age group of 30-39 years followed by 40 and older (36.8%). Nearly 65% of respondents were Europeans with the remaining respondents from other

ethnic backgrounds collapsed into an ‘others’ group. Over 17% of the others group comprised of Māori respondents and 23% were Pacific respondents.

Over 60% of respondents were university graduates and postgraduates. The household income of nearly 60% of the participants was above \$70,000. The demographic characteristics of the respondents are outlined in Table 2.

Number of children

The majority of the respondents had one or two children and a few parents had third and fourth children under the age of 10. The mean age of the first child was 5.48 years old ($SD = 2.76$), second child at 4.62 ($SD = 2.49$), third child at 3.38 ($SD = 2.17$) and for the fourth child it was 2.40 years ($SD = 2.49$). Figure 6 shows the number of children the respondents had.

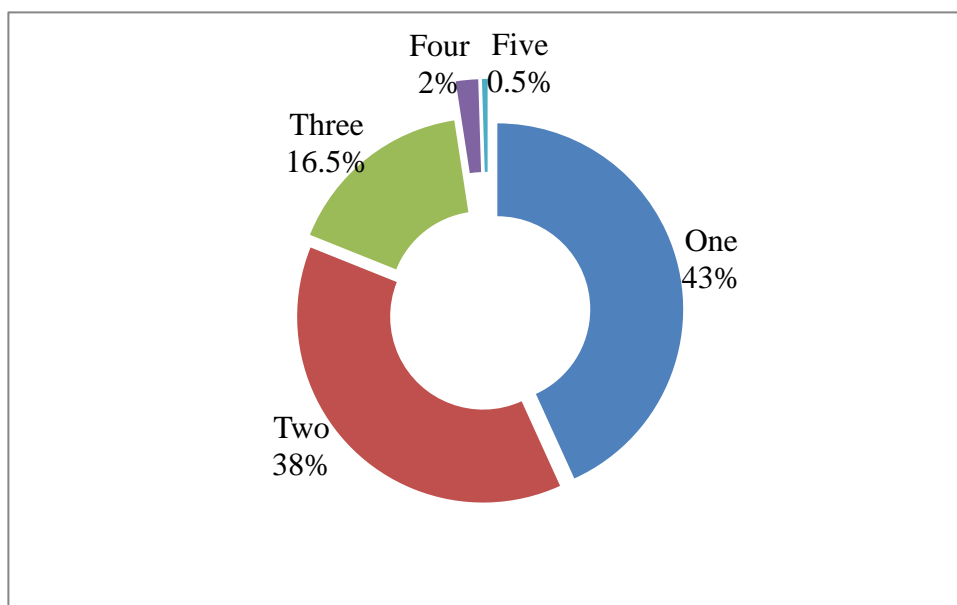


Figure 6. Number of children of respondents.

Table 2.
Characteristics of respondents.

Variable	Number (n)	Percentage (%)
Gender		
Male	18	9.8
Female	166	90.2
Total	184	100
Age (years)		
Under 30	26	14.1
30-39	91	49.2
40 and older	50	36.8
Total	185	100
Ethnicity		
Europeans	125	64.4
Others	69	35.6
Māori	12	
Samoan	4	
Cook Island Māori	3	
Tongan	3	
Niuean	6	
Chinese	14	
Indian	13	
Other	14	
Total	194	100
Education level		
Diploma or Technical college	68	37
University undergraduate degree	76	41.3
University postgraduate degree	40	21.7
Total	184	100
Income		
Up to \$70,000	58	28.1
\$70,001 or more	105	57.4
Not Stated	43	20.9
Total	183	100

NOTE: All responses do not amount to a total of 206.

Results of Section A: Products and influence

Fruit beverage purchased in a week

Nearly 60% of the respondents were buying half a litre or less of fruit beverages in their weekly shopping, followed by 20% who were buying two litres or more (Figure 7).

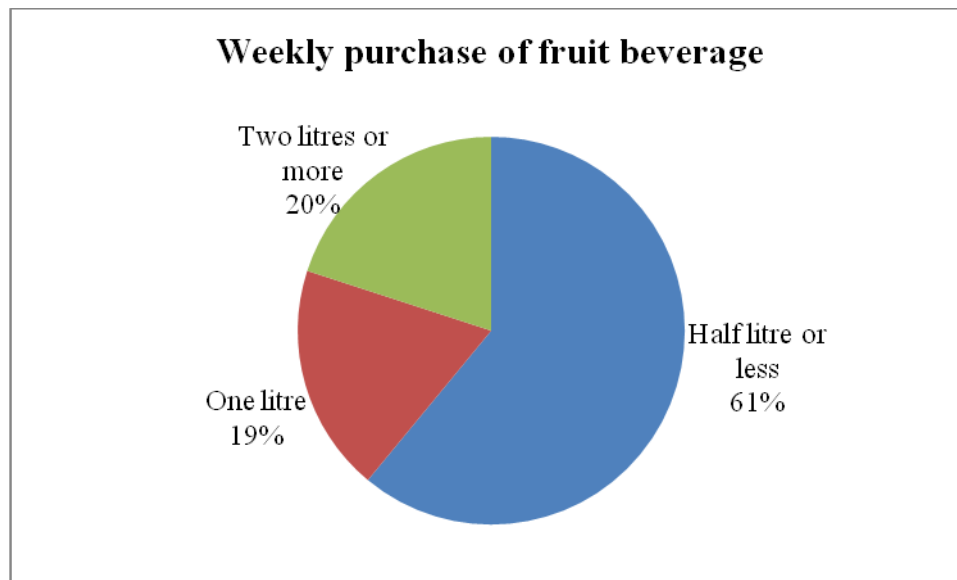


Figure 7. Average purchase of fruit beverage in weekly shopping.

As outlined in Figure 8, the partners of the respondents consume the majority share of beverages bought, followed by respondents themselves, their guests during social occasions, and the least by their children or grandchildren.

Consumption over weekdays and weekends

A minority of respondents (41%) claimed that their children never drank fruit beverages over weekends compared to weekdays (67%). As shown in Figures 9 and 10, children drank fruit beverages more frequently over weekends than on weekdays.

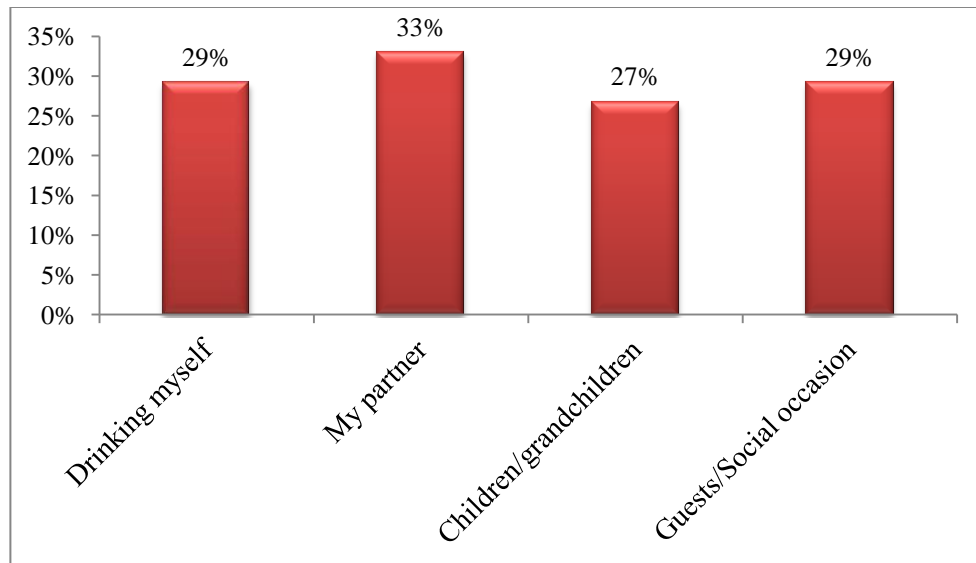


Figure 8. Fruit beverage consumption by family members.

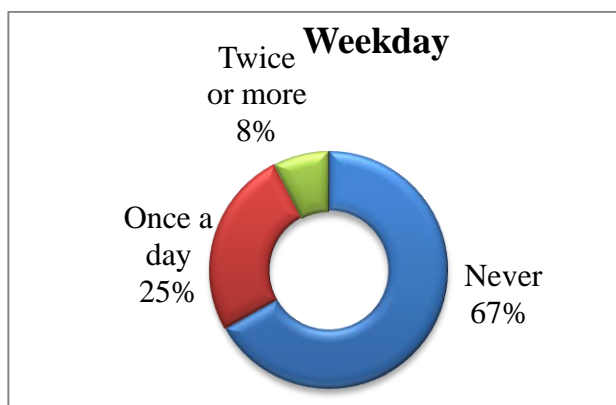


Figure 9. Frequency of consumption of fruit beverage on weekdays.

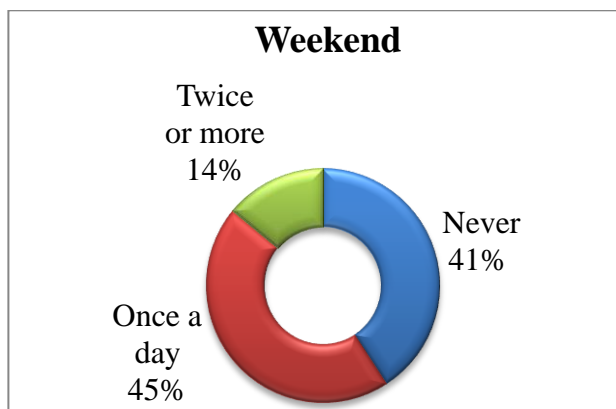


Figure 10. Frequency of consumption of fruit beverage on weekends.

Juice in the lunch box

A majority of the participants (85%) reported that they never put fruit juice in their child's school lunch box. Even those who put a juice bottle in the lunch box did only so occasionally across a week.

Difference between fruit juice and fruit drink

Just over half of the respondents knew that fruit juice contains more fruit than fruit drinks while 8% responded otherwise (Figure 11). Almost 20% of participants were unsure about the right answer. According to 17% of the respondents, fruit drink was only a synonym of fruit juice.

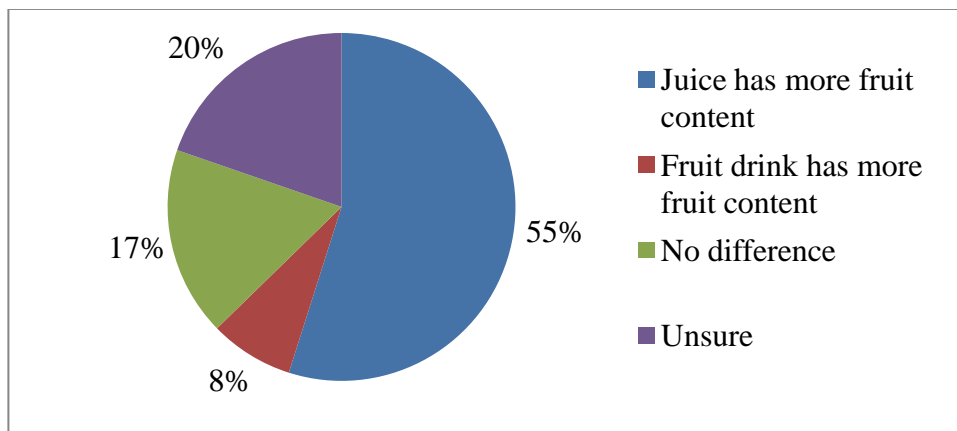


Figure 11. Difference between a fruit juice and a fruit drink in terms of fruit content.

Factors influencing the purchase

The influencing factors on respondents' fruit beverage purchasing have been tabulated in Table 3. Their child's liking for the sweet taste of the preferred fruit beverage was the most important influencing factor while making a choice of brand and fruit-type, with 40% of the respondents in agreement with this.

Availability and convenience of purchase in their neighbourhood and affordable price were other important considerations for their choice. Interestingly, only a percentage of parents and caregivers (14%) looked for the benefits of fruit beverages that had stevia.

Table 3.

Reasons that influence respondents' choice of fruit beverages for their children.

Reasons	Disagree		Neither agree nor disagree		Agree		Total
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Brand name	78	37.9	52	25.3	51	24.8	181
Good for health	92	50.8	43	23.8	46	25.4	181
Child likes its sweet taste	58	32.3	47	24.4	71	40.3	176
Child likes its tangy taste	77	43.6	67	37.8	33	18.6	177
Affordable price	60	33.4	58	32.2	62	34.4	180
Availability and convenience	57	31.8	54	30.2	68	38	179
It has stevia	79	38.3	69	33.5	29	14.2	177

NOTE: All responses do not amount to a total of 206. *n* = number of participants.

When asked about participants' preference to purchase stevia-containing fruit beverages in a separate question, only 12.5% of the participants opted for fruit beverages with stevia for their children. This percentage is comparable with the responses in the previous question regarding stevia (Table 3). Nearly 60% did not buy fruit beverages or fruit drinks which contained stevia, while a quarter of them did not know if stevia was present in the fruit beverage they chose for their children.

Respondents who ticked 'No' for the question: "Do you buy fruit beverages for your child that contain stevia as an alternative sweetener?" were asked about the reason for not buying stevia-containing beverages. This question was answered by 101 participants. A majority of respondents (44%) were sceptical about the safety and effectiveness of the stevia-containing fruit beverages. Around 14% did not know about

stevia and nearly 39% did not want to buy any fruit juice that contained a sweetener for their children. Only a small percentage of respondents reported that their child could not accept the taste. No experience of hypersensitivity reaction to the sweetener was reported.

Reasons to give fruit beverage to children

As depicted in Figure 12, over 70% of the respondents claimed that they give fruit beverages to their children once a week or not at all. One third of respondents gave fruit beverages to their child in response to his/her demand and a small percentage (5%) of them gave it to stop their children from crying or to put them to sleep. Only 18% of the participants gave fruit beverages as a healthy option for their children. In the 'other' option, out of the 27 responses, most of the respondents said that they give fruit beverages to children only as a treat.

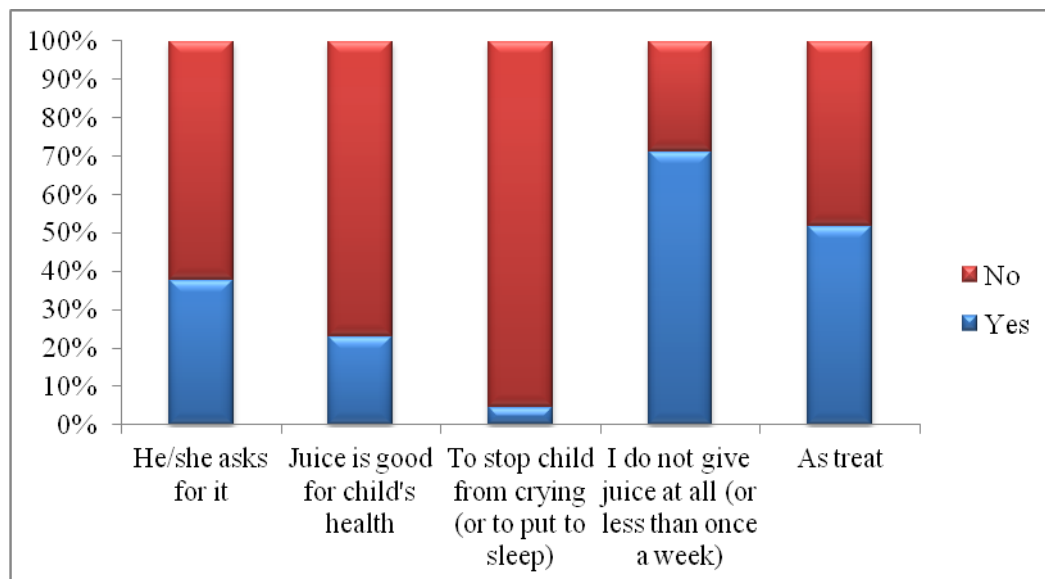


Figure 12. Reasons to give fruit beverage to children.

Server of fruit beverage to children

As shown in Figure 13, around 40% of the parents and caregivers responded that they usually served fruit beverages to their children. A fifth of respondents claimed their children were not served fruit beverages by anybody; this was indicated by ticking the “does not apply to me” option.

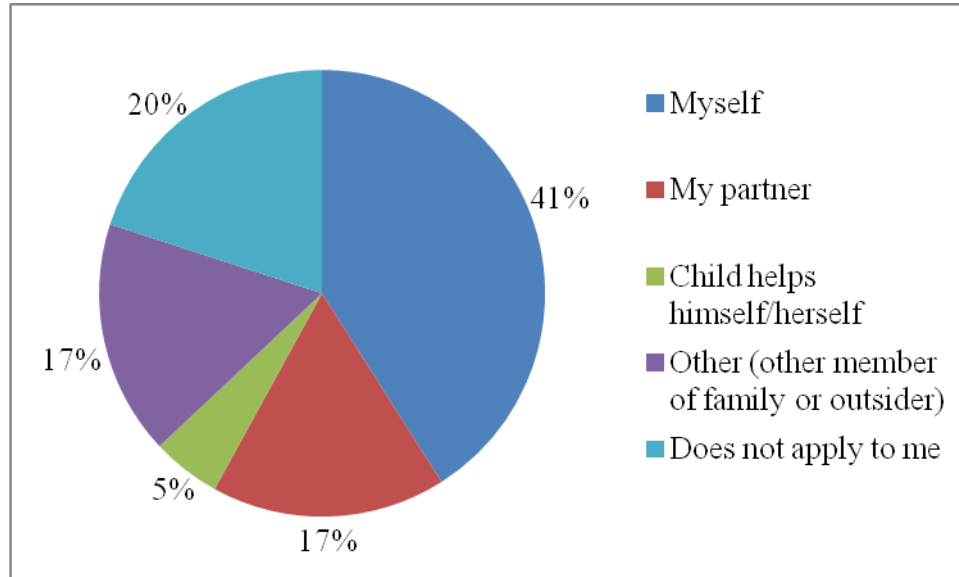


Figure 13. Person who serves fruit beverage to children.

Some respondents claimed that their children were served by their partners or other members of the family or outsiders. Only 5% of the participants indicated that their child helped himself/herself.

Effects of availability of commercial fruit beverage on amount and frequency consumed

Nearly half of the respondents (see Figures 14 and 15) agreed that if readily available commercial fruit beverages were not on the market, there would be a reduction in both amount and frequency of their children’s fruit beverage consumption. Only a quarter of the respondents were in disagreement with this.

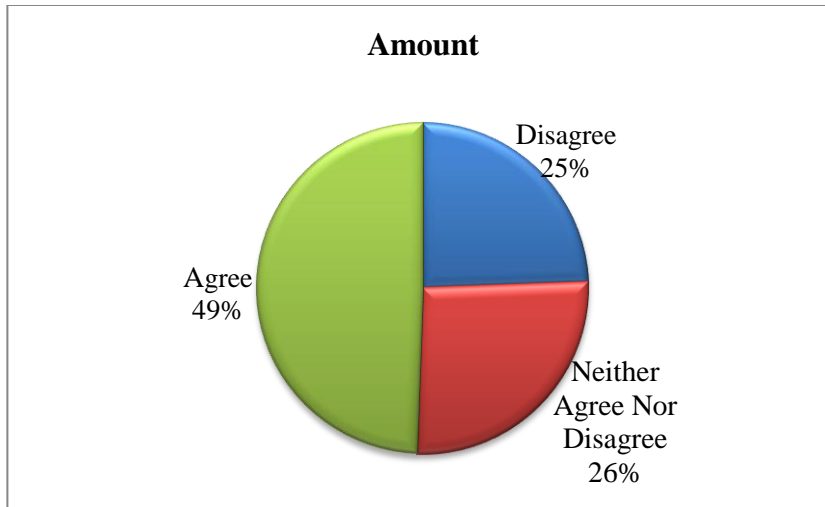


Figure 14. Anticipated effects of availability of commercial fruit beverages on amount of fruit beverage consumption.

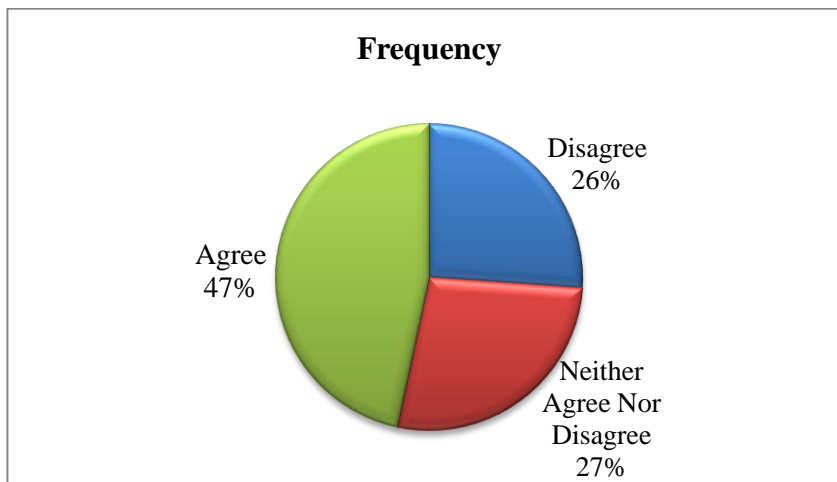


Figure 15. Anticipated effects of availability of commercial fruit beverages on frequency of fruit beverage consumption.

Results of Section B: Knowledge, activities and information source

Dental harmfulness of fruit beverages

As presented in Table 4, most of the respondents agreed that both natural and added sugars in the fruit beverage are bad for teeth. The rate was even higher for added sugar,

with 98% agreeing and only two respondents disagreeing while none ticked “neither agree nor disagree”.

Table 4.

Natural and added sugars in fruit beverages are bad for teeth.

	Natural sugar		Added sugar	
	<i>n</i>	%	<i>n</i>	%
Disagree	10	7.9	2	1.6
Neither agree nor disagree	13	10.3	0	0
Strongly agree	103	81.8	125	98.4
Total	126	100	127	100

NOTE: Online responses only. *n* = number of participants.

Nearly 73% of respondents disagreed that the fruit-based beverages contained lot of fruit, and only around 15% agreed. When asked to identify the agents present in fruit beverages which can cause harm to teeth, more than 88% of the respondents were aware that the sugar and acidity present in fruit beverages affect teeth. Eight percent of respondents, however, believed that only sugar is bad for teeth while 3% attributed harm to the acidic content alone.

Dental harmfulness of behaviours

Knowledge about the dental harmfulness of drinking behaviour of fruit beverages was assessed with a five-point Likert scale. The scale endpoints were labelled with “not at all harmful” and “very harmful”. Mean score of the values shows that drinking juice in small amounts every 20-30 minutes was identified as the most detrimental behaviour ($M = 4.43$) whereas drinking milk and water in between meals was believed to be the safest of all types of behaviours listed with a mean score of 1.44 (Table 5).

Table 5.

Mean scores of harmfulness of some activities to teeth.

Behaviour	<i>n</i>	Mean	<i>SD</i>
Drinking one glass of juice with meal	185	3.12	1.164
Drinking fruit milkshakes	185	2.81	1.086
Drinking one glass of juice in between meals	184	3.77	1.082
Drinking juice in small amounts every 20-30 minutes	184	4.43	0.961
Drinking milk or water in between meals	182	1.44	0.746

NOTE: *SD* = Standard deviation; *n* = number of participants.

Dental health-related activities

Some common dental health-related activities were assessed on a five-point Likert scale. The endpoints of the scale were labelled as “never” and “everyday”. The mean scores presented in Table 6 show that brushing the child’s teeth twice daily was the most common practice ($M = 4.42$) followed by consumption of milk-based drinks (with no or low sugar) with a mean score of 3.86. Rinsing the child’s mouth after consumption of fruit beverages was the least desired activity ($M = 1.92$).

Source of child oral health information

A majority of the respondents (81%) had accessed the free community dental service for their child in the past twelve months. School dental nurses (now called dental therapists) or dentists appear to be the main source of dental advice for child dental health. Some of the respondents have sought advice from media and family and friends (9.7%), while some obtained dental health advice in health class (12%). Fifteen participants (7.3%) did not get any dental advice for their children.

Table 6.

Mean scores of preventive activities related to fruit juice consumption

Preventive activities	<i>n</i>	<i>M</i>	<i>SD</i>
I dilute the juice with water	176	3.22	1.546
The child rinses mouth or drinks water after consumption of fruit juice	173	1.92	1.327
Brush child's teeth twice daily	182	4.42	1.108
I give only milk drinks (with little or no sugar) and water	185	3.86	1.293

NOTE: *n* = number of participants; *M* = Mean; *SD* = Standard deviation.

Association between awareness level and covariates

Number of children

A chi-square test of independence was used to investigate the association between participants' knowledge of the difference between fruit juice and a fruit drink and the number of children they had. According to the study findings, almost 80% of the participants who knew that juice contains more fruit than a fruit drink had one or two children (39% each). This result however was not statistically significant ($\chi^2(6) = 3.545$ and $p = .738$). A Kruskal-Wallis H test showed no statistically significant difference in any of the preventive activities related to fruit juice consumption between respondents with one child, two children and three or more children (Table 7).

Gender of respondents

A chi-square test for independence was performed to calculate the association between the gender of the participants and the availability of fruit beverages in their neighbourhood influencing the selection of brand and sub-brand of a fruit beverage. The

test showed a significant association between the two variables ($\chi^2 (3) = 6.214$ and $p = .04$). Availability of fruit beverages in their neighbourhood store was not as important a consideration for female respondents as their male counterparts. However, since only 10% of respondents in this study are men, this association cannot be generalised to the population.

Table 7.

Preventive activities related to fruit juice consumption among different respondents with different number of children.*

Activity	Number of children of the respondents	<i>n</i>	Mean Rank	Chi-square	<i>df</i>	<i>p</i>
I dilute the juice with water	One Child	73	84.12	.986	2	0.611
	Two Children	70	91.94			
	Three or more Children	33	90.89			
	Total	176				
The child rinses mouth or drinks water after consumption of fruit juice	One Child	72	90.65	.928	2	0.629
	Two Children	68	85.38			
	Three or more Children	33	82.39			
	Total	173				
Brush child's teeth twice daily	One Child	75	89.36	.342	2	0.843
	Two Children	72	93.21			
	Three or more Children	35	92.57			
	Total	182				
I give only milk drinks (with little or no sugar) and water	One Child	76	88.09	1.351	2	0.509
	Two Children	73	95.15			
	Three or more Children	36	99.00			
	Total	185				

NOTE: *Kruskal Wallis Test; *n* = number of respondents; *df* = degree of freedom; *p* = *p*-value.

Age of respondents

The relation between age of the respondents and their weekly purchase of fruit beverages was tested with a chi-square test of independence. The association was

significant ($\chi^2 (4) = 12.39, p = .015$). Most of the respondents who purchased less than half-a-litre of fruit beverages per week were in the age group of 30-39 years, followed by 40 and older (Figure 16). The trend shows that parents aged over 30 years are less likely to buy more than one litre of fruit beverages per week than those aged less than 30 years.

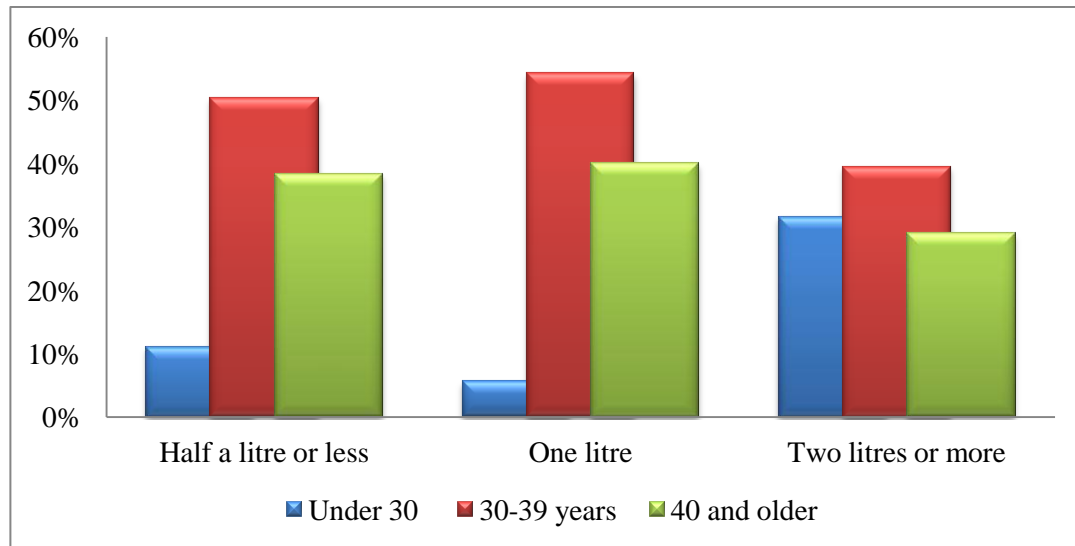


Figure 16. Different age groups of respondents and their responses about the quantity of fruit juice they purchase weekly.

A chi-square test of independence was used to examine the association between the age of the respondents and their child's liking for its tangy taste influencing on their choice of brand and sub-brand of fruit beverage. The difference noticed between different age groups was statistically significant ($\chi^2 (4) = 10.266, p = .03$). As shown in Figure 17, most of the respondents in the 30-39 age group compared to other age groups, disagreed that they would buy a fruit beverage for their child in response to child's liking for its tangy taste.

A Kruskal-Wallis H test showed a marginally insignificant difference in the activity of the child rinsing their mouth or drinking water after beverage consumption between different respondents aged under 30, 30-39 and 40 and older. The results are, $\chi^2 (2) = 5.047, p = .08$, with a mean rank of activity score of 61.81 for respondents aged under

30, 44.14 for those who were aged between 30-39 years and 53.28 for respondents aged 40 and older. This indicated that more respondents under 30 years of age encourage their child to rinse their mouth with water after fruit juice consumption than other respondents. Other preventive activities showed no significant correlation with the age of the respondents ($p > .05$).

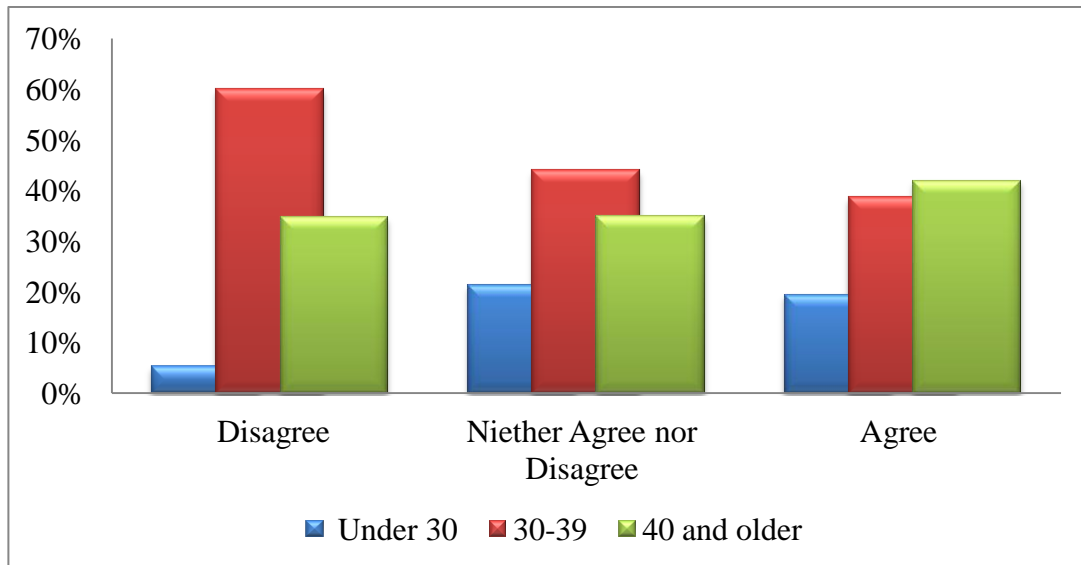


Figure 17. The age group of respondents and their preference to purchase fruit beverage of their child based on child's liking for tangy taste.

Education level

When tested with a chi-square test of independence, there was a significant correlation ($\chi^2 (2) = 10.725, p = .005$) between education level of the respondents and the mode of the survey they preferred. More of the respondents who completed paper questionnaires were educated up to diploma or technical college, followed by university graduates and postgraduates (Figure 18).

Thirty percent of the participants ticked “no” to “I do not give juice at all (or less than once a week)”. A chi-square test of independence was used to analyse the association between the education levels of the participants who answered “no” to this question. A marginally insignificant relation was found ($\chi^2 (2) = 5.696, p = .058$). As shown in

Figure 19, most of the participants were educated up to diploma or technical college or were university graduates. Only a small percentage of respondents with postgraduate education ticked “no” to this question. There was also a statistically significant linear trend ($p = .026$) which infers that as the education level of the respondents increases, the rates for people giving fruit beverage to their children more than once a week is likely to decrease.

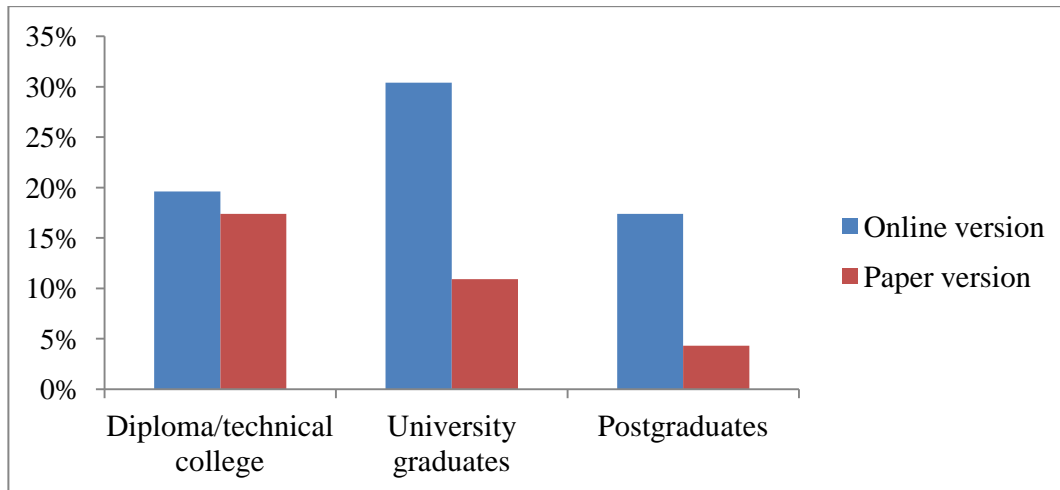


Figure 18. Education level of the respondents and their preferred mode of survey.

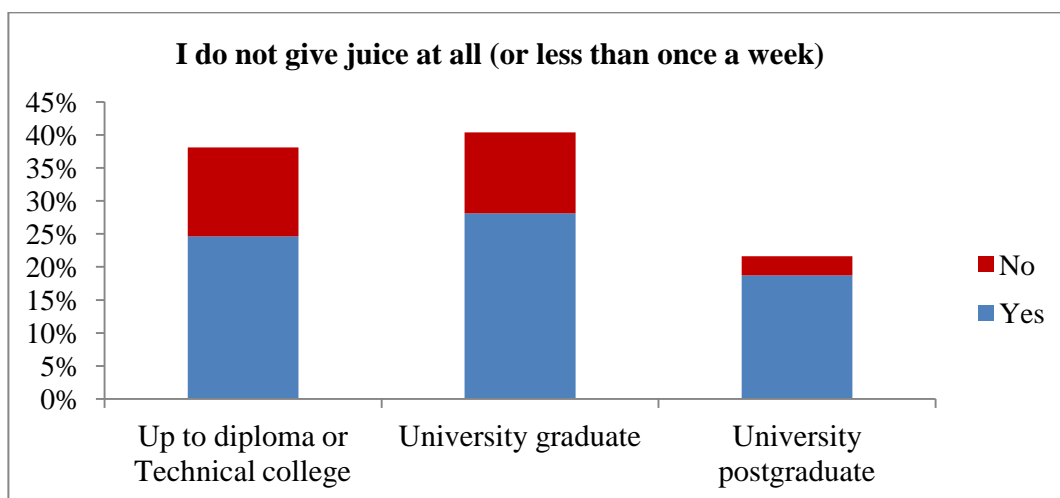


Figure 19. Association between education level of respondents and the practice of giving juice to children less than once a week.

The relation between education levels of participants and the price influencing the purchase of a fruit beverage was tested with a chi-square test of independence. A significant association was found ($\chi^2 (4) = 9.89, p = .04$). This infers that the price determined the preference of brand and sub-brand of the fruit beverage among respondents from different education levels. Respondents educated up to diploma or technical college agreed that price is an important factor in buying fruit beverage (Figure 20).

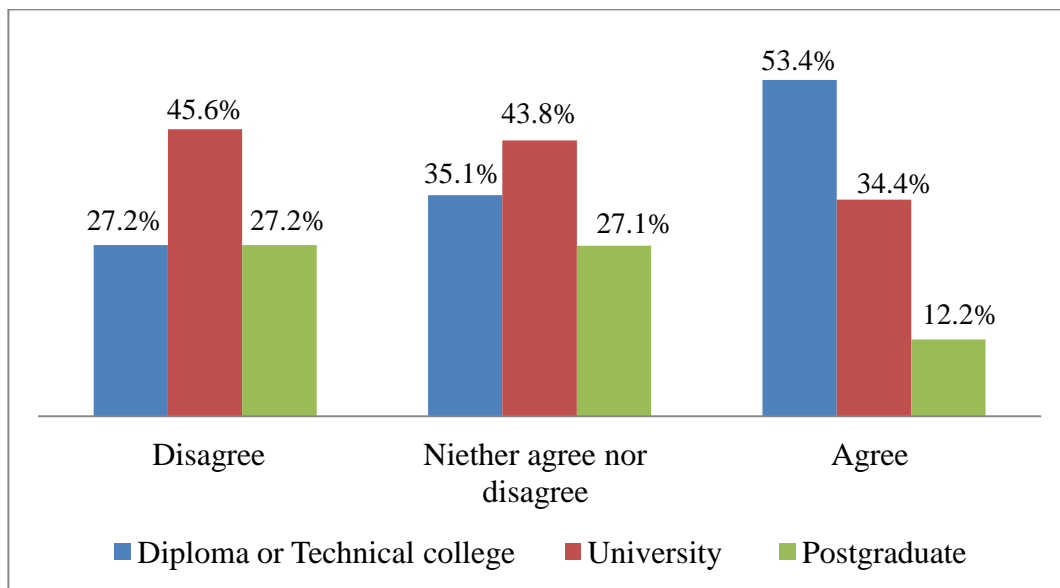


Figure 20. Education level of the respondents and affordability of the fruit beverage influencing the purchase.

The Kruskal-Wallis H test showed a statistically significant difference in the activity: it related “child rinses mouth or drinks water after consumption of fruit juice” to respondents with different educational levels. The results are, $\chi^2 (2) = 11.726$ and $p = .003$, with a mean rank of activity score of 99.58 for the respondent group educated up to diploma or technical college, 73.57 for respondents with university education and 85.32 for respondents with a postgraduate qualification. It infers that more respondents educated up to diploma or technical college ensure their child rinses their mouth or drinks water after fruit juice consumption than other respondents. Other activities related to consuming fruit juice such as “I dilute the juice with water”, “brushing child's teeth

twice daily” and “I give only milk drinks and water” showed no statistically significant difference across different education levels of respondents ($p > .05$).

Ethnicity

A chi-square test of independence showed a significant relation between ethnicity of the participants and their understanding of the difference between fruit juice and a fruit drink ($\chi^2 (3) = 13.07, p = .004$). As shown in Figure 21, approximately 60% of the Europeans agreed that fruit content is greater in fruit juice than in a fruit drink, while the others group was at around 40%.

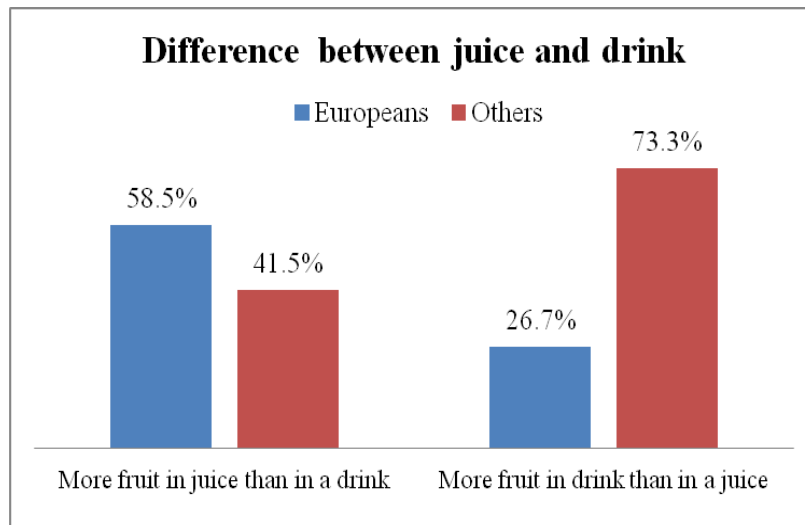


Figure 21. Ethnic breakdown of respondents and their knowledge of difference between fruit juice and a fruit drink.

A Mann-Whitney test showed a marginally insignificant difference in activity related to fruit beverage consumption “I dilute the juice with water” between Europeans and others groups. It indicates that Europeans dilute their child’s fruit juice with water more often than their counterparts from the others ethnic group. The results are, $U = 3133$ and $p = .08$. Other activities related to fruit juice consumption such as “child rinses mouth or drinks water after consumption of fruit juice”, “brush child's teeth twice daily”

and “I give only milk drinks (with little or no sugar) and water” did not show statistically significant results between these two groups ($p > .05$).

The association between ethnicity and respondents’ readiness to seek professional oral health advice could not be tested using the chi-square test due to the small number of responses for some options. However, when the responses were cross-tabulated, the findings showed that more Europeans than non-Europeans had sought advice from a dental professional for their child’s oral health in the past year. Other responses were too small to make an inference, though there is a trend for more respondents from the ‘others’ group than from the ‘European’ group to seek oral health advice from family and friends or not to seek advice at all (Table 8).

Table 8.

Source of child oral health information by ethnicity.

Information source	Europeans		Others	
	<i>n</i>	%	<i>n</i>	%
School dental nurse/community dental clinic/dentist	106	85	61	75
School/health class	17	13	8	10
Media (TV, internet, radio)	20	16	10	12
Family and friends	10	8	11	14
Did not get advice	7	6	8	10

NOTE: *n* = number of participants.

Family income

When calculated using a chi-square test of independence, there was a significant correlation ($\chi^2 (2) = 34.447, p < .001$) between family income of the respondents and the mode of the survey they preferred. More participants among the respondents who

completed paper questionnaires were earning up to \$70,000 than those with a family income above \$70,000 (Figure 22).

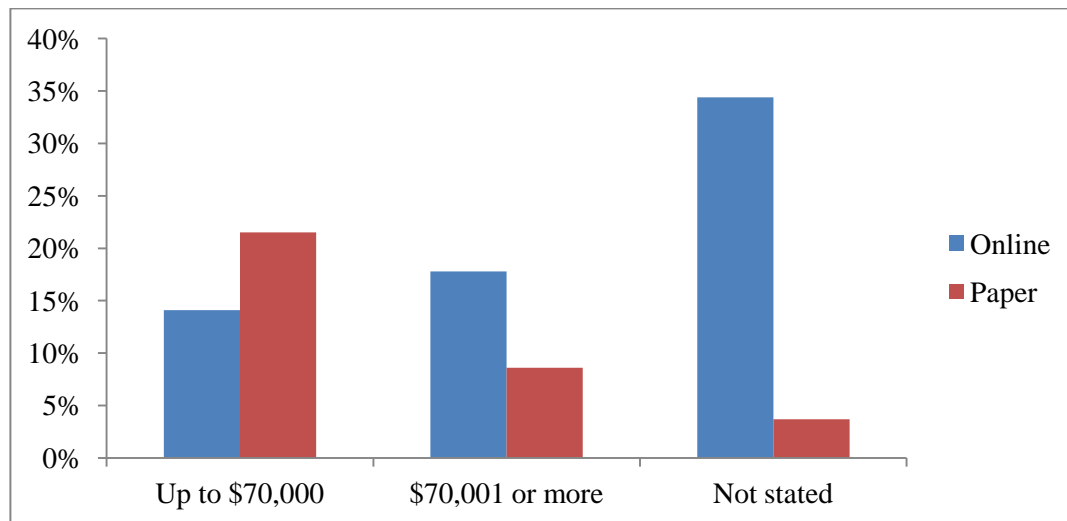


Figure 22. Family income of the respondents and their preferred mode of survey.

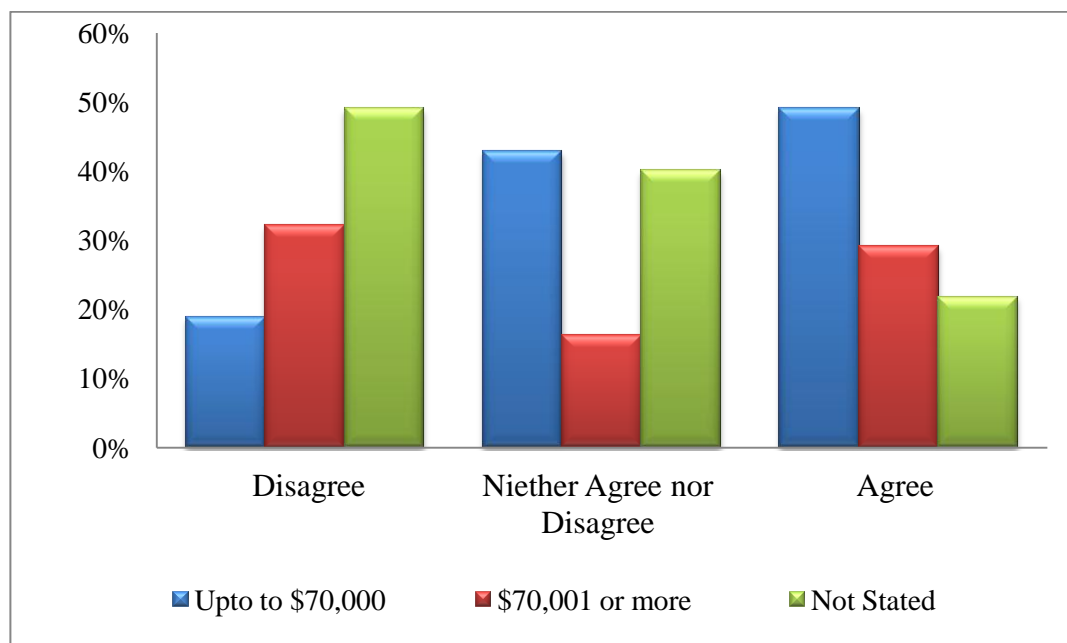


Figure 23. Family income of the respondents and affordability of the fruit beverage influencing the purchase.

The association between income levels of the participants and the price of the fruit beverage influencing the purchase was calculated using a chi-square test of independence. The association was statistically significant ($\chi^2 (4) = 12.183, p = .016$). The price of the fruit beverage determined the preference of buying among respondents from different income groups (Figure 23).

The relation between the income levels of the participants and the availability of the fruit beverage in their neighbourhood influencing the purchase was also examined using a chi-square test of independence. There was a statistically significant relation between these two variables ($\chi^2 (4) = 16.643, p = .02$). The respondents with income levels up to \$70,000 also considered that the availability of the fruit beverage in their neighbourhood store is important in buying (Figure 24). This association was statistically significant. When tested with chi-square test of independence, almost equal proportions of the respondents in both income groups felt that drinking fruit juice in small amounts every 20-30 minutes is very harmful to teeth ($\chi^2 (8) = 18.096, p = .002$).

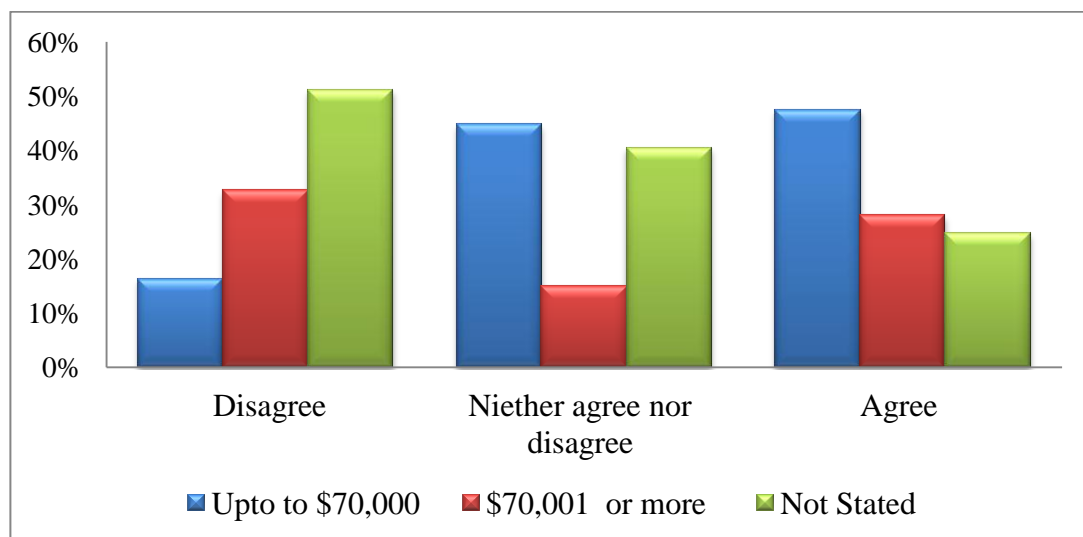


Figure 24. Family income of respondents and availability of the fruit beverage in their neighbourhood influencing the purchase.

A Kruskal-Wallis H test showed a marginally insignificant difference in the preventive activity “child rinses mouth or drinks water after juice consumption” between

respondents with a family income up to \$70,000 and those with the income above \$70,000. The likelihood of performing this activity by respondents with income level up to \$70,000 was more than other groups. The results are $\chi^2 (2) = 5.020$, $p = .08$ with a mean rank of activity score of 86.69 for respondents with income up to \$70,000, 72.82 for respondents who earned more than \$70,000 and 70.90 for respondents who did not state their income. Other preventive activities such as “I dilute the juice with water”, “brush child's teeth twice daily” and “I give only milk drinks and water” showed no statistically significant difference between different income groups of respondents ($p > .05$).

Results of label reading

Only half of the respondents reported buying a specific brand and fruit-type of a beverage. Some participants had entered only the brand while others did not answer the question. Some of the varieties chosen during the data collection were off the shelf at the time of data analysis, as new flavours had entered the market. Eighty participants reported a specific flavour from a specific brand while forty-six respondents said that there is no specific choice.

Based on the available data, Just Juice, Fresh Up, Keri, Golden Circle, Greenways, Mc Coy, Charlies and Homegrown were the most popular brands of fruit beverages among the participants of this survey. These brands include many varieties with fruit content ranging between 98-100%, with only a few fruit drink varieties. All brands mentioned above sell reconstituted fruit juice, with the exception of Charlies and Homegrown brands which sell cold pressed juice. The total sugar content of cold pressed juice was slightly less (18-23 grams per 250 ml) than that of the reconstituted varieties (24-29 grams per 250 ml). Less than 10% of the respondents chose cold pressed juice.

Some of the flavours chosen from aforementioned brands had less than 30% fruit juice. For example, Keri Orange & Mango has a fruit content of 25% with added sugar. Keri Kids Apple Blackcurrant contains 25% fruit along with added sugar, though the total

sugar content in this drink was 12.5 grams per serving. Eight participants claimed that they buy Just Juice's '50% Less Sugar' variety, which is a combination of 50% reconstituted fruit juice and stevia. Only two respondents claimed that they buy Just Juice Veges, which is a combination of fruits and vegetables. Total sugar content of this juice was 19 grams per serving.

It was noted that the same brands that sell fruit juices also sell fruit drink varieties under the same names as the juice varieties; fruit drink varieties were slightly cheaper. Buyers who fail to notice the front-of-pack labels or those who do not know the difference between a fruit drink and a fruit juice can easily fail to understand the fruit content present in the beverage. Since around half of the respondents of this survey did not know the difference between a fruit juice and a fruit drink, it is difficult to conclude that participants who opted for these brands chose pure juice only.

Some participants chose Ribena, Homebrand, and Thextons, which sell fruit drinks only with reconstituted fruit juice ranging between 5 and 35%. The total sugar content however was equal or higher than that of pure juice varieties, implying that they had a significant amount of added sugar. It can be concluded from these findings that participants who selected these beverages chose only fruit drinks for their children.

Summary

The study was hypothesis generating and exploratory in nature, so most of the data analysed were descriptive in format and were expressed in frequencies and percentages. Bivariate analysis using Kruskal-Wallis H tests, a Mann Whitney test and a chi-square test were done for various demographic variables and activities related to children's fruit juice consumption. The overview of the findings depicts that the majority of the participants were European women aged above thirty years with university education who earned a family income above the median level. Fewer participants from other groups consented to complete the survey despite sufficient recruitment efforts.

Gender, income, education and age group of the respondents had some influence on the purchase of fruit beverages, but there was no significant association noticed for the dental health-related activities with these covariates except for activities like diluting the juice with water and encouraging children to rinse their mouth. Overall, the awareness level appears to be reasonable, particularly in the European group. However, based on the label reading, it is difficult to make an assumption that the respondents who wanted to make healthier choice for their children did so, due to ambiguity in the types of products available in the market.

Chapter 7: Discussion

Introduction

This study has examined the awareness level of parents and caregivers about the effects of store-bought fruit-based drinks on their children's oral health. This chapter focuses on analytical discussion regarding the implications of the findings of this study. The information collected from the participants of the survey about their knowledge, behaviour and practices pertaining to their children's fruit beverage consumption was analysed and compared with their demographic characteristics. The research questions were:

What is the awareness level of parents and guardians regarding the effects of commercial fruit beverages on their children's teeth?

Does the awareness level vary according to education levels, age groups, ethnicity and socioeconomic status of parents?

What are the factors that influence their selection of fruit beverages?

The strengths and limitations of this study are made explicit in the beginning of the chapter.

Strengths

The seed of the idea for this research came from observations from dental clinics and existing literature, wherein there was evidence of increased consumption of fruit juice among pre-schoolers. It is also known from previous studies that the pH of commercial fruit beverages is more acidic, thereby making the oral cavity more conducive to dental caries and erosion while affecting the strength of the dental fillings as well. Threading these observations, the research questions were designed for an exploratory study

seeking to assess the awareness level of parents and caregivers of the children of the Auckland region. The strengths of this study are discussed as follows:

Study objective

To the best of my knowledge this is the first study in New Zealand which has investigated the knowledge of caregivers about the dental effects specific to commercial fruit beverages on their children. The focus of the study was to augment the oral health promotion strategies, improve advocacy and to design a more explicit nutritional advisory module for feeding practices in children. In this regard, the study findings have considerable implications for further policy directions and future research. Since ECC and erosion are multifactorial in nature, the attempt was made to gather information from respondents about most of the factors and knowledge levels that could influence their efforts to prevent these two common dental problems in their children.

Methodology and sample

Methodologically speaking, the cross-sectional design, self-administered, mixed mode and anonymous nature of the survey were able to achieve the study objective and minimise possible biases (Engel et al., 2015; Fowler Jr, 2013; Gordis, 2009). The mixed mode design has helped to achieve the objective of including people from different socioeconomic backgrounds. More people who participated in the online survey are from higher socioeconomic background than lower socioeconomic background, while the opposite was true for the paper survey. Although some participants did not state their suburb, considering the available data it appears that the survey has covered a cross section of the Auckland region including Great Barrier and Waiheke islands.

Although a sample size of 322 participants would have been ideal to obtain valid results in “stringent conditions” (5% accepted margin of error and 95% CI), a sample of 206 respondents is acceptable in “liberal conditions” (6.35% margin of error and 90% CI) (Nulty, 2008, p. 310). Only one of the responses obtained for this study was unusable, which implies that the questionnaire was comprehensible and acceptable for the

participants who had an interest in the topic. Since the participants were the parents and caregivers who directly controlled the feeding practices of children aged between 1- 10 years and the questions were directed at the current practices followed by them, it is unlikely that there is any recall bias in the responses.

Validity

A majority of respondents in this survey are European women from higher socioeconomic background in the age group of 30-39 years, however the external validity of the study findings is considerable since biases were controlled and respondents were representative of the population from where they were selected. According to the 2013 Census, the median age of Aucklanders is 35.1 years and there are 40,563 more females than males (Auckland Council, 2014). Since women are the primary caregivers of children in general (Savage et al., 2007), it is natural that more mothers responded than their male counterparts. The mean age of the children in this study shows that it has targeted the right population because that age is the most vulnerable age range for common childhood dental problems (Lee & Lee, 2006; Rugg-Gunn & Nunn, 1999). The percentage of university graduates and postgraduates living in Auckland is higher than the national average and the rates are even higher for women (Auckland Council, 2014).

Limitations

The findings and implications of this study should be considered with following limitations:

Methodology and response rate

While a self-selection sampling method gives randomness to the sample, it is often associated with non-response bias (Engel et al., 2015; Fowler Jr, 2013). Though it is not possible to draw a concrete conclusion about the awareness level of non-respondents, it possibly implies that the survey topic was less salient to non-respondents (Cook, Heath,

& Thompson, 2000). Since no contact information of the respondents was available to the research team due to the anonymous nature of the survey, sending reminders depended solely on compliance of the staff of institutions in the sampling frame. An accurate response rate for this study cannot be obtained because the total number of potential respondents who received the invitation is not known.

Although the centres were selected according to the representativeness of participants for ethnicity and geographic location, Māori and Pacific centres were less interested in becoming involved in the research. Those who agreed found it challenging to remind their clients to participate in the survey. A stratified random sampling would have helped to draw a more representative sample, particularly for various ethnic and income groups.

Sample characteristics

Though the sampling frame included Plunket clinics, primary schools and ECE centres, response rate was very low during the initial stages of recruitment when only Plunket clinics were approached. In addition, the willingness of institutions to become the intermediaries between the researcher and study population was also crucial for reaching the potential participants. Most of the primary schools did not agree to be involved in the recruitment of samples. Rate of response was higher when more ECE centres were approached. Availability of contact details for the coordinators of ECE centres on the 'Education Counts' website made it easier to directly approach them and seek support. It should be noted that for paper questionnaires only ECE centres were included, as most of them agreed to take responsibility to oversee distribution and collection of questionnaires. Therefore, most of the participants recruited for this study are from ECE centres.

According to the *New Zealand Childcare Survey 2009*, fewer children from 'Māori-only' and 'Pacific-only' families than European and 'European/Māori' families attend formal care (Statistics New Zealand, 2010). This could be a reason for the smaller

number of Māori and Pacific respondents in this study. Since cost of the formal care was one of the factors pointed out in the Childcare Survey, this deters many low-income parents sending their children to ECE centres. Consequently, study participants are from higher income groups.

Due to the small number of male participants in this study, the findings related to gender of respondents cannot be extrapolated to the male population of Auckland. As noted in Chapter Five, participants were re-grouped (as the responses in various categories were too small) in order to draw meaningful inferences, so the inferences drawn from these mixed groups should be considered with caution.

Questionnaire

The questionnaire was a mixed type, consisting predominantly of closed-ended questions with multiple choices and Likert scale, having ordinal and interval scales. Though these questions were framed to answer the research questions of the study, the questionnaire was not validated for content, criteria and construct types. Some of the responses may not reflect current practices of the respondents because of the non-validated questions. The ordinal scales with only endpoints labelled in some questions might have affected the reliability of the responses, since scaling is subjective and may differ at different points of time when the same question is asked (Engel et al., 2015). Like other self-reported studies (National Research Bureau, 2008), this study is not immune to possible inherent non-sampling error; this might limit the external and internal validity of the findings.

The study used the label-reading method in addition to collecting subjective response about the awareness level, with an aim to control response bias. Since label-reading is a small part of this research and there is a large presence of several brands and types of fruit beverages in the market, participants could not be probed more in a fifteen-minute oral health survey. Less than 50% of the respondents stated their preferred brand and flavour of fruit beverage whereas other participants said there was no specific choice or

did not answer the question. A few sub-brands were off the shelf due to the time gap between the survey and label-reading.

Study findings

There are several studies and a number of health promotion activities and advocacy efforts addressing the dental effects of carbonated soft drinks (Beaglehole, 2014; Gambon et al., 2012). This study explored the knowledge of parents and caregivers about the dental effects of commercial fruit-based drinks on their children. The main findings of this study indicate that the overall awareness level of parents and caregivers in the Auckland region is good. Since a majority of the respondents of this study were European women from higher socioeconomic background, the findings can be extrapolated to the wider European community in this region.

Purchase and consumption of commercial fruit beverages

The consumption patterns of fruit beverages by respondents or their children can be tracked by the quantity they purchase in their weekly shopping. A majority of the study participants purchased less than half a litre of fruit beverages on weekly basis. A major proportion of those who bought less than half a litre were aged between 30-39 years. Average purchase of fruit beverages, however, is not comparable with the sales data of New Zealand (as discussed in Chapter Two and Three). Some researchers (Eyles, Jiang, & Mhurchu, 2010; Hamilton, Mhurchu, & Priest, 2007) have also suggested the use of supermarket sales data to analyse the food purchasing behaviour of people in order to reduce possible reporting bias. This approach appears to be a promising way to estimate household purchase of food and drinks with minimal participant burden and possible recall and reporting biases. However, it is not immune to inaccuracies since not everybody will purchase fruit beverages only from supermarkets. This method can only supplement the traditional methods of data collection.

In the present study, though the proportion of the fruit beverages consumed by children is less than amounts consumed by respondents' partners, respondents themselves and

guests, the difference is small. Increased juice consumption in children is linked to their parents' and caregivers' consumption levels (Health Promotion Agency, 2014). More research is needed to find out which age group is drinking more juice.

This study shows that children drink juice more frequently over the weekends than weekdays, with only a few parents and caregivers putting a juice box in their child's school lunch box. This may be an indication that the school policies such as 'traffic light system', 'water-only schools' and 'Fuelled4life' are yielding success in reducing sugar intakes of students at schools and ECE centres ("2016: The year of the water-only school?," 2016, March 21; Heart Foundation, 2012; Waitemata District Health Board, n.d.). Following the Voluntary Schools Beverage agreement with the New Zealand government, Coca-Cola and Frucor brands "have seen the removal of an estimated 52.8kgs of sugar from the diet of every kid since its introduction in 2009" (Frucor, 2014, para.1). In this regard, improving parental awareness and oral health literacy level could be the next focus in order to reduce fruit juice consumption of children over weekends. Parents and caregivers also need to know how their fruit beverage consumption influences their children's consumption.

Parental knowledge about commercial fruit beverages

Most of the study participants did not believe that the fruit beverages sold in supermarkets contained a lot of fruit. Most of them also knew that the fruit beverage can cause harm to teeth through its sugar content and acidity. However, it is evident from the findings that the difference between the terms 'fruit juice' and 'fruit drink' were confusing to the respondents. Only half of the respondents knew that fruit juices contain more fruit than fruit drinks do. More Europeans than other ethnicities knew the difference between these two terms and it appears that the terms are often used interchangeably. The observations can be related to label-reading capacity of the parents and caregivers while purchasing fruit beverages. Since there are both fruit drinks and fruit juices sold under the same brands and flavours with little difference in packaging, it

can be confusing for buyers unless they read labels precisely. This infers that there is a need to promote label reading in the oral public health messages.

Factors influencing the purchase

Price of the beverage was an important factor in making a choice among lower socioeconomic groups (low-income and education up to diploma or technical college). This may encourage low-income people to buy fruit drink varieties because they are cheaper options than juice varieties.

However, while there are notable national-level health promotion activities to control sugar intakes by children (as discussed earlier in this chapter), there is a need to shift the focus on the erosive potential of fruit beverages. For example, the traffic light beverage guidelines do not allow the foods and drinks listed in the red group to be sold in the school premises (Waitemata District Health Board, n.d.). But it has placed fruit juices with 250 ml or smaller sized packages, fruit drinks up to 350 ml and artificially-sweetened carbonated beverages up to 400 ml package size in the amber group. It means that they can be consumed in moderation and sold in tuck shops. This suggests that existing health promotion activities are focused primarily on the effects of sugar-component of the drinks on general health. Furthermore, replacing sugar with artificial sweeteners does not reduce the erosive potential of a drink (Beaglehole, 2014). It is time to note that though the causes and pathogenesis of caries and erosion are different, the burden of the diseases to individuals and the community is equally significant.

Child's liking for sweet taste was the main consideration when parents selected the brand and sub-brand of the beverage, while the child's liking for tangy taste was least considered, particularly in 30-to 39-year-old respondents. Price and availability of the beverage in their neighbourhood were also other important factors recorded, especially for lower socioeconomic groups and male respondents. A review from New Zealand highlights the influence of neighbourhood on health status and health-behaviour of people (Stevenson, Pearce, Blakely, Ivory, & Witten, 2009). A report of food security

among Pacific peoples in New Zealand discusses some issues in the rural suburbs such as fewer healthy food and drink choices than urban suburbs. Milk is lot more expensive than fruit drinks and foods sold in local dairies are more expensive than foods in supermarkets (Rush, 2009).

A literature review at the global level confirms that availability of healthy foods in the neighbourhood is one of the most important determinants for healthy eating behaviours in children (Blanchette & Brug, 2005). The review also states that the low availability of fresh fruits may limit exposure to these foods, which may affect children's liking for the taste of fruits in the future. In this regard, introducing the sweeter taste of fruit beverages to children may lead to low preference of whole fruits. The reason for this is that processed fruit beverages sold in the market contain added sugar and other ingredients (Caswell, 2009), hence may taste different from whole fruits. Future oral health promotion should make parents and caregivers aware of how preference to a particular taste is developed in children. Developing self-efficacy and asking skills are other recommendations made by the researchers (Blanchette & Brug, 2005; Jaeger & Bava, 2009).

Interestingly, only a quarter of the respondents bought a fruit beverage for their children after considering its health benefits. In support of this, the recent Euromonitor report shows that juice sales showed a small decline since 2014, particularly for reconstituted varieties. Premiumisation within not-from-concentrate juices and smoothies was a trend in 2015 (Euromonitor International, 2016). It may be an indication that there is improvement in parental health awareness levels pertaining to general health, though it is difficult to conclude that it is due to importance given to oral health specifically. Label reading results also showed that not-from-concentrate juices and smoothies were more expensive than reconstituted varieties. Those on low budgets may settle for cheaper drinks. More research is needed to understand which populations consider fruit juice healthy so that oral health promotion activities can be targeted.

Only a few parents and caregivers considered fruit beverages with stevia for their children. A quarter of respondents did not know if the beverage they bought for their children contained stevia, which may suggest that these respondents have lower health literacy levels. Over half of the respondents did not buy a fruit beverage that contained stevia. The main concern reported for not buying stevia-containing beverage was the scepticism about its safety and effectiveness in children. Another major group of respondents did not want to give any sweetened fruit beverage to their children. In contrast to media reports discussed in Chapter Two, none of the participants in this study reported any hypersensitivity to this sweetener. A minority of respondents were unaware of the sweetener. Since the introduction of stevia-containing fruit beverages by Frucor in 2012 (Frucor, 2012), many stevia-containing juice varieties from other brands also can be seen on the supermarket shelves. It is important to increase awareness about stevia and its benefits and limitations so that people can make an informed choice.

Although there is sufficient evidence for the health benefits and safety of stevia, the possibility exists that people will consume more of such beverages as they perceive them to be safer than sugary drinks. This may still be considered as training people to like sweet foods (Beaglehole, 2014). Also, as discussed earlier in this chapter, including stevia does not help in controlling the erosive potential of a drink.

Practice of commercial fruit beverage consumption in children

The study findings suggest that most of the respondents do not give juice to their children at all or less than once a week. Respondents with postgraduate qualifications were less likely to give juice to their children more than once a week when compared to those with lower educational levels. The significant linear-by-linear association shows that the amount of juice the respondents gave to their children was inversely related to the education levels of the respondents. The main reasons for giving juice to children were (a) child's demand, and (b) health benefits of fruit juice. Only a small group (5%) in this study gave juice to children as a soothing agent or for putting them to sleep. This finding suggests that the oral health information given by Plunket and similar

organisations is effectively reaching the public (Plunket, 2016; Riches, 2015). Giving fruit juice or any sugary drink to console a child increases the frequency of acid attack by the drink, whereas the child going to sleep sipping juice increases the chances of acquiring ECC (Jensdottir et al., 2006; Noble, 2006). Since a majority of the participants in the present study obtained oral health information from dental professionals, this could also be a contributing factor to the increased awareness. The reasons for giving fruit beverage to their children were not associated with education, income, age or ethnicity of the respondents.

The drinks were usually served by the respondents themselves, giving less chance for recall bias. This also infers that respondents usually have more control over the fruit beverage consumption of their children. Improving parental awareness may help in reducing the fruit beverage consumption in children.

Over half of the respondents believed that availability of commercial fruit beverages contributed to increased frequency and amount consumed by their children. Commercial fruit-based drinks offer consistency in taste and flavour, better accessibility and longer shelf life than home-made beverages, making it easier to drink in small amounts at short intervals. As discussed earlier in Chapter Four, according to the *2007 New Zealand Children's Food and Drinks Survey*, a majority of the parents and caregivers agreed that their children drank fruit beverages more often when they were readily available in their home. It also shows that more Māori and Pacific children than European and Asian children had access to “other juice” varieties such as juice-from-concentrate, powder and cordials in their home (National Research Bureau, 2008, p. 14). Only a few respondents of the present study have reported that their children help themselves to fruit beverages; however, availability of ready-made fruit beverages can increase the chances of children drinking these beverages without the permission of parents or caregivers or in their absence.

Over 80% of respondents agreed that the natural sugar present in the fruit beverages is bad for teeth, though a small percentage neither agreed nor disagreed. However, almost

all of the respondents agreed that the added sugar in the fruit beverages is bad for teeth. This is an indication of good awareness levels among the participants about natural and artificial sugars. When respondents' knowledge about the relationship between dental health and fruit juice drinking behaviour was assessed, a majority of respondents rated "drinking juice in small amounts every 20-30 minutes" as the most detrimental behaviour whereas 'drinking milk or water in between meals' was considered the safest of all activities listed. Furthermore, the order of scores for other activities also shows reasonable awareness among the respondents. These study findings cannot be compared with existing data due to unavailability of similar studies.

Brushing child's teeth twice daily was the most common practice among the study participants, performed more regularly by all demographic groups. According to the findings of the *2009 New Zealand Oral Health Survey* (Ministry of Health, 2010), only 66% of 2- to 4-year-old and 5- to 11-year-old children brushed their teeth twice daily. The rates were notably lower for Māori children and adolescents than their non-Māori counterparts. In the present study, giving their child only water and milk with little or no sugar was the second most performed activity reported by the participants, followed by diluting juice. Diluting juice was more common among European parents and caregivers than those in the 'others' group, though the correlation was marginally insignificant. Further research is needed to support this correlation.

Rinsing their mouth or drinking water after juice consumption was the least desired activity. There was a marginally insignificant correlation between encouraging this activity in children and the age, education and income level of parents and caregivers. Those who were less than thirty years of age and lower socioeconomic groups were more likely to ensure that their child rinsed their mouth or drank water after juice consumption, compared to older and higher socioeconomic groups. Since similar findings from other studies are not available to compare the present study findings, further research in this area may be needed to draw a conclusion.

Over 80% of the respondents have sought professional oral health advice for their children in the past twelve months. While a majority of the participants from the ‘others’ group also had a dental visit for their children, more participants from this group than their European counterparts have sought advice from family and friends or did not seek advice at all. Even though this result cannot be generalised to the population due to the small number of respondents, the trend is consistent with existing literature (Health Promotion Agency, 2015). In contrast to the study by Rothnie et al. (2012), there was no significant correlation between the dental awareness level and practices of the respondents in relation to their children’s fruit beverage consumption and the number of children they had.

Label reading

Asking the respondents about their choice of beverage is likely to give less biased information about their health literacy level than using the eye-tracking device as used in the study by Graham and Jeffery (2011). The reason is that people may not read the labels every time for the products that they are already familiar with.

Label reading results show that cold-pressed juices, smoothies and vegetable juice varieties had slightly lower amounts of sugar and were more expensive than other varieties. Evidence shows that smoothies have higher fibre content (Tiwarly et al., 1997). However most of the participants bought reconstituted fruit beverages, with only a few opting for fresh, cold-pressed juices and raw smoothies. There were too few participants who disclosed the brand and sub-brand of their preferred fruit beverage to find correlation between nutrition level of the drinks and demographic characteristics of the respondents. However, the recent report from Health Promotion Agency (2014) depicts that children from a Māori background and whose parents or caregivers have low education levels are more likely to drink reconstituted juice, cordials and powdered drinks.

Some health-conscious respondents might have wanted to buy fruit juice for their children for its nutritional benefits over fruit drinks. However, some brands sell both fruit juices and fruit drinks under the same sub-brand names with little difference in packaging. There was little difference in the total sugars displayed on the nutrition panel when compared with 100% juice varieties, which implies that the sweetness was adjusted by significant amounts of added sugar. Even some sub-brands developed specially for children by these most popular brands had only 25% of reconstituted juice and added sugar. Despite the type of the beverage being displayed with front-of-pack labelling, people seem to be confused with the terms ‘fruit juice’ and ‘fruit drink’. Due to this ambiguity in labelling, it is difficult to conclude that all health-conscious respondents have bought fruit juice only.

The children, who drank mainly fruit drink varieties, must be consuming notable amount of sugar while gaining little nutritional benefit of the fruit content of the drinks. The reason is that all fruit drinks sold in the supermarkets had very low proportions of fruit content in the form of reconstituted juice, ranging between 5-35% with no difference in total sugars. For example, Ribena (a blackcurrant fruit drink), which was in the news in 2007 and 2014 for its false claims about vitamins A and C in the blackcurrant fruit, had only 5.7% reconstituted blackcurrant juice; total sugars per serving however was 25.5 grams (APNZ, 2014, May 15; Vasagar, 2007, March 27). All fruit beverages containing added sugar had declared the presence of sugar in the ingredient list as per the Food Standards Australia New Zealand (2012) guidelines. However, in some drinks it was displayed using synonyms such as sucrose, glucose, cane sugar and many more, which can confuse those with limited health literacy levels.

Front-of-pack labelling through Health Star Rating (HSR) was launched in Australia and New Zealand in 2014 (Brunton, 2016). It has received mixed reviews from public health experts and customers, both for being voluntary and for glaring inconsistencies in the system—which could be easily exploited by the food companies to advertise their products that are less healthy (Johnston, 2016, September 9; Stanford, 2016). Before launching its first social awareness campaign on HSR in New Zealand, the Health

Promotion Agency conducted a baseline measure of awareness of New Zealanders in January 2016, which shows that only 1-3% of shoppers could recall about HSR without any prompts. According to this study, currently HSR is a more popular and trusted mode for making healthier food choices among Pacific people. Even in this population the final decision on food choice is influenced mainly by the price of the item and preferences of their family members (Brunton, 2016). The post-campaign study may show the role of HSR in encouraging the companies to reformulate their products to make them healthier in response to rising consumer awareness.

Graham and Jeffery (2011) argue that the location of the nutrition information displayed on the product has a major influence on consumer use of these labels. According to the recordings of the eye-tracking device used in their study, labels presented on the centre of the screen were viewed more commonly by the shoppers than those printed on the sides. The labels which are easily readable without turning or moving the products were also commonly viewed. Similarly, the nutrition components located at the top of the nutritional panel were viewed more often than those at the bottom. In the present study many fruit beverages had labels on the side of the pack, while in some the font-size was too small to read without having to bring the pack closer to the eyes. Studying the perception of New Zealanders on structure and location of the nutrition information may help to augment the current regulations.

Summary

This study was conducted to assess the child oral health awareness of parents and caregivers regarding the dental effects of store-bought fruit beverages. The respondents of the study have reasonable knowledge about the dental effects of commercial fruit beverages. A major proportion of the respondents were European women aged above thirty years and from higher socio-economic backgrounds, so the results can be generalised to this population. Though gender, age, socioeconomic status and ethnicity had some influence on the awareness level and on child oral health practices, there was no significant association with the number of children of each respondent. Since average

purchase and consumption of fruit beverages in this study was not comparable with existing data, and some components of this research were newly acquired knowledge, there is need for further research to confirm these findings. Despite sufficient awareness, the ambiguity in understanding of difference between fruit juices and fruit drinks in terms of fruit contents may still lead parents and caregivers to make poor choices.

Chapter 8: Conclusion and Recommendations

Conclusion

Since a major proportion of the respondents were European women from the Auckland region with university education and higher household income, it can be concluded that this population presents with sound oral health awareness. The oral health-related knowledge, in particular to fruit beverage consumption and preventive methods, practised in children are also satisfactory in this group.

However, only half of the respondents knew the difference between a fruit juice and a fruit drink. Two in ten respondents thought that a fruit drink had more fruit content than a juice, almost two in ten thought that there is no difference, while one in ten was unsure about the difference between the two. Some leading brands are selling both reconstituted fruit juices and fruit drinks under the same sub-brands with little difference in packaging. Added sugar was disguised in the list of ingredients using scientific names. Despite distinguishing the type of the drink on the front of the packs, reconstituted fruit juices and fruit drinks were still popular among the respondents.

There was a modest disparity in the awareness level between European and non-European respondents in general. Understanding of the terms ‘fruit juice’ and ‘fruit drink’, activities such as diluting the juice and seeking professional oral health advice were higher in Europeans than non-Europeans. Children were consuming fruit beverages more often on weekends than on weekdays. This may be because parents and caregivers are less concerned about the health impacts of fruit beverages when school policies were not applicable. Likewise, children might be tempted to drink juice after seeing other family members drinking it.

Recommendations

Integrated approach

In a television show, broadcast in March 2015 (Kamo & Hudson), the Associate Health Minister Peter Dunne states that the control of tooth decay does not start with controlling sugar consumption but with cleaning teeth twice a day. However, it should be noted that consumption of juice softens the enamel of the teeth and brushing teeth more often will only hasten the process of enamel loss through abrasion (Noble, 2006). This indicates that the public health burden of sugary drinks is still trivial in the political arena. There is a need among policy-makers for a shift in this attitude.

Some public health experts in New Zealand are advocating for the imposition of ‘sugar tax’ on sugar-sweetened beverages. The definition of sugar-sweetened beverages varies across different countries and among different researchers (Beaglehole, 2014). In Australia it includes reconstituted 100% fruit juices whereas in New Zealand fruit juice is not included in SSBs because it contains mainly natural sugars (Australian National Preventive Health Agency, 2014; Beaglehole, 2014). It should be noted that both natural and added sugars are associated with dental caries and obesity whereas fruit juices rich in these sugars also play a major role in tooth wear. More than half of the parents and caregivers in the current study agreed that availability of commercial fruit beverages increases the amount and frequency of juice consumption in children. A Herald poll conducted in March 2016 showed 80% support for a sugar tax (Plumb, 2016, April 2).

Most nutrition health promotion activities and educational campaigns highlight the sugar contents of the fruit beverages (Beaglehole, 2014; Heart Foundation, 2012; Waitemata District Health Board, n.d.). It appears that these activities are mainly aimed at controlling obesity and non-communicable diseases. This might underemphasise the effects of erosive nature of the drinks on teeth. If health promoters keep highlighting the

adverse effects of sugars only, then people may drink more beverages with alternative sweeteners. This study recommends more precise and consistent health messages.

User-friendly labelling

Taking the ambiguity in labels and packaging into account, this study recommends clearer labelling of fruit beverages with pictorial warning signs on the front of the package. Pictorial warnings are better than exhaustive label reading since they are more comprehensible for individuals with limited oral health literacy. Along with HSR symbols on the pack, a ‘happy tooth logo’ is also recommended. Happy Tooth mark was first introduced in Switzerland in early 1980s by Toothfriendly, a non-profit organisation (Gambon et al., 2012; Toothfriendly International, n.d.). As of 2010, 90% of the Swiss population recognise the logo (Toothfriendly International, n.d.). It separately measures both erosive and caries potential of a food or a beverage using standard tests such as pH-telemetry test (Toothfriendly International, 2015). Children at school are taught about benefits of consuming products which have tooth-friendly labels. Now the programme is been extended to forty countries (Toothfriendly International, n.d.). Introducing this concept in New Zealand may assist the consumers to make better choices for their family while encouraging the food and beverage companies to make their products more ‘tooth friendly’. Before launching this policy, concept testing might help to understand its acceptance among New Zealanders.

Equity-focused policy actions and educational programmes

Commercial fruit beverages are readily available and accessible and their marketing usually targets children, adolescents and low-income people (Beaglehole, 2014). This could be controlled by restrictions on advertisements and sales and sponsorship bans on these drinks.

Price of a drink and its availability in their neighbourhood was important for the participants from lower socioeconomic backgrounds. It infers that in conjunction with developing self-efficacy skills, if healthier drinks such as milk and bottled waters

become cheaper and more readily available than fruit drinks, people with low-income may prefer them to fruit beverages. This can be achieved by keeping the price of healthier drinks notably low, taking actions such as removal of GST (Goods and Service Tax) and providing subsidies on these drinks. In many developed countries, such as Australia and the countries of the United Kingdom, unflavoured milk beverages are exempt from GST, which makes them markedly cheaper than in New Zealand (Australian Taxation Office, 2016; Woodford, 2014, March 30).

While food pricing strategies and advertising strategies could help in curbing the purchase of fruit beverages, raising parental awareness cannot be decelerated. Oral health campaigns should make the meanings of fruit juice and fruit drink clear to the consumers, along with an emphasis on diluting the fruit beverages of children with water or unsweetened milk. Providing oral health information in learner-centred small groups may encourage the underprivileged population to challenge the beliefs and norms that are adverse to good oral health and foster empowerment.

Future research

As the first of its kind, this study has set a basic foundation to further research on dental effects of fruit beverages. While dental caries has been a recognised public health problem for many decades, dental erosion has often gone unrecognised, mainly due to its slow progression and coexistence with other forms of tooth wear. Knowledge of dental erosion is developing in recent years among clinicians and researchers in many developed countries. However, as discussed in Chapter Two, erosion is still understated in New Zealand and the prevalence of erosion is not known (Health Promotion Agency, 2015; Taji & Seow, 2010). Presence of dental erosion may be a risk indicator for dental caries and unhealthy dietary habits. This study recommends inclusion of prevalence of dental erosion in national oral health surveys in New Zealand like United Kingdom and Iceland (Arnadottir et al., 2010; Nunn et al., 2003). It may help to assess the burden of the disease and help to encourage people to work in collaboration to mitigate it.

This study encourages further research to find out the difference in the nutritional benefits of squeezed or cold-pressed juices and from-concentrate varieties sold commonly in New Zealand. If there is no difference in the health benefits of these two groups, then they should be treated as any other sugary drinks. This evidence may also encourage people to reduce consumption.

Although the reported average amount of fruit beverages purchased by most of the study respondents is less than half litre per week, the sales records of New Zealand show that the sale of commercial fruit beverages still remains high. My literature review illustrated that the children of New Zealand consume more of these beverages than recommended, with significant disparities across certain ethnic and lower socioeconomic groups. Therefore, this study encourages further research in larger, more diverse populations in order to understand their fruit beverage consumption patterns and the factors influencing them. This study also encourages future studies to correlate the knowledge of parents about the dental health effects of the fruit beverages and measure the oral health findings in their children. This may provide conclusive evidence to the potential interconnectedness between the knowledge of parents and caregivers, their oral health-related practices and the oral health of their children.

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Appendices

Appendix A: Participant Information Sheet



Participant Information Sheet

Date Information Sheet Produced: 14 November 2014

Project Title

An Investigation into Parents' Awareness of Effects of Commercial Fruit Beverages on Their Children's Teeth.

Invitation

Hello,

I am Prathibha Sural, a MPH (Master of Public Health) student of AUT (Auckland University of Technology). I would like to invite you to participate in this research which will be contributing to the completion of my qualification.

Commercial fruit beverages offer better accessibility and storability than home-made beverages; hence they are likely to be preferred by many parents. This study explores parents' knowledge of effects of commercial fruit beverages on their children's teeth through this survey.

Purpose of the study

The aim of the research is to assess parents' knowledge of the impact the store-bought fruit drinks could have on their children's teeth. The output of this study will be a thesis and potentially a journal article or other academic publication or presentation.

Identifying Participants

The study is open to parents (including guardians) **who look after at least one child aged between 1-10 years**. Please note that all the questions in the questionnaire are about **the child/children of this age group only** and the term 'fruit beverage' is used to refer to **any drink that contains 5% or more fruit**. It does not include powdered drinks.

What will happen in this research?

This study involves a written or online survey of parents which should take no more than 15 minutes. Your participation is voluntary and anonymous (I will not know who you are). Please note that your consent to participation in this study is confirmed by you completing the survey.

Benefits

Being the first of its kind, this study will provide a platform to more precise oral health education programmes, health policy and more research to understand the factors and control common dental problems in children.

Participant Privacy

The research team will have access to the data during the collection and analysis stages. It will be securely stored and destroyed after six years.

Agreeing to Participate

After reading this sheet and you feel as though you would like to participate in the study, please fill out the survey questionnaire. Both online and paper copies of the questionnaire are available. If you prefer the paper copy, please collect it from the reception of this office along with a postage-paid envelope or use this link to go to online survey: https://www.surveymonkey.com/s/Fruit_Juice

Paper questionnaires should be mailed to:

Dr. Heather Came
Department of Public Health, Mail Code A12,
AUT University, North Shore Campus,
Private Bag - 92006
Auckland 1142

Obtaining Study Results

A summary of the research report will be made available on 'AUT Scholarly Commons' (<http://aut.researchgateway.ac.nz/>) which you can find by searching under the author 'Prathibha Sural' after December 2015. We also plan on submitting a peer reviewed article to a high-profile journal.

Participants Concerns

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor: Dr. Heather Came, hcame@aut.ac.nz or 09 9219999 ext 7799.

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTECH, Kate O'Connor, ethics@aut.ac.nz , 921 9999 ext 6038.

Researcher Contact Details

For further details regarding the study please contact one of the individuals below:

Primary Researcher: Prathibha Sural, zs0638@autuni.ac.nz.

Project Supervisor: Dr. Heather Came, hcame@aut.ac.nz or 09 9219999 ext 7799.

Approved by the Auckland University of Technology Ethics Committee on *30 January 2015*, AUTECH Reference number *14/388*.

Appendix B: Advertisement



An Investigation into Parents' Awareness of Effects of Commercial Fruit Beverages on Their Children's Teeth

Are you a parent/guardian of a child aged between 1-10 years?

We would like to invite you to participate in this research by completing a survey.

The study is open to parents (including guardians) who look after at least one child aged between 1-10 years.

- This survey should **take no longer than 15 minutes** and participation is entirely voluntary.
- **It will be completely anonymous.** Participants will not be able to be individually identified at any stage of this study.
- Completion of survey indicates consent to participate in this research.
- Participants may refuse to answer any question

If you would like to contribute to this study by completing an **online survey, please go to** https://www.surveymonkey.com/s/Fruit_Juice. For more information about the study, please request for a Participant Information Sheet from the reception/staff of this organisation.

Researcher Contact Details:

For further details regarding the study please contact one of the individual's below:

Primary Researcher: Prathibha Sural, zs0638@autuni.ac.nz.

Project Supervisor: Dr. Heather Came, hcame@aut.ac.nz or 09 9219999 ext 7799.

Approved by the Auckland University of Technology Ethics Committee on *30 January 2015*, AUTECH Reference number *14/388*.

Appendix C: Questionnaire

An Investigation into Parents' Awareness of Effects of Commercial Fruit Beverages on Their Children's Teeth

Survey Questionnaire

Thank you for consenting to take part in this study.

1. Please indicate the gender and age (to the nearest year) of your child / children

	Male	Female	1	2	3	4	5	6	7	8	9	10
Child 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Child 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Child 3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Child 4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Child 5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section A: Products and Influence

1. How much fruit beverage do you (or the person who buys groceries for your household) usually prefer to buy in your weekly shopping?

Less than half a litre ☐ Half a litre ☐ 1 litre ☐ 2 litres ☐ 3 litres or more ☐

2. Who usually drinks most of the fruit beverages bought? (Tick all that apply)

Myself ☐ My partner ☐ My children/grand children ☐ Guests/Social occasions ☐

3. Approximately how frequently does your child consume fruit beverage on a typical week day and a weekend?

Week day	Never <input type="checkbox"/>	Once a day <input type="checkbox"/>	Twice a day <input type="checkbox"/>	3 times a day <input type="checkbox"/>	Four or more times <input type="checkbox"/>
Weekend	Never <input type="checkbox"/>	Once a day <input type="checkbox"/>	Twice a day <input type="checkbox"/>	3 times a day <input type="checkbox"/>	Four or more times <input type="checkbox"/>

4. How often do you put a fruit juice box in your child's school lunch box?

Never ☐ less than once a week ☐ Once a week ☐ 2-3 times a week ☐
Everyday of the week ☐

5. All fruit beverages contain a lot of fruit.

Strongly disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. Is there a difference between fruit juice and a fruit drink?

Yes, fruit juice contains more fruit than a fruit drink ☐
Yes, fruit drink contains more fruit than a fruit juice ☐
No, I don't see any difference ☐
Not sure ☐

7. What reasons influence your preference to buy this beverage for your child?

REASONS	Strongly disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
Brand name, advertisements, appealing packaging	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think it is good for health	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Child likes its sweet taste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Child likes its tangy Taste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Affordable price	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Availability and convenience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It has Stevia (a natural sweetener)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. Do you buy fruit beverages for your child which contains Stevia as an alternative sweetener?

Yes ☐ No ☐ Don't know if it contains Stevia ☐

9. (Answer this question only if you have answered 'no' to the previous question) What is the reason for not buying Stevia-containing fruit beverage?

I don't know what it is ☐

I have heard about it but not sure about its safety and effectiveness..... ☐

My child had some reaction to it..... ☐

Child could not accept its taste..... ☐

Other (Please specify).....

10. If you are able, name the brand and fruit type of the beverage your child drinks most often.

Brand Fruit type/s..... . No specific choice ☐

11. I often give fruit beverage to my child because (answer all questions)

He/She asks for it Yes ☐ No ☐

Fruit juice is good for my child's health Yes ☐ No ☐

To stop my child from crying (or to put to sleep)..... Yes ☐ No ☐

I do not give juice at all (or less than once a week)..... Yes ☐ No ☐

Other reason (Please specify).....

12. Who usually gives fruit beverage to the child/children (tick one option)

Myself ☐ My partner ☐ Child helps himself/herself ☐

Other (other member of family or outsider) ☐ Does not apply to me ☐

13. If ready-made fruit drinks were not available in the market, that would reduce the amount and frequency of my child's consumption.

	Strongly disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
<u>Amount</u>					
<u>Frequency</u>					

Section B: Knowledge, Activities and Information Source

1. Natural and added sugars in the fruit beverage are bad for teeth

	Strongly disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
<u>Natural sugar</u>					
<u>Added sugar</u>					

2. How do fruit beverages affect teeth?

By sugar ☐ By acidity ☐ By both sugar and acidity ☐ Fruit beverages don't affect teeth ☐

3. How harmful is each of these activities to teeth?

Habit/Activity	1 Not at all harmful	2	3	4	5 Very harmful
Drinking one glass of juice with meal					
Drinking fruit milkshakes					
Drinking one glass of juice in between meals					
Drinking juice in small amounts every 20-30 minutes					
Drinking milk and water in between meals					

4. Please tick the most appropriate number from 1 to 5 for each statement which corresponds to your desired response.

Habit/Activity	1 Never	2	3	4	5 Everyday
I dilute the juice with water					
The child rinses mouth or drinks water after consumption of fruit juice					
Brush child's teeth twice daily					
I give only milk drinks (with little or no sugar) and water					

5. Where have you/your child received advice on your child's dental care in the last 12 months?

- School dental nurse/Community dental clinic/dentist..... ☐
- School /health class..... ☐
- Media (TV, Internet, Radio) ☐
- Family & friends ☐
- Did not get advice ☐

Section C: Demographic Information

1. Gender: Male ☐ Female ☐

2. My age falls in this group (years)

24 or less ☐ 25-29 ☐ 30-34 ☐ 35-39 ☐ 40 - 44 ☐ 45-49 ☐ 50-59 ☐ 60 or above ☐

3. Which ethnic group do you belong to? Tick the option or options that most apply to you.

New Zealand European ☐ Māori ☐ Samoan ☐ Cook Island Māori ☐

Tongan ☐ Niuean ☐ Chinese ☐ Indian ☐ European ☐

Other, please state:

4. This best describes my education

Secondary school ☐ Diploma ☐ Technical College ☐ University Graduate ☐

University Postgraduate ☐ Other (Please specify)

5. This best describes our annual household income (before tax) (in NZ dollars)

30,000 or less ☐ 30,001- 50,000 ☐ 50,001- 70,000 ☐ 70,001- 100,000 ☐

100,001 or more ☐ Not stated ☐

6. Suburb (Please specify)

..... **End of Survey, Thank you**.....