Children's oral health-related quality of life five to seven years after comprehensive care under general anaesthesia for early childhood caries

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Dedication

My Thesis is dedicated to my wife Prasuna and my children Shrima, Akhil and Nikhil who always believed in me and supported me.

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Abstract

Early childhood caries (ECC) is one of the most common childhood diseases in preschool children. Untreated ECC can lead to pain, sepsis, periapical infection, malnutrition and may result in poor Oral Health Related Quality of Life (OHRQoL) and general health. Many children are treated successfully in the dental clinic with local anaesthesia. Children with ECC who cannot cooperate well for traditional restorative care require comprehensive dental care under general anaesthesia (GA). Many early studies suggest an improved OHRQoL immediately after the dental care under GA. However, none of these studies have looked at the OHRQoL in the mixed dentition period. While it has been reported that caries in preschool years is a significant indicator of caries risk in adolescence, it is unknown whether this risk is also evident in the mixed dentition. The significance of the current research is that this is the first study to investigate the OHRQoL during mixed dentition of the children five to seven years after they received comprehensive dental care under general anaesthesia for ECC. Furthermore, this study has compared the OHRQoL of children who had dental care under GA with children who had dental care without GA, and children who did not have caries.

The aim of the study was to compare the OHRQoL in children in the mixed dentition period following comprehensive dental treatment and/or extractions for early childhood caries under GA with that of children who had received dental restorations in the chair or children of the same age who were caries-free. This was done by using the 16-item Short-Form Child Perceptions Questionnaire (CPQ_{11-14}). The findings of this research will help with development of appropriate preventive strategies and recommendations to improve quality of life and dental outcomes.

Following ethics approval, 346 children were invited to participate in the study. Children who had comprehensive dental care or extractions only for ECC under GA, before five years of age in 2009-2011, were age-matched with a group of children who had treatment for caries in the dental chair and a group of children who had been diagnosed as caries-free. Following consent from both the participants and parents, participants were recruited into one of the four groups, depending on the type of

dental care they had received. Participants completed the Impact 16-item Short-Form Child Perceptions Questionnaire (CPQ_{11-14}), to evaluate their current OHRQoL.

Children who had comprehensive care under GA reported poorer OHRQoL mainly in the oral symptoms/functional limitation domains, whereas children who reported poorer OHRQoL also reported that their overall health was affected by their oral condition. There were no statistically significant differences in OHRQoL reported between children who had comprehensive dental care under GA and children who had teeth extractions only under GA. While all the children who had high caries in the primary dentition reported poorer OHRQoL, children who had dental care under GA had more caries currently than children in the other groups. Approximately 45% of these children had two or more carious lesions in the permanent dentition at the time of the study.

The present study determined that the children who had dental care under general anaesthesia have a poorer OHRQoL in the mixed dentition period. Further research is needed to understand the factors that are contributing to the ongoing poorer OHRQoL.

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List of Abbreviations

AAPD	American Academy of Pediatric Dentistry
ANOVA	Analysis of Variance
CDC-GA	Comprehensive dental care under general anaesthesia
CFSS-DS	Children's fear survey schedule dental subscale
CHILD-OIDP	Child Oral Impacts on Daily Performance scale
COHIP	Child Oral Health Impact Profile
COHRQoL	Child oral health related quality of life
COHS	Community Oral Health Service
CPQ	Child Perception questionnaire
Dmft	Decayed missed filled teeth of primary teeth
DMFT	Decayed missed filled teeth of permanent teeth
ECC	Early childhood caries
ECOHIS	Early childhood oral health impact scale
EXO-GA	Only primary teeth extraction under general anaesthesia
FIS	Family impact scale
GA	General anaesthesia
Glo G H	Global general health
Glo O H	Global oral health
HRQoL	Health related quality of life
ICDAS	International caries detection assessment system
ISF	Impacted short form
LA	Local anaesthesia
MI	Motivational interview

N	Number
OHI	Oral hygiene instructions
OHRQoL	Oral health related quality of life
P-CPQ	Parent/caregiver perception questionnaire
QoL	Quality of life
SD	Standard deviation
SDHB COHS	Southern District Health Board Community Oral Health Service
S-ECC	Severe early childhood caries
SES	Socioeconomic status
SPSS	Statistical Package of Social Studies
Tx-Chair	Children treated in dental chair
WHO	World Health Organisation

Chapter 1
Literature Review

1 Introduction

Early childhood caries (ECC) is defined as the presence of one or more decayed (cavitated or non-cavitated lesions), missing (because of caries), or filled tooth surfaces in the deciduous dentition of children under six years-of-age (AAPD, 2011). In children younger than three years-of-age, any sign of smooth surface caries (including enamel white spot lesions) is indicative of severe early childhood caries (S-ECC). Between the ages of three to five years, S-ECC is indicated by the decayed, missing or filled surfaces (dmfs) scores of ≥ 4 for age 3, ≥ 5 for age 4, or ≥ 6 for age 5. Early childhood caries has been regarded as one of the most prevalent diseases of early childhood (AAPD, 2011). Early treatment of ECC is important because untreated caries can lead to pain, sepsis and periapical infection, malnutrition and poor overall general health (Drury et al., 1999). Traditional ways of managing ECC include removal of caries and restoring the cavities, extractions, or by non-surgical means (application of fluoride agents to arrest caries). Many children with ECC who cannot cooperate well for traditional restorative care require comprehensive care under general anaesthesia (GA) (Chu, 2000).

In New Zealand, Ministry of Health data show ECC prevalence to be around 43% in children at the age of five years (Ministry of Health NZ, 2013). Several previous studies have shown improvements in oral health related quality of life (OHRQoL) of children after comprehensive dental care under GA (Acs et al., 1999; Acs et al., 2001; Anderson et al., 2004; Jankauskiene et al., 2014; Malden et al., 2008). Most studies have looked at the impact soon after treatment, but no studies have investigated oral health or oral health-related quality-of-life in middle childhood for children who had a history of S-ECC and furthermore most studies did not have control groups (Knapp et al., 2016). In addition, most studies evaluated the child oral health-related quality-of-life (COHRQoL) after dental care under GA by using proxy reported or answered questionnaires (Knapp et al., 2016; Wilson-Genderson, 2007). Earlier studies reported that proxy reported questionnaires show low to moderate overall agreement with child ratings (Knapp et al., 2016; Wilson-Genderson, 2007).

1.1 Early childhood caries

Early childhood caries (ECC) is one of the most prevalent chronic diseases in young children. Previously it has been referred as 'baby bottle tooth decay', 'bottle caries' or 'rampant caries' to describe the caries in early childhood (Yiu and Wei, 1992). Further understanding of the disease and the different factors contributing to the aetiology lead the adoption in 1999, of the term 'early childhood caries' (ECC) (Drury et al., 1999; AAPD 2011). ECC is defined as the presence of one or more decayed, missing, or filled tooth surfaces in the deciduous dentition of children under six years-of-age (AAPD 2011). Many studies have shown that ECC often left untreated can lead to pain, spread of infection, poor weight gain and growth due to the inability to eat, difficulty in sleeping and possibly poor general health (Acs et al., 1992; Ayhan et al., 1996). Children who are not able to cope with traditional restorative treatment in the dental chair because of their young age often require GA and the cost and waiting time for this treatment is high, in the public and private sectors (Foster et al., 2006).

1.1.1 Aetiology of ECC

ECC is a complex multifactorial disease, which includes infection with bacteria, dietary factors, host factors and influences from environment and socio- economic status (Beighton, 2005). ECC occurs when there is a microbiological shift in the commensal oral microflora, promoting a biofilm (plaque) favouring acidogenic and aciduric bacteria due to frequent exposure to fermentable carbohydrates (Kleinberg, 2002; Luo et al., 2012). If the plaque is left undisturbed, acidogenic bacteria metabolize carbohydrate and produce lactic and other acids which induce demineralisation of tooth enamel, (Takahashi and Nyvad, 2011). However, if these episodes of demineralisation are of short duration and infrequent, the homeostatic mechanisms in the plaque may restore the mineral balance to an overall mineral gain that will lead to remineralisation of the tooth (Takahashi and Nyvad, 2011).

The known cariogenic bacteria that play a major role in caries development include *Streptococcus mutans (S.mutans)* and *Streptococcus sobrinus (S.sobrinus)* (Leong et

al., 2013; Luo et al., 2012; Takahashi and Nyvad, 2011). Other species—such as *Lactobacilli,* Non-mutans *streptococci, Actinomyces, Bifidobacterium,* and *Veillonella* (van Houte, 1993)—have been shown to be involved in later stages of caries progression. More recently it has been shown that there is a much more complex biofilm involved in dental caries than previously understood and that the biofilm as whole undergoes a shift in its characteristics to result in caries (Gross et al., 2012; Lif Holgerson et al., 2015; Luo et al., 2012; Tanner et al., 2011).

Associated factors are related to the diet and the host. Dietary factors include frequency, amount and timing of consumption of fermentable carbohydrates (especially sucrose) that play an important role in increasing a child's risk of developing ECC. There is a strong association between the frequency of consumption of sugar and the prevalence of caries, with a weaker association with the amount of sugar consumed (Harris et al., 2004). A study conducted in Australian children with ECC showed that consumption of sugar between meals, especially in the form of fruit juices and soft drinks increased the caries risk. Daily feeding with juices, cordials and soft drinks in bottles greatly increases the prevalence of ECC (Hallett and O'Rourke, 2003).

In New Zealand, a study reported that children are consuming increasing amounts of sucrose in their diets, with the main sources being powdered drinks, soft drinks, cordials and fruit drinks (Thornley et al., 2010). Host factors include developmental defects of enamel, hypomineralisation and hypoplasia of primary and permanent teeth inherited or acquired from systemic conditions. Saliva is an important protective factor comprising inorganic and organic components that can contribute to the prevention of carious lesions (Rodriguez et al., 2015). When there is disruption or alteration in saliva flow or quantity, there is an increased risk of dental disease. Children with respiratory diseases like asthma tend to have decreased salivary function both due to the tendency to mouth breathe and because of medication (Rodriguez et al., 2015).

It is generally believed that the presence of dental plaque is a risk factor for developing caries in young children. Many studies have reported that children's

brushing habits, frequency of brushing and use of fluoride toothpaste are associated with the prevention of dental caries (Harris et al., 2004; Misra et al., 2007). It was found that children who did not have their teeth cleaned at bedtime had a higher risk of developing ECC. As young children lack the ability to clean their own teeth effectively, it is recommended that parents clean their children's teeth at least until they reach school age (Bach and Manton, 2014). Regular tooth-brushing with fluoridated toothpaste and brushing before going to bed are important measures for the control of caries, since they maintain the concentration of fluoride in the oral cavity for longer periods. Fluoride in the oral cavity is important for enamel resistance, reducing the amount of mineral loss during demineralization and accelerating remineralisation (Marinho, 2003).

Socio-demographic factors that are important risk factors for caries development and progression have been reported (Reisine and Psoter, 2001). An inverse relationship is seen between socioeconomic status and the incidence and prevalence of dental caries (Reisine and Psoter, 2001). Children from low socioeconomic status groups are reported to consume more sugary edibles and have poorer dental health practices such as tooth brushing, using fluoride toothpaste, and attending regular dental visits which result in high prevalence of dental caries (Reisine and Psoter, 2001). A higher incidence of ECC is found in children who belong to indigenous ethnic groups and racial minorities (Bach and Manton, 2014; Sujlana and Pannu, 2015).

1.1.2 Clinical features of ECC

Early development of ECC usually follows a specific pattern. Initial caries develops on the labial surfaces of the upper incisors and appears as white demineralised areas (white spot lesions) along the gingival margins (Chu, 2000). These lesions may soon become pigmented and spread laterally and coronally. Caries develops on the upper first primary molars in pit and fissure regions and on the buccal surfaces near the gingival margins. The pathogenesis of ECC is related to the eruptive patterns of the primary dentition and particular cariogenic feeding patterns (Chu, 2000; Yiu and Wei, 1992). The upper primary incisors are usually more severely affected as they erupt

earlier than the posterior teeth and therefore potentially have longer exposure to cariogenic insult. The mandibular incisors are thought to be more resistant to caries, due to their close proximity to salivary secretions from the submandibular salivary glands and because the tongue covers them during infant feeding (Yiu and Wei, 1992).

1.1.3 Effects of untreated ECC

ECC is one of the most common chronic diseases among preschool-aged children and has a significant impact on oral and general health in children (Bach and Manton, 2014). It can lead to pain, reduced ability to eat and may result in delayed growth and weight gain (Acs et al., 1992; Ayhan et al., 1996). Where there is pulpal involvement, a periapical infection may cause damage including enamel hypoplasia or incomplete development to developing permanent teeth (Lo et al., 2003). Early loss of primary teeth may lead to disrupted development of the dental arches with the ectopic eruption of permanent teeth, tilting, or rotations. Moreover, early loss of upper anterior teeth may affect speech (Artun and Thalib, 2011). Dental caries-related pain in children may cause a diminished quality of life, with sleep disturbance, difficulty in eating and concentration problems at school (Acs et al., 1992). Pain and infection due to caries can interrupt education and involvement in other daily activities. ECC can result in aesthetic and speech problems, and children may avoid smiling and laughing (Arora et al., 2011). Furthermore, hospitalization and emergency visits are often required to manage pain and infection due to caries (Arora et al., 2011). These visits increase treatment costs and time, with further loss of school days and restricted school activity (Gift et al., 1992; Griffin et al., 2000). ECC has been shown to be associated with high risk of developing new carious lesions in primary and permanent dentitions (Gray et al., 1991; Grindefjord et al., 1995). Management of ECC under GA is common. However, it has a high cost and has other risks (Cravero et al., 2006). In Western Australia, the economic burden of oral-health-related conditions in children is more than Aus$92 million over 10 years (Alsharif et al., 2015).

1.1.4 Clinical management of ECC

Conventional management of ECC includes preventive and restorative therapy. Preventive care includes oral health education and promotion, diet analysis and advice, use of home and professional fluoride agents, use of antibacterial agents such as chlorhexidine, and pit and fissure sealants. Restorative care involves restoration of carious lesions with dental materials including glass ionomer cements, compomer, composites, silver amalgam, stainless steel crowns, composite crowns, zirconia crowns (Finucane, 2012). Pulpally involved teeth may be treated with indirect pulp capping, pulpotomy or pulpectomy, while teeth with poor prognosis are extracted to prevent pain and further infection (Foley, 2010). Children with ECC who cannot cooperate well for conventional restorative care often require comprehensive care under sedation or GA (Chu, 2000).

1.1.5 Dental care for children with ECC under GA

The clinical management of ECC can pose a challenge for clinicians as children who present with the disease are often young and have little experience of dental care. They may be anxious if they have been in pain or fearful if their previous care has been badly managed or unable to communicate well because of lack of language development (Savanheimo et al., 2005). Behavioural management strategies such as Tell Show Do, modelling, desensitisation and behavioural shaping, can be utilised for treating these young children. Children who do not respond positively to these strategies, or who are developmentally or medically-compromised often require pharmacological behavioural management to complete dental treatment (Chu, 2000). When options such as oral sedation or inhalation sedation are inadequate to allow comprehensive dental care, GA may be required (Seheult et al., 1993). Guidelines (AAPD, 2012; Forsyth et al., 2012) for the use of GA for paediatric dental care recommend it for:

1. patients who cannot cooperate due to a lack of psychological or emotional maturity and/or mental, physical or medical disability;

2. patients for whom local anaesthesia (LA) is ineffective because of acute infection, anatomical variations, or allergy;
3. patients who require significant surgical procedures or immediate, comprehensive oral/dental care;
4. patients who are extremely uncooperative, fearful, anxious, or uncommunicative; and
5. patients for whom the use of dental GA may protect the developing psyche and/or reduce the medical risk.

Treatment under GA for paediatric patients has advantages which include the provision of treatment that is efficient, less stressful for children and clinicians and safe with careful pre-GA assessment (Amin et al., 2010). Extensive high quality care can be provided in a single visit for the patient and to some degree, there is less physical and mental stress for the patient and the clinician (Amin et al., 2010; Anderson et al., 2004; Lee and Roberts, 2003; Wilson, 2004). There is an immediate improvement in the quality of life for both children and their families (Acs et al., 1999; Anderson et al., 2004; Drummond et al,.2004; Glassman et al., 2009; Malden et al., 2008; Jankauskiene et al., 2017). The disadvantages and limitations of dental care under GA is it does not alleviate the dental anxiety in children even after treatment (Cantekin et al., 2014) and expense with the provision of dental care under GA. Moreover, it has been reported that there is a high recurrence of caries following dental care under GA, which indicates that dental care under GA only treats existing carious lesions and does not provide complete prevention against further caries (Jankauskiene et al., 2017). This emphasises the necessity to enhance preventive efforts (oral hygiene and diet advice, fluoride tooth paste use, motivational interviewing, and professional fluoride varnish application) while improving parental knowledge and attitudes towards oral hygiene to improve oral health for children after dental care under GA (Jankauskiene et al., 2017).

1.1.6 Follow-up care after dental care under GA

Children with a history of ECC should be regarded as being at greater risk for the disease in the future and that the treatment of ECC under GA does not eliminate future tooth decay (Berkowitz, 2003). Earlier studies of children having had treatment under GA found that the on-going risk of caries is high. It was shown that despite more intensive preventive measures, this group of children is still greatly susceptible to greater caries incidence in future (Drummond et al., 2004; Foster et al., 2006). It seems that attending the immediate post-GA appointment for evaluation and reinforcement of oral hygiene and dietary counselling appears to reduce the likelihood of recurrence of caries (Amin et al., 2010). It is unknown whether this is because of the reinforcement of good practice or whether those who attend for follow-up are more likely to be receptive to changing behaviour (Lingard et al., 2008). The AAPD recommends that children who have a greater risk of developing future caries would benefit from recall appointments at a greater frequency than every six months (AAPD, 2011). In New Zealand, it was recommended that all high-risk patients in the Community Oral Health Service should be seen within three months of dental treatment under GA (Lingard et al., 2008).

There is general agreement in the literature that each recall appointment following dental care under GA should include professional fluoride treatment, appropriate anticipatory guidance and counselling that includes oral hygiene instruction and dietary advice (AAPD 2011, Featherstone et al., 2007). Fluoride therapy has been the centrepiece of caries-preventive strategies for many years. There is clear evidence that fluoride toothpastes are effective in preventing caries (Marinho, 2003). In New Zealand, the Ministry of Health recommended that toothpaste of 1000ppm be used twice daily for all ages, and be part of the oral hygiene instruction (Coop et al., 2009). Fluoride varnish has also been shown to be effective in preventing dental caries (Marinho, 2003). The AAPD recommends that children with high caries-risk should receive anticipatory guidance (appropriate discussion and guidance) at every recall including dietary and oral hygiene advice as well as professional fluoride varnish applications every 3-6 months (AAPD, 2011). Featherstone et al., 2007 also

recommended that high-risk patients should receive 3-monthly anticipatory guidance and fluoride varnish. In addition to this, they recommended salivary testing (determining the salivary pH, flow and quality), bitewing radiographs 6-monthly, and fissure sealants for deep pits and fissures (Featherstone et al., 2007).

1.2 ECC impact on the quality of life of children and families

It is well recognised that dental caries can impact on children's wellbeing and development (Acs et al., 1999; Blumenshine et al., 2008; Casamassimo et al., 2009; Fisher-Owens et al., 2007; Thomas and Primosch, 2002). Previous studies have suggested that dental caries can affect a child's physical and emotional wellbeing, and school performance (Thomas and Primosch, 2002). Many children will experience disruption of sleep, eating habits, behaviour, and ECC may affect the academic performance of older children (Nuttall et al., 2006). ECC may lead to a lack of self-esteem resulting in a lower level of social functioning. A New Zealand study reported that, before dental treatment under GA for ECC, 48% of children had complained about their teeth, 43% had complained about chewing certain foods, 61% had difficulty in finishing meals, 35% had disrupted sleep, and 5% had some form of negative behaviour (Anderson et al., 2004). Another study reported that ECC patients weighed 13.7% less than their ideal weight (Acs et al., 1999). A study conducted in the United States showed that children who have poor oral health are more likely to have poor school performance, and it suggested that improvement of children's oral health may help to improve their educational experience (Blumenshine et al., 2008).

Children with dental caries avoid chewing food because of discomfort. It has been reported that the average time a child spent in pain before accessing dental care was 17.7 days (± 2.2 days) (Thikkurissy et al., 2012). A study in the United Kingdom showed that 16% of five year-olds and 26% of 12 year-olds had experienced pain over the past 12 months because of caries (Nuttall et al., 2006). With such high percentages of children experiencing pain for long durations of time, it is clear that the children and their families' lives can be affected. ECC may also impact on families as parents/caregivers may feel a sense of guilt for their children's condition. Further

concerns include stress related to the attention given to the affected child; time lost from school and work, travel expenses and lost wages (Griffin et al., 2000; Lee et al., 2001).

Although there are benefits and advantages to dental care under GA, there are other risks and costs involved compared with conventional dental care (Griffin et al., 2000). It has been shown that families can have significant financial and non-monetary expenses throughout the course of dental care under GA in the private sector (Griffin et al., 2000; Lee et al., 2001). Pain medication, dietary changes, lost wages, travel expenses, hotel, and parking costs are among the most substantial monetary expenses in both the private and public sectors. The non-monetary factors include sleep loss, missed meals and missed school. Also frequent sleep disruption as the child wakes with dental pain or having to prepare different food because child's teeth hurt can be burdensome on families (Anderson et al., 2004). As waiting times from the initial assessment to the treatment under GA increase, the quality of life of children and families can be affected for significant periods of time (Badre et al., 2014). No research to date has explored the longer-term impact that may be present after S-ECC and its treatment under GA. Previous studies have reported that families had loss of income before their child's GA and parents took leave from work on the day of surgery (Anderson et al., 2004). Often, families have to arrange care for other children (Holt et al., 1991).

1.2.1 OHRQoL measurement in children

The origins of OHRQoL measurement started in 1948 with the World health Organization (WHO) definition of health and quality of life. Health is defined as "*a complete state of physical, mental and social wellbeing and not merely the absence of illness*" (WHO, 1948). It describes the individual's perception of their position in life is in relation to the culture and value systems in which they live (WHO Quality of Life Assessment 1995). The WHO definition highlights the multidisciplinary, multifaceted nature of the quality-of-life construct. However, this leads to a lack of consensus in defining the quality of life (QoL) (Farquhar, 1995). QoL can be described globally as a whole, at the individual level, broken down into components, or further

broken down into focused definitions which specify features of QoL (Farquhar, 1995).

Although OHRQoL is a small part of general QoL, it is a multidimensional concept made up of multiple domains such as physical symptoms, functional status, psychological functioning, and social functioning (Cunningham et al., 2000). Combined, these domains will define health in a wider sense. The growing demand for more thorough assessment of disease states recognises that oral health cannot be measured by clinical indicators alone. Oral health is not as simple as the absence of disease. Conventional measures do not give sufficient information about the impact of dental disease (Locker, 1988). QoL measures may be suitable for measuring the effects of orofacial disorders, which are often chronic and non-fatal (Locker, 1988). Orthodontic treatment cannot be said to increase the life span, it may improve an individual's experience of life. This experience can be captured in a QoL measure (Cunningham et al., 2000). Orofacial diseases in children are separated into three groups: caries, malocclusion, and orofacial deformities despite all the other presenting conditions (Jokovic et al., 2002). The effect of these disorders can be measured using quantitative methods that provide a part of the picture of the disease experience. QoL instruments sit at the interface between quantitative and qualitative research and can give a clearer picture of the effect of the disease. Therefore, use of QoL instruments with routine quantitative measurements can more accurately measure the effect of orofacial diseases in children (Locker, 1988).

The Parental-Caregivers Perceptions Questionnaire (P-CPQ) was the first OHRQoL scale developed for measuring the OHRQoL in very young children with ECC (Jokovic et al., 2003). A separate Family Impact Scale (FIS) was developed for use alongside it (Jokovic et al., 2003). The higher the scores, the poorer the OHRQoL. The scales are intended for use with younger children and their families. The 33-item P-CPQ has four subscales (oral symptoms, functional limitation, emotional well-being and social well-being), and the 14-item FIS has three (parental emotions, parental/family activity, and family conflict).

Short-form versions have been developed more recently in order to lessen the respondent burden. This process has resulted in two closely related sets of measures: the 13-item Early Childhood Oral Health Impact Scale (ECOHIS) (Pahel et al., 2007); and the short-form P-CPQ (with 8- and 16-item versions available) and 8-item FIS (Thomson et al., 2013). Both measures arose from the pioneering work of Jokovic and Locker, but differ in how they were developed (Thomson et al., 2014). In short, the ECOHIS was developed using an epidemiological sample, and the short-form P-CPQ and FIS measures arose from secondary analysis of data from two New Zealand studies of OHRQoL changes in ECC-affected children undergoing dental treatment under GA. Unsurprisingly, perhaps, a direct comparison of the properties and responsiveness of the measures found that the ECOHIS was less suitable for investigating dental care under GA treatment-associated changes in OHRQoL in young children, and suggested it might be more suitable for epidemiological use (Thomson et al., 2014).

1.2.2 Changes in OHRQoL following treatment under GA

OHRQoL has been used to measure outcomes following dental treatment for children under GA. Many studies have shown an immediate improvement in OHRQoL after dental care under GA for ECC. In 2004, Anderson and associates explored the treatment-associated changes in OHRQoL in 95 children with a mean age of 5.1 years who had dental care under GA. In this study, parents completed a structured questionnaire to determine the COHRQoL one week pre and two weeks post treatment. Comprehensive care under GA resulted in an immediate improvement in oral health and aspects of quality of life for both the children and their families (Anderson et al., 2004). In 2008, Malden and associates evaluated the changes in OHRQoL in 208 children aged between 2 and 15 years, who had dental care under GA. Parents/caregivers filled the 49 item parent/caregiver perception questionnaire (P-CPQ) and family impact scale (FIS) questionnaire before treatment and one to three weeks after treatment. The P-CPQ and FIS questionnaires measure quality of life with the four domains of oral symptoms, functional limitations, emotional and social wellbeing. They reported that the overall mean scores of P-CPQ

decreased from 25.9 to 11.8, and the FIS scores from 10.1 to 4.0. They concluded that comprehensive dental care under GA has a significant improvement in both oral health-related quality-of-life and in the impact on the children's families (Malden et al., 2008).

In 2009, Klaassen and associates conducted a randomised control study of 104 children with a mean age of 4.8 years in the Netherlands to determine the OHRQoL and whether dental fear changes after comprehensive dental under GA. In this study, a 13-item early childhood oral health impact scale (ECOHIS) and children's fear survey schedule dental subscale (CFSS-DS) were used to evaluate COHRQoL and dental fear. Parents were asked to fill in the questionnaires before treatment and three to four weeks after treatment. The authors reported that ECOHIS scores reduced from 12.9 to 7.4 showing significant improvement in COHRQoL after comprehensive dental care under GA. This study found no reduction in children's dental fear after treatment and they concluded that children need guidance to help reduce dental fear after treatment under GA (Klaassen et al., 2009). In 2012, Gaynor and Thomson assessed COHRQoL in 157 children 10 years-of-age and below, who had dental care under GA. In this study, they used the P-CPQ and FIS to evaluate COHRQoL. This study reported that mean pre- and post-treatment P-CPQ scores decreased from 22.8 to 8.8. They concluded that dental treatment for children under GA is associated with considerable improvement in parent-reported OHRQoL (Gaynor and Thomson, 2012).

In 2014, Baghdadi, in Saudi Arabia, examined the impact of comprehensive dental care under GA on COHRQoL in 67 young children aged from 3 to 10 years, using the short form version of P-CPQ and the FIS. Parents answered the questions at the time of GA and 4-8 weeks later. Pre- and post-treatment P-CPQ overall mean scores were reduced from 19.4 to 2.8, whereas pre and post-treatment FIS mean scores were reduced from 10.6 to 2.5. The limitation of this study was the small sample size. The author concluded that there was a significant improvement in COHRQoL after comprehensive dental care under GA and suggested that a child self-reported questionnaire could be more valuable in assessing COHRQoL than proxy reporting questionnaires as there have been conflicting results from previous studies

(Baghdadi, 2014). In 2014, Cantekin and associates conducted a study in Turkey to investigate COHRQoL and dental anxiety after dental rehabilitation under GA on 311 children aged from 4 to 6 years, using the early childhood oral health impact scale (ECOHIS) and the children's fear survey schedule-dental subscale (CFSS-DS). Parents/caregivers completed the questionnaire at the time of GA and at one to three weeks post treatment. They found the overall pre-and post-treatment ECOHIS mean scores had improved from 20.6 to 11.5. The CFSS-DS anxiety scores after dental rehabilitation were significantly higher than the pre-treatment scores ($p<.001$). The authors concluded that COHRQoL had improved after dental rehabilitation under GA, while the child anxiety levels had increased after associated with the numbers of extractions (Cantekin et al., 2014).

A Lithuanian study (Jankauskiene et al., 2014) examined COHRQoL in 122 children below 6 years-of-age who had comprehensive dental care under GA, using the short version ECOHIS questionnaire. Parents completed the questionnaire at base line and one month after the treatment. The study reported that pre-and post-treatment ECOHIS mean scores were reduced significantly, from 21.3 to 6.5. However, the authors noted that, despite the considerable improvement in the scores after comprehensive dental care under GA, this had not always eliminated other impacts of ECC such as functional limitations and parental distress (Jankauskiene et al., 2014). In 2015, Baghdadi conducted a further study to investigate COHRQoL in 80 children aged from 3 to 10 years who had dental care under GA. The 33 item P-CPQ and FIS questionnaires were used, and parents completed the questionnaires before and 6-12 months after treatment. The study reported that the P-CPQ and FIS scores in all the domains (oral symptoms, functional limitations, emotional and social wellbeing) decreased after dental treatment (Baghdadi, 2015). An Australian study (Yawary et al., 2016) assessed changes in COHRQoL in 136 Australian children aged between 6 and 14 years using the ECOHIS questionnaire, after comprehensive dental care under GA. Parents filled the questionnaires at the time of GA and at two weeks and three months post treatment. The mean ECOHIS scores from pre-treatment to post- treatment at two weeks and three months were reduced from 27.8 to 19.2 and

17.1. The study concluded that the overall COHRQoL had improved significantly after comprehensive dental care under GA.

In 2017, De Souza and associates conducted a study in the United Kingdom to assess OHRQoL in 78 children with a mean age of 4.8 years, who had oral rehabilitation or extractions under GA. In this study, P-CPQ and FIS questionnaires were completed by telephone interview by parents at baseline, at the time of GA and one month later. Pre- and post-treatment P-CPQ and FIS overall mean scores were reduced by 18.7 to 5.8. There were no statistically significant differences between the oral rehabilitation group and the extraction group (de Souza et al., 2017). Jankauskiene and associates in 2017, measured COHRQoL in 144 Lithuanian children with a mean age of 3.9 years, who had comprehensive dental care under GA. The short version ECOHIS questionnaire was completed by parents at the time of GA and one and six months post treatment. They found ECOHIS mean scores were reduced after treatment. At baseline, the mean score was 1.6; one month post treatment 0.5 and six months post treatment 0.7. There was a greater caries experience at the six month follow-up with new carious lesions, indicating that dental care under GA only treats existing carious lesions but does not prevent further caries. The authors emphasized the necessity to enhance preventive efforts and improve parental knowledge and attitudes towards oral hygiene to improve oral health for their children (Jankauskiene et al., 2017).

Even with such a positive change in the quality of life for children and their families immediately after dental care under GA, it is not possible to assume that their long-term oral health will remain better (Al-Malik and Al-Sarheed, 2006). A study conducted in Saudi Arabia reported that out of 182 children who received dental treatment under GA for ECC, only 10% returned for post-GA recall visits (Al-Malik and Al-Sarheed, 2006). This may be because parents do not consider the need for dental care after treatment since the child no longer has pain or discomfort. Earlier studies reported that once a child received dental treatment under GA, they had a greater risk of a second GA for dental care in the future (Almeida et al., 2000). However, it is not clear whether this is different for children who have comprehensive care and those who have extractions only.

In a retrospective study conducted in the United States, 33 (78%) of 42 children who had received dental treatment for ECC under GA had detectable carious lesions at recall visits with 17% having a further GA within two years. This study concluded that children with ECC are highly predisposed to a higher caries incidence despite increased preventive measures (Almeida et al., 2000). A further study reported that parents perceived their child to less susceptible to new caries lesions because the teeth were restored and they were less motivated to spend time on their child's oral health (Amin and Harrison, 2007). This demonstrates that parents may not understand the risks for dental caries. The same study reported that parental beliefs were believed to stem from their own poor childhood dental care, limited family income, inadequate knowledge and less accessibility to dental services and commercial products. Therefore, it is important to understand how parental beliefs and attitudes impact on the family, and on engaging with oral health services.

The studies conducted so far have determined the COHRQoL immediately after dental care under GA. Moreover, most previous studies have used proxy reported questionnaires showing low to moderate overall agreement with child ratings (Knapp et al., 2016; Wilson-Genderson et al., 2007). A systematic review of parent and child reports on health related quality of life (HRQoL) revealed a greater agreement between proxy and child ratings with some subscales (e.g., physical HRQoL) than with other less observable subscales (e.g., emotional or social HRQoL). This highlights the need for child reported measures in OHRQoL measurement (Eiser and Morse, 2001; Gilchrist et al., 2015). Furthermore, many of the earlier studies did not have a control group, which could have been an appropriate methodology (Knapp et al., 2016). Moreover, none have assessed the long-term OHRQoL following dental care under GA. This is essential for knowing whether there is any greater caries risk prevalence; if so, then there would be a need to enhance caries prevention efforts for this group (Knapp et al., 2016).

1.2.3 Issues in measuring OHRQoL in children

As children are psychologically different to adults, measuring OHRQoL in very young children can be difficult and adult measures are not appropriate for them (Jokovic et al., 2003). As children are in a constant state of change in relation to their psychological development, OHRQoL measures need to consider the developmental stages of children in relation to comprehension, time awareness, and QoL markers (Wallander et al., 2001). Adult measures for QoL are not suitable for children as they generally need a high level of comprehension, and some instruments may have irrelevant items for children (Spieth and Harris, 1996). Even with the difficulties, older children can provide reliable information on QoL when developmental considerations are taken into account (Eiser and Morse, 2001; Jokovic et al., 2003). Even though older children can provide valid and reliable information on their own OHRQoL (Jokovic et al., 2004a), proxy raters are also useful in providing responses in situations where a child may be medically compromised or unable to communicate. A proxy rater can be a parent, caregiver or clinician who could provide information about the child's QoL. The information provided differs depending on the proxy, the disease, and the child. Proxy rater information has some limitations. A parent's knowledge is limited to direct interactions with the child and this will lead to strengths and weaknesses in reporting (Eiser and Morse, 2001). Parents will have minimal information about activities that are unsupervised or occur outside the home or changes that are not externalised (Jokovic et al., 2004a). Parents are better at judging functional limitations than emotional and social well-being (Jokovic et al., 2004a). This highlights the need for child-reported measures in OHRQoL (Eiser and Morse, 2001; Gilchrist et al., 2015).

1.2.4 OHRQoL questionnaires

OHRQoL in children is an increasingly important concept in dental health services research. A number of child OHRQoL measures have been developed in recent years. These include the 37 item Child Perceptions Questionnaire (CPQ_{11-14}), the 34 item Child Oral Health Impact Profile (COHIP) and the eight item Child Oral Impacts on Daily Performance scale (CHILD-OIDP) (Thomson et al., 2016). The CPQ_{11-14} remains

the most commonly used instrument for measuring self-reported oral health in children (Gilchrist et al., 2014). This questionnaire has used items representing each of the domains of oral symptoms, functional limitations, emotional well-being, and social well-being. Furthermore, a short-form version of this instrument was developed, with items covering each of those four domains (Thomson et al., 2016).

1.2.5 Child Perception Questionnaires

The Child Perception Questionnaire (CPQ) developed by Jokovic and associates in 2002 was the first instrument used to evaluate OHRQoL in children (Jokovic et al., 2006). In addition to the CPQ, there is a Parent's Perceptions Questionnaire (P-CPQ) (Jokovic et al., 2003) and a Family Impact Scale (FIS) (Jokovic et al., 2006; Locker et al., 2002), which are instruments that provide information at different levels and perspectives for OHRQoL in children. The CPQ has two versions; one is the $CPQ_{11–14}$ for children from 11 to 14 years of age; the other is the CPQ_{8-10}, for children aged 8 to 10 years. Both are used to evaluate the impact of oral and orofacial conditions in children at functional, emotional, and social levels. The $CPQ_{11–14}$ is the most commonly used instrument, comprising 37 items divided into four domains or subscales: oral symptoms (n=6), functional limitations (n=9), emotional well-being (n=9) and social well-being (n=13). The questions ask about the frequency of events in the previous three months in relation to the child's oral/oro-facial condition. The response options are: 'Never'=0; 'Once/twice'=1; 'Sometimes'=2; 'Often'=3; 'Everyday/almost every day'=4. The questionnaire also contains global ratings of the child's oral health and the extent to which the oral/oro-facial condition affected his/her overall wellbeing. Jokovic and co-workers developed short-form versions of the $CPQ_{11–14}$ using two different approaches. This resulted in the development of two short versions to facilitate the administration of the questionnaire in clinical settings (16 item short-form) and in epidemiological surveys involving general populations (8 item short-form) (Jokovic et al., 2006). The short version was first tested and validated epidemiologically in a sample of 12-and 13-year-old children with malocclusion and dental caries in New Zealand (Foster Page et al., 2008).

The CPQ $_{8-10}$ contains 29 questions. The first two relate to demographic information; the next two pertain to global items; the remaining 25 are divided into four domains: oral symptoms (OS), functional limitation (FL), emotional well-being (EW), and social well-being (SW). The questionnaire registers problems occurring during a prior four-week period and the responses are recorded on a Likert scale from 0 to 4, where 0=never; 1=once or twice; 2=some- times; 3=often; and 4=every day or almost every day (Jokovic et al., 2004b). Foster Page and associates in 2013 suggested that these two questionnaires are acceptable to be used in younger age groups from five. They proposed using a single questionnaire, the CPQ $_{8-10}$ or the short CPQ $_{11-14}$, to evaluate OHRQoL in children from 5 to 14 year of age (Foster Page et al., 2013), thus facilitating use in prospective studies following children through different life stages.

Recently Thomson and associates in 2016 examined the factor (domain) structure and other psychometric characteristics of the CPQ$_{11-14}$ in a large data-set of over 5000 children. This study reported that the CPQ $_{11-14}$ was found to perform very well with consistent psychometric characteristics, albeit with two underlying factors rather than the originally hypothesised four-factor structure. Its internal consistency reliability and concurrent validity were acceptable (Thomson et al., 2016). The authors concluded that, instead of using the original four factors (*oral symptoms, functional limitations, emotional wellbeing, and social wellbeing*) in the CPQ $_{11-14}$, it is appropriate to use the *symptoms/function* and *well-being subscales* (Thomson et al., 2016).

The aim of this study was to compare the OHRQoL in children five to seven years after they received comprehensive dental treatment or extractions only under GA for early childhood caries with that of children who had received restorations in the dental chair and with children who had remained caries-free.

1.3 Rationale for the current study

Almost all previous studies have investigated OHRQoL soon after dental treatment was carried out under GA. No studies appear to have looked at the OHRQoL in middle childhood several years after children have had treatment for early childhood caries as pre-schoolers. While it has been reported that caries in preschool years is a significant indicator of caries-risk in adolescence, it is not known whether this risk is already evident in the mixed dentition (Al-Malik and Al-Sarheed, 2006). When considering the appropriate level of prevention of caries in the early permanent dentition, it is important to determine whether higher caries-risk may be detected during the development and eruption of the permanent dentition. This would allow development of appropriate strategies and recommendations for this age group to develop professional preventive care and home preventive care strategies, and to recommend appropriate monitoring for this group of children.

1.4 Aims of the study

The aim was to:

Compare OHRQoL in children five to seven years after they received comprehensive dental treatment and/or extractions for early childhood caries under GA with that of children who had received dental restorations in the dental chair or children of the same age who were caries-free.

1.5 Research questions

1. Do children who have treatment under GA for early childhood caries in the preschool period have poorer OHRQoL in middle childhood than children who have had dental treatment in the dental chair?
2. Do children who had only tooth extractions under GA have similar OHRQoL to children who had comprehensive dental care to restore all their teeth under GA?
3. Do children who are caries-free have a better OHRQoL than children who had comprehensive dental care to restore all their teeth under GA?

1.6 Hypothesis

Children who present with severe early childhood caries and have treatment under GA in the preschool period will demonstrate poorer oral health in the middle mixed dentition period and poorer OHRQoL than either children of the same age group who have dental treatment in the dental chair or children who are caries-free.

Chapter 2
Materials and methods

2 Materials and methods

2.1 Ethical approval for the study

Before commencing the study, ethical approval was obtained from the University of Otago Human Ethics Committee (Ethics approval no: 16/124; Appendix 1) and the Health Research South Ethics Committee. Further approval was obtained to access the Southern District Health Board Community Oral Health Services (SDHB COHS) patient records to identify potential participants for the study (Appendix 2).

2.2 Maori consultation

Ngāi Tahu Research Consultation Committee approval was obtained prior to commencing the study (Appendix 3).

2.3 Study population

Participants were selected from dental records of patients (aged 8 to 13 years) who had received dental care under general anaesthesia provided by the University of Otago Paediatric Dentistry Discipline, from 2009 to 2011. Participants in the other two groups were selected from dental records in the SDHB COHS. Four groups were recruited to enter the study, defined by the type of dental treatment they had received:

1. Group 1 - Comprehensive treatment under GA (CDC-GA): Children who had comprehensive dental care (restorations, extractions and preventive care) for s-ECC under GA before five years of age;
2. Group 2 - Extractions under GA (Exo-GA): Children who had extraction of teeth because of s-ECC under GA before five years of age;
3. Group 3 - Restorative treatment in the chair (Tx-chair): Children who had treatment for caries in the dental chair (dmfs >2 or DMFT >1); and
4. Group 4 - Caries–free (No caries): Children who were caries-free (dmft = 0 and DMFT = 0).

2.4 Inclusion criteria

1. Children aged less than five years of age at the time of having comprehensive dental care or extractions under GA in 2009, 2010, and 2011.
2. Children of the same age group who have had treatment for dental caries in the chair (dmfs >2 or DMFT >1)
3. Children of the same age group who are caries-free (dmft = 0 and DMFT = 0)
4. All children who have had continued treatment in the SDHB COHS or the Faculty of Dentistry.

2.5 Exclusion criteria

1. Children lost to contact by the COHS or Faculty of Dentistry.
2. Children with a significant medical or developmental problem (autistic spectrum disorder, attention deficit hyperactivity disorder, cerebral palsy, cardiac condition, respiratory condition or syndrome).
3. Children with dental anomalies of hard tooth structures (eg: *Amelogenesis imperfecta*, or *Dentinogenesis imperfecta*).

2.6 Study participant selection

Children aged less than 5 years who had comprehensive dental care or only extractions under GA at the Faculty of Dentistry, University of Otago in 2009-2011 were identified from clinical records and were invited to participate in the study. In the comparative group, similar age matched children (currently 8 to 13 years of age) who had treatment for caries in the dental chair and children who remained caries-free were identified from SDHB COHS records and were also invited to participate in the study.

One hundred and ninety six children less than five years of age had dental care under GA in the years 2009, 2010 and 2011. Of these, 146 met the selection criteria to be included in the study, 102 children having had comprehensive dental care and 44 having had extractions only.

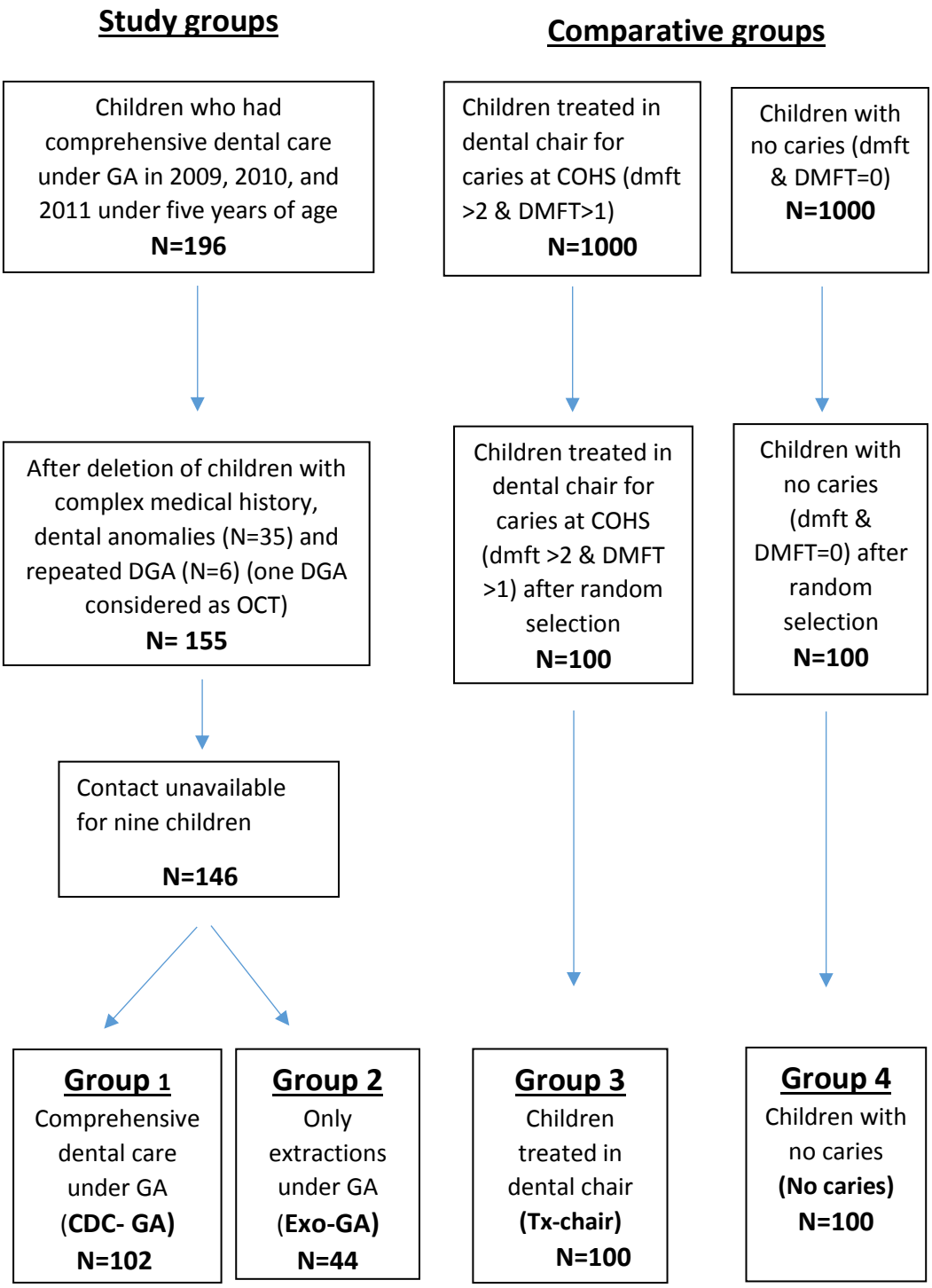
From the SDHB COHS, age-matched children were identified to be in the two comparative groups. One thousand children who had restorative dental treatment in the dental chair with dmft >2 or DMFT >1 and one thousand children who never had caries were identified. One hundred children from each of these two groups were randomly selected to be invited to take part in the study using SPSS 24 software. The study population selection is illustrated in the flow chart in Fig: 1.

The four groups with the numbers of selected participants were:

1. Group 1 (Comprehensive treatment under GA) CDC-GA (N=102)
2. Group 2 (Extractions under GA) Exo-GA (N=44)
3. Group 3 (Treatment in the chair with dmft >2 or DMFT >1) Tx-chair (N=100)
4. Group 4 (Caries –free with dmft = 0 and DMFT=0) No caries (N=100)

Fig: 1

Participant selection flow chart



2.6.1 Group 1 (CDC-GA)

Participants in this group had comprehensive dental care under GA when they were below five years of age. They were referred to the Paediatric Dental Clinic at the Faculty of Dentistry as they had severe early childhood caries and were unable to be treated in the Community Oral Health Service or with family dentists in 2009-2011. Children had been assessed by specialist paediatric dentists to determine whether treatment under GA was the most appropriate option. This was done by reviewing their dental and medical histories, the extent of dental care required and the child's coping ability for conventional dental care. If the treatment under GA was the most appropriate option then parents and caregivers were given necessary information to make an informed decision about the child's management. They were informed about the estimated waiting times and the procedures that were likely to be undertaken.

The final treatment plan was done on the day of treatment after taking radiographs in the operating theatre. The waiting times for the participants for having dental care under GA were between six and 12 months. Depending on medical conditions and/or acute problems, children were prioritized on the waiting list. During the waiting period, where possible, the children were reviewed in Paediatric Dentistry for preventive care every three months, where they received temporary restorations with glass ionomer cement or intermediate restorative material (IRM), diet advice, and prophylaxis and fluoride treatments.

Comprehensive dental care under GA was provided by specialist paediatric dentists or paediatric dentistry post-graduate students either in the Faculty of Dentistry Day Surgery Unit or the Day Surgery Unit of Dunedin Public Hospital. The treatment provided under rubber dam isolation included composite or compomer restorations, stainless steel crowns, composite strip crowns and fissure sealants. Pulpally involved primary teeth were treated with indirect pulp capping, pulpotomy and a small number with pulpectomy. Primary teeth were extracted if they had radiolucency in the furcation area, evidence of a sinus, or resorption of roots. Preventive care was provided with, prophylaxis and fluoride treatments.

Where possible the children were reviewed within three months in Paediatric Dentistry for preventive dental care that included prophylaxis, fluoride treatment, diet advice and oral hygiene advice. After this appointment they were usually referred to the COHS for ongoing care. Children coming from out of Dunedin were referred back immediately after GA to the COHS for follow up. Twenty-three participants were referred back to the COHS for routine and preventive care and 13 participants were reviewed in Paediatric Dentistry.

The COHS protocol for children who have been treated for severe early childhood caries under GA is to recall six monthly. All children have radiographs and receive prophylaxis, fluoride treatment and diet and oral hygiene advice (Clark, 2017).

2.6.2 Group 2 (Exo-GA)

Participants in this group only had primary teeth extracted under GA. They were referred to Paediatric Dentistry because of acute dental pain, abscessed primary teeth or infection from the COHS or family dentists when they were unable to manage the dental care required. These children were assessed by a specialist paediatric dentist and if the child required extraction of pulpally infected or abscessed primary teeth and could manage the remaining restorative care, they were referred for extraction of the teeth under GA. While waiting, the symptoms were managed by pulpal dressings or antibiotics and pain relief as required.

The waiting times for only extraction of primary teeth under GA were two to four months. Extractions were done at GA by specialist paediatric dentists or paediatric dentistry postgraduate students. The restorative and preventive dental care was provided later in the dental chair in one of the Faculty of Dentistry Paediatric Dentistry clinics or in the COHS. Of the 23 participants in this group, 13 participants had routine and preventive dental care in the COHS, two participants had continuing care in a Paediatric Dentistry clinic and eight participants had shared care in the COHS and the Faculty of Dentistry.

The COHS protocol for children who had primary teeth extractions for severe early childhood caries under GA is to recall six monthly. All children have radiographs and receive prophylaxis, fluoride treatment and diet and oral hygiene advice (Clark, 2017).

2.6.3 Group 3 (Tx-chair)

The participants in this group, who also had diagnosed with ECC, had restorative and preventive dental care in the COHS. In New Zealand, COHS provides routine oral health care for children under 13 years-of-age. These children were assessed and treated by dental therapists by reviewing their dental and medical histories, the extent of dental care required and the child's coping ability for conventional dental care. The treatment provided for these children included small occlusal dentinal carious lesions restored with silver amalgam, large occlusal or two or three surface carious lesions restored with stainless steel crowns. Care was carried out under local anaesthesia without rubber dam isolation. Glass ionomer restorations were used in a few patients for restoring carious lesions especially in the initial appointment stages of treatment where children were not able to manage. Abscessed primary teeth were extracted under local anaesthesia. Parents were informed about potential space loss for permanent teeth prior extraction of primary teeth. Preventive dental care provided included fissure sealants, prophylaxis, fluoride treatment with 22.6% sodium fluoride varnish, and diet and oral hygiene advice.

After completion of treatment, the COHS protocol for children who have been treated for caries is to recall six monthly. They receive radiographs between six months and yearly. The preventive dental care includes fissure sealants, prophylaxis, fluoride treatment and diet and oral hygiene advice (Clark, 2017).

2.6.4 Group 4 (No caries)

The participants in this group were diagnosed as clinically caries-free in both primary and permanent dentitions. These children are reviewed yearly by the COHS. They receive radiographs between yearly and two yearly. The preventive dental care

provided includes fissure sealants on primary molars when indicated, prophylaxis, fluoride treatment with 22.6% sodium fluoride varnish, and diet and oral hygiene advice. Parents usually attended the visits with their children (Clark, 2017).

2.7 Study Design

The contact addresses and telephone numbers for the selected children were retrieved from the records at the Faculty of Dentistry or from the SDHB COHS database. Each selected potential participant was assigned a specific identification number by a departmental administrator. Information sheets explaining the study to parents and children of both study and comparative groups (Appendices 4, 5 and 6), and consent forms to parents and children (Appendices 7 and 8) were mailed to each potential participant and parent with the 16-item Short-Form Child Perceptions Questionnaire (CPQ_{11-14}), as this questionnaire is acceptable to evaluate OHRQoL in children from 5 to 14 years-of-age (Thomson et al., 2016) (Appendix 9). A stamped addressed return envelope was included in the package invited the children and parents to participate in the study. Those who participated were invited to go in a draw for 5 X $100 grocery vouchers. After six weeks, a second mailing was sent to those who had not responded and then at 12 weeks potential participants who had not responded were contacted by telephone. If they were interested, they were sent an invitation.

The parent and child were sent separate information sheets about the study, what data or information would be collected, how it would be used, and telephone numbers of principal investigators and associate investigators if they had any questions. Parents were asked to guide their children filling out the questionnaire by reading out the questions where needed and allowing their child to choose the appropriate response. Parents were also asked to indicate what degree of help they gave their child in completing the questionnaire.

2.8 Data collection

Demographic data was collected after obtaining written consent from both parent and child. The data collected included date of birth, gender and ethnicity. Current age was recorded in years. Ethnicity was as New Zealand European, Maori, Pacific Island (included Samoan) and others which included Asian, Tongan, and Middle Eastern. The socioeconomic status (SES) was determined from each participant's school decile (NZ School deciles 2015, www.education.govt.nz). In New Zealand, the school decile indicates the socioeconomic position of the school's student community; the lower the school decile, the higher the deprivation. SES was recorded into three groups: High deprivation (scores 1-3), Medium deprivation (scores 4-7), and Low deprivation (scores 8-10).

The fluoridation status of the participants was recorded from their current address obtained from SDHB COHS and Faculty of Dentistry, University of Otago and the status was verified from the New Zealand drinking water supply website. www.drinkingwater.org.nz/supplies/fluoridation.asp. The dmfs scores (decayed missing filled surfaces, primary teeth) of participants at the time of dental care under GA were recorded for groups 1 and 2 from the GA treatment records.

The current dmfs and DMFT (Decayed Missing Filled permanent Teeth) were recorded for all participants from the most recent dental examination records at the Faculty of Dentistry or from the SDHB COHS database. The caries prevalence was categorised into three groups as little caries, low caries, and high caries. Children with a dmft or DMFT of 1 or less were placed in the little caries group; dmft or DMFT of 2 or less in the low caries group; and dmft or DMFT of 3 or more in the high caries group.

For measuring the OHRQoL, the 16-item "impact" short-form (ISF) version of the CPQ_{11-14}, questionnaire was used, which was developed by Jokovic and associates (2006). It has been tested and validated epidemiologically in New Zealand (Foster Page et al., 2008; Foster Page et al., 2013; Thomson et al., 2016). This 16-item Short Version Child Perception questionnaire (CPQ_{11-14}) includes two global rating questions. The two global questions are:

(a) Would you say the health of your teeth, lips, jaws and mouth is: Excellent/Very good/Good/Fair/Poor Global oral health-Glo O H).

(b) How much does the condition of your teeth, lips, jaws or mouth affect your life overall? Scored on a 5-point ordinal scale ranging from 'Not at all' to 'Very much', (Global general health-Glo G H). The CPQ_{11-14} measures items representing each of the domains of *oral symptoms*, *functional limitations*, *emotional well-being*, and *social well-being*.

The response options and scores for each item are: "Never" (scoring 0); "Once or twice" (1); "Sometimes" (2); "Often" (3); and "Every day or almost every day" (4). The CPQ_{11-14} subscales *oral symptoms* and *function limitations* were combined together *symptoms/function* (Symptoms) and subscales *emotional wellbeing* and *social wellbeing* were combined together as wellbeing (Wellbeing). A recent study conducted by Thomson and associates reported that CPQ_{11-14} was found to perform very well with consistent psychometric characteristics, with two subscales rather than the four subscales (Thomson et al., 2016). Accordingly, in this study, two subscales Symptoms and Wellbeing were used in determining the COHRQoL instead of using four domains (Thomson et al., 2016).

2.9 Statistical analysis

The data were analysed by using Statistical Package for the Social Sciences (SPSS) version 24.0 (IBM corporation, USA). Data was entered by the principal investigator into the Microsoft excel spread sheet and then exported for analysis to SPSS version 24.0. Internal consistency was assessed using Cronbach's alpha. Children's oral health related quality of life CPQ and global items and its subscales of four groups of participants were calculated as mean scores. Higher CPQ or global item scores indicate poorer oral health related quality of life (OHRQoL), whereas lower scores indicate better OHRQoL. One way Analysis of Variance (ANOVA) was used to compare the means. The alpha value was set at 0.05.

Chapter 3
Results

3 Results

3.1 Study participants

Participants were allocated to one of four groups depending on the previous dental care they received and their current age range between 8-13 years.

3.2 Participant response rate

In the present study, of 346 invited potential participants, 144 responded with signed consent forms and completed CPQ questionnaires. Two participants were helped by a parent (mother) to read the questionnaire, while all other participants completed the questionnaires by themselves. The response rate is presented in Table 1. Only 68 participants responded to the first mailing and 14 participants were not living at the recorded address. Another 34 participants responded to the second mailing. The remaining 230 non-respondents were contacted by telephone. Contact was made with 182 potential participants and 48 had recorded telephone numbers that were disconnected. Following verbal explanation to those contacted, written information was sent to parents who requested new forms and 42 participants responded in the following six weeks. The numbers of children who completed the questionnaires in each group were: Group 1 (CDC-GA) = 39 (26%); Group 2 (Exo-GA) = 23 (52%); Group 3 (Tx-Chair) = 36 (36%); and Group 4 (No caries) = 46 (46%).

Table 1 Response rates of study participants

Group	Eligible participants N	First response N	Second response N	Third response N	Total response N (%)	No response N (%)
CDC-GA	102	19	7	13	39 (38)	63 (62)
Exo-GA	44	8	5	10	23 (52)	21 (48)
Tx-Chair	100	18	8	10	36 (36)	64 (64)
No Caries	100	23	14	9	46 (46)	54 (54)
Total	346	68	34	42	144 (42)	202 (58)

3.3 Socio-demographic characteristics of study participants

The socio-demographic characteristics of the participants are described in Table 2. The children's ages ranged from 8 to 13 years with a mean age of 10.3 years. There were 71 males and 73 females. New Zealand European children accounted for 69%, Māori children 18%, Pacific Island children at 7% and other children 18% (Asian, Indian, and Sri Lankan) participated in this study. Those who were identified in the low deprivation socioeconomic status (SES) band made up 52% participants with only 3% of participants in the high deprivation SES band. There were no statistically significant differences by with age (p=0.244), gender (p=0.137), ethnicity (p=0.072), or SES (p=0.122) among the groups.

Table 2 Socio-demographic characteristics of study participants

	CDC-GA N (%)	Exo-GA N (%)	Tx-Chair N (%)	No caries N (%)	Total N (%)
Age range (mean)	8-10 (10.4)	8-10 (9.8)	8-10 (10.5)	8-10 (10.5)	8-10 (10.3)
Gender					
Male	23 (59)	14 (61)	17 (47)	17 (37)	71 (49)
Female	16 (41)	9 (39)	19 (53)	29 (63)	73 (51)
Ethnicity					
NZ European	26 (67)	13 (56)	27 (75)	34 (74)	100 (69)
Māori	4 (10)	2 (9)	3 (8)	9 (20)	18 (12)
Pacific Island	4 (10)	2 (9)	1 (3)	1 (2)	8 (7)
Other	5 (13)	6 26)	5 (14)	2 (4)	18 (12)
Socio economic status					
Low	0	1 (4)	2 (6)	1 (3)	4 (3)
Medium	22 (56)	12 (53)	17 (47)	14 (30)	64 (44)
High	17 (44)	10 (43)	17 (47)	31 (67)	75 (52)
Number of participants	39 (27)	23 (16)	36 (25)	46 (32)	144 (100)

3.4 Fluoride status of study participants

The fluoride status of the participants was recorded according to the water supply at their current addresses. Participants living in fluoridated water supply areas made up 58% of the total numbers, with 42% living in non-fluoridated areas. There was no statistically significant difference in fluoridation status between the groups with p=0.913 (Table 3).

Table 3 Water fluoride status of study participants

	CDC-GA N (%)	Exo-GA N (%)	Tx-Chair N (%)	No caries N (%)	Total N (%)
Fluoride status					
Fluoridated water	24 (62)	14 (61)	21 (58)	25 (54)	84 (58)
Non-fluoridated water	15 (38)	9 (39)	15 (42)	21 (46)	60 (42)

3.5 Current caries status of study participants

In this study, the current caries prevalence was categorised into three groups: little caries, low caries, and high caries. Children with a dmft or DMFT of 1 or less were placed in the little caries group; those with a dmft or DMFT of 2 or less were in the low caries group; and those with a dmft or DMFT of 3 or more were in the high caries group. This is detailed in Table 4. In the CDC-GA group, 37 (95%) of 39 children were categorized as having evidence of caries in the primary dentition. Of these, 19 (51%) had evidence of high caries. In the Exo-GA group, 15 of 23 children were categorized as having evidence of caries in the primary dentition. Of these, nine (60%) had evidence of high caries. In the Tx-chair group, 30 of 36 children were categorized as having evidence of caries in the primary dentition. Of these ten (33%) had evidence of high caries experience. No children in the No caries group had evidence of high caries experience currently.

In the CDC-GA group, 14 (36%) of 39 children were categorized as having evidence of caries in the permanent dentition. Of these 2 of 14 (14%) had evidence of high caries. In the Exo-GA group, 7 (30%) of 23 children were categorized as having evidence of caries in the permanent dentition. Of these one (14%) had evidence of

high caries. In the Tx-chair group, 16 of 36 children were categorized as having evidence of caries in the permanent dentition. Of these, three (19%) had evidence of high caries. No children in the No caries group had evidence of high caries in the permanent dentition currently. Around 45% of participants who caries in the primary dentition had two or more lesions in the permanent dentition currently.

The mean current dmft score of the CDC-GA group was 2.43, whereas the mean current dmft scores for the Exo-GA and Tx-chair groups were 2.04 and 2.11. A current DMFT score of 1.52 was recorded for the Tx-chair group, whereas the mean current DMFT score for the CDC-GA and Exo-GA groups were 1.41 and 1.34. The mean dmft at GA of 2.97 was recorded for CDC-GA group, whereas the Exo-GA groups mean dmft at GA was 2.39. There were no statistically significant differences among the groups regarding current dmft or DMFT and dmft recorded at GA.

Table 4 Mean current dmft, current DMFT and dmft at GA of the study participants

	CDC-GA N (%)	Exo-GA N (%)	Tx-Chair N (%)	No caries N (%)	Total N (%)
Current dmft					
Little caries	2 (5)	8 (35)	6 (16)	46 (100)	62 (43)
Low caries	18 (46)	6 (26)	20 (56)	0 (0)	44 (31)
High caries	19 (49)	9 (39)	10 (28)	0 (0)	38 (26)
Mean present dmft	2.43	2.04	2.11	0.00	
Current DMFT					
Little caries	25 (64)	16 (70)	20 (56)	46 (100)	107 (73)
Low caries	12 (31)	6 (26)	13 (36)	0 (0)	31 (22)
High caries	2 (5)	1 (4)	3 (8)	0 (0)	6 (5)
Mean present DMFT	1.41	1.34	1.52	0.00	
dmft at GA					
Little caries	0 (0)	0 (0)	-	-	-
Low caries	1 (3)	14 (61)	-	-	15 (24)
High caries	38 (97)	9 (39)	-	-	62 (76)
Mean dmft at GA	2.97	2.39			

3.6 Participant OHRQoL CPQ scores

The mean CPQ total and subscales domain scores are presented in Table 5. The total mean CPQ score recorded after 5-7 years for children who had received comprehensive dental care under GA during their preschool years was statistically significantly higher than the scores for children in the other treatment groups (p=0.014). Similarly, the oral symptom/functional limitations (Symptoms) subscale domain mean scores were statistically significantly higher in the CDC- GA and Exo-GA groups than the scores for the other two groups (p< 0.007). Children who had remained caries-free (No caries group) were found to have the lowest mean CPQ total and subscale domain scores. There was no statistically significant difference reported in the emotional/social wellbeing (Wellbeing) domain scores between the groups.

Table 5 OHRQoL mean CPQ scores for participants

	CDC-GA (SD)	Exo-GA (SD)	Tx-Chair (SD)	No caries (SD)	*p*-value
Total CPQ	15.6 (10.6)[a]	13.6 (6.6)	12.3 (7.2)	10.0 (7.7)	<0.014
Symptoms	8.6 (5.4)[a]	8.6 (4.4)	6.6 (4.1)	5.4 (4.7)	<0.007
Wellbeing	7.0 (5.9)	5.0 (3.4)	5.7 (4.5)	4.6 (4.2)	<0.109

[a] $p < 0.05$

3.7 Participant OHRQoL against global questions

There were two global items (questions) on oral health related quality of life (OHRQoL) included in the questionnaire:

a. *"Would you say the health of your teeth, lips, jaws and mouth is?" (Scored: 1-5 as Excellent/Very good/Good/Fair /Poor.* (Glo O H).

b. *"How much does the condition of your teeth, lips, jaws or mouth affect your life overall?" (Scored on a 5-point ordinal scale ranging from 'Not at all (scores 1) to Very much (score 5)'.* (Glo G H).

The CPQ_{11-14} showed higher scores in groups with worse self-reported oral health are presented in Table 6. A consistent gradient was observed in the scores across the response categories from 'Not at all' to Some/A lot/Very much' with the impact on quality of life among all groups. A similar gradient was gradient was observed for the self-rated oral health responses 'Excellent' to 'Fair/Poor' except in the Tx-chair group. All the groups demonstrated positive, statistically significant and similar correlations with the ratings of oral health impact on quality of life.

Table 6 Participant OHRQoL against global item scores

Global questions	CPQ_{11-14} ISF (SD)		
	CDC-GA + Exo-GA groups N=61	Tx-chair N=34	No caries N=45
Glo O H			
Excellent	11.6 (7.5)[a]	4.8 (3.8)[a]	6.1 (4.2)[a]
Very good	13.9 (6.8)	11.4 (7.4)	8.9 (4.4)
Good	15.6 (8.3)	13.6 (6.9)	20.6 (10.8)
Fair/Poor	25.5 (13.6)	10.3 (5.5)	24.0 (11.6)
Glo G H			
Not at all	11.0 (6.5)	11.1 (8.9)	7.7 (6.2)[a]
Very little	15.7 (6.8)	13.6 (5.4)	10.9 (5.9)
Some/A little/Very much	27.9 (12.7)	17.8 (5.5)	21.5 (12.9)

[a] $p < 0.05$

3.8 OHRQoL CPQ and global item mean scores for participants who had dental care under GA

The overall mean CPQ and global items, and subscales domains mean scores of the CDC-GA and Exo-GA groups of children are presented in Table 7. There were no statistically significant differences between children who had comprehensive care under GA and children who had only extraction of teeth.

Table 7 OHRQoL mean CPQ and global item scores for participants who had care under GA.

	CDC-GA (SD)	Exo-GA (SD)	*p*-value
Total CPQ	15.6 (10.6)	13.6 (6.6)	0.382
Symptoms	8.6 (5.4)	8.6 (4.4)	0.986
Wellbeing	7.0 (5.9)	5.0 (3.4)	0.152
Glo G H	2.3 (1.0)	1.8 (1.0)	0.071
Glo O H	1.7 (0.8)	1.5 (0.5)	0.200

[a] $p < 0.05$

3.9 OHRQoL CPQ and global items by sociodemographic characteristics

The overall mean CPQ and global item scores according to sociodemographic characteristics of the study participants are presented in Table 8. The emotional and social wellbeing CPQ subscale domain scores in children living in non-fluoridated water supply areas were statistically significantly higher than the scores for children living in fluoridated water supply areas (p=0.043). There were no statistically significant differences in the CPQ and global item subscale mean scores by gender, ethnicity or the socioeconomic status of participants.

Table 8 Participant OHRQoL mean scores of CPQ domains and global item scores by sociodemographic characteristics

	Symptoms (SD)	Wellbeing (SD)	Total CPQ (SD)	Glo G H (SD)	Glo O H (SD)
Gender					
Male	7.3 (4.5)	5.7 (4.9)	13.1 (8.2)	2.1 (0.9)	1.5 (0.6)
Female	6.9 (5.2)	5.4 (4.8)	12.3 (8.9)	2.0 (0.9)	1.7 (0.7)
Ethnicity					
NZ European	6.8 (4.7)	5.1 (4.9)	11.9 (8.6)	1.9 (0.9)	1.5 (0.6)
Māori	8.9 (6.6)	7.3 (4.7)	16.9 (10.1)	3.4 (0.9)	1.7 (0.8)
Pacific Island	8.9 (5.9)	6.6 (3.9)	15.5 (8.9)	2.6 (0.9)	1.7 (0.7)
Other	6.2 (2.8)	5.9 (3.8)	12.5 (4.7)	2.2 (1.1)	1.7 (1.6)
SES					
Low	8.0 (7.0)	9.0 (8.1)	19.7 (12.2)	2.0 (0.8)	1.7 (0.9)
Medium	7.1 (4.8)	5.2 (4.3)	12.4 (8.3)	2.3 (1.0)	1.6 (0.7)
High	7.0 (4.9)	5.8 (4.9)	12.9 (8.6)	1.9 (0.8)	1.6 (0.6)
Fluoride status					
Fluoridated water	6.6 (4.7)	4.9 (4.1)	11.6 (7.8)	2.0 (0.8)	1.5 (0.6)
Non-fluoridated	7.7 (5.0)	6.5 (5.4)[a]	14.3 (9.3)	2.2 (1.0)	1.7 (0.7)

[a] $p < 0.05$

3.10 Participant overall CPQ and global item scores by dmft and DMFT

The overall mean CPQ and global item scores according to the current dmft, DMFT and the dmft at GA are presented in Table 9. Children who had high caries in the current dmft group had statistically significantly higher mean CPQ and subscale domain scores (Symptoms p=0.003; Wellbeing p=0.027; and total CPQ p=0.002). They also showed statistically significantly higher mean global general health scores (Glo G H) (p<0.023). There was no statistically significant difference reported CPQ scores related to the current DMFT, and the dmft at GA.

Table 9 Participant OHRQoL mean scores of CPQ domains and global item scores by current dmft & DMFT, and dmft at GA

	Symptoms (SD)	Wellbeing (SD)	Total CPQ (SD)	Glo G H (SD)	Glo O H (SD)
Present dmft					
Little caries	5.9 (4.5)	4.5 (4.1)	10.4 (7.3)	1.9 (0.8)	1.4 (0.6)
Low caries	5.9 (4.6)	5.8 (4.6)	11.7 (7.9)	2.2 (1.0)	1.6 (0.7)
High caries	9.3 (5.3)[a]	7.1 (5.5)[a]	16.4 (9.9)[a]	2.3 (0.8)[a]	1.8 (0.7)
Present DMFT					
Little caries	6.9 (5.2)	5.5 (4.8)	12.5 (9.1)	2.0 (0.9)	1.5 (0.7)
Low caries	7.5 (3.9)	5.9 (4.5)	13.5 (7.0)	2.2 (0.8)	1.7 (0.6)
High caries	6.9 (3.2)	5.1 (4.6)	12.0 (7.5)	2.3 (1.2)	1.5 (0.5)
dmft at GA					
Low caries	9.8 (5.0)	5.9 (4.0)	15.7 (8.0)	2.0 (1.2)	1.5 (0.6)
High caries	8.2 (5.0)	6.3 (5.5)	14.5 (9.7)	2.7 (0.9)	1.6 (0.7)

[a] $p < 0.05$

3.11 Comments from respondents

Some of the children who participated in the study wrote comments about their oral condition in the CPQ_{11-14} questionnaire. The children in the CDC-GA group commented about their oral symptoms and functional limitations suggesting how their teeth were affecting their lives.

"mostly apples stuck between the teeth"

"difficulty in saying three"

"especially cold foods hurts teeth"

A child in the Exo-GA group stated the functional limitations indicating difficulty in speaking specific words because of early loss of teeth.

"not good at "th" and "rr" sounds"

In the Tx-chair group children reported oral symptoms and social and emotional wellbeing.

"bottom teeth and jaw hurts"

"Alex teased me when my teeth hurts"

"wasn't able to watch rugby"

No additional comments were reported in the No caries group.

Chapter 4
Discussion

4 Discussion

This is believed to be the first study to have investigated the OHRQoL of children in the middle mixed dentition period following a history of severe early childhood caries and treatment under general anaesthesia when they were of preschool age. Furthermore, the study compared the OHRQoL of these children with children who had dental caries treated in the dental chair and children who have never been diagnosed with dental caries. In this study, children in the CDC-GA group had poorer OHRQoL, mainly in the oral symptoms/functional limitation domains. However, there were no statistically significant differences in OHRQoL between children in the CDC-GA and Exo-GA groups. While children who have high caries (high current dmft) in the primary dentition reported poorer OHRQoL, children who had high caries at the time of dental care under GA have more caries currently than that of the children in the other groups. Approximately 45% of the participants who had dental caries in the primary dentition have two or more carious lesions in the permanent dentition.

Severe health inequalities exist in oral health, both internationally and in New Zealand. In New Zealand, the caries prevalence is around 43% in children below five years-of-age. It is reported to be greater in Maori (63%) and Pacific Island (67%) children (Ministry of Health NZ, 2013). Moreover, many studies have demonstrated considerable evidence of poor oral health being linked to socioeconomic deprivation (Harris et al., 2004; Ministry of Health NZ, 2006; Kawashita et al., 2011). It has also been shown that rurally-based children have a much higher risk of poor oral health than urban-based children due to lack of access to fluoridated water and poorer access to dental care (Ministry of Health NZ, 2013). Specifically, the proportion of caries-free children (under the age of five) is significantly higher among those who live in areas of fluoridated water supply, than with those who live in areas where the water supply is not fluoridated (Ministry of Health NZ, 2013).

In contrast to previous studies investigating OHRQoL soon after the care under general anaesthesia, the present study has not shown any significant differences in OHRQoL between the different groups of participants by ethnicity, socioeconomic

status or fluoridation status. This may be due to the low numbers of participants in the study and the lower proportions of ethnicities other than NZ European (NZ European (69%), Maori (12%), Pacific Island (6%) others (12%)). Interestingly, 96% of participants who responded were categorised from their school decile as having low or medium deprivation. This possibly reflects the higher caries experience in children with low socioeconomic status. Around 58% of the participants were from an area with a fluoridated drinking water supply area which reflects the population seeking care under general anaesthesia in the Otago region.

In the present study, the CDC-GA group reported a poorer overall OHRQoL. This follows previous research findings in children with severe early childhood caries around the time they receive care under GA (Foster Page et al., 2008). Children in this study who had severe caries in their primary teeth reported a poorer OHRQoL in the middle mixed dentition period. Several studies have shown an immediate improvement in quality of life in children who had dental care under GA for ECC (Anderson et al., 2004; Malden et al., 2008; Klaassen et al., 2009; Cantekin et al., 2014; Jankauskiene et al., 2014; Jankauskiene et al., 2017; de Souza et al., 2017). However, it appears from the present study that having S-ECC has an ongoing impact on OHRQoL through middle childhood and which is able to be measured. This impact has also been described in an older group of children (D'Mello et al., 2011).

The study also found that children with ECC who had received care in the dental chair reported that their overall general health was affected by dental caries. This was noted more by this group than in the other groups in the study. It is not clear why this should be as the questionnaire did not allow for specific detail about the aspects of health they may have been referring to.

4.1 Comparison of OHRQoL between the four groups

Children who had comprehensive dental care under general anaesthesia for ECC when they were below five years of age reported poorer OHRQoL at 8-13 years of age than to the other groups in this study. Moreover, they reported poorer OHRQoL in the oral symptoms and functional limitation subscales than in the emotional and

social well-being subscales. The data in Table 5 demonstrate that both total CPQ and the oral symptoms/functional limitation domains show substantially greater mean scores than the CPQ scores for the other groups**.**

While children in the Exo-GA and Tx-chair groups reported similar poorer OHRQoL with mean total CPQ scores of 12.6, the numbers of participants were too small to show statistical significance. They were also not statistically significantly different to the scores of the CDC-GA group. The children in Exo-GA group may have reported poorer OHRQoL because of malocclusion or difficulty in chewing. However, this is not known. The children in the Tx-chair group might have reported poorer OHRQoL because of recurrence of caries, failure of restorations, use of local anaesthesia during restorations, malocclusion because of early loss of teeth, or dentally related pain. Similar issues to these were reported in children who had dental care for ECC in a Trinidad study (Naidu et al., 2016). Overall the children in the No caries group reported a better OHRQoL when compared to all other groups in this study. This indicates that dental caries in the primary dentition does have a significant impact on OHRQoL in the middle mixed dentition period.

Previous studies have measured pre-and post-treatment OHRQoL immediately, after one month, three months, six months or one year for children who have had dental care under GA for ECC (Anderson et al., 2004; Malden et al., 2008; Klaassen et al., 2009; Cantekin et al., 2014; Jankauskiene et al., 2014; Jankauskiene et al., 2017; de Souza et al., 2017). One difficulty with these studies is that they have used parents or guardians as proxy reporters for the information. The parental perception questionnaire was used in most studies and this has been suggested to have a risk of observer bias (Gilchrist et al., 2014). The children themselves were asked to complete the questionnaire in this study which should give a more accurate reflection of their beliefs of the impact of their oral health on their lives. At the present time, there is no validated instrument for very young children to provide this information.

A significant issue for children who receive dental care under GA is the recurrence of caries at six months follow-up, which has been reported to be 52%, 24%, and 37% in

three previous studies (Berkowitz et al,. 2011; Amin et al,. 2010; Graves et al,. 2004). Almeida and associates reported that there was 17% recurrence of caries in children who had restorative dental care under GA after 24 months (Almeida et al., 2000). A retrospective study conducted in New Zealand in 292 children who dental care under GA for ECC found that 55% had developed new caries within two to four years (Drummond et al., 2004). These studies indicate that children who have comprehensive dental care under GA are still at high caries risk in middle childhood and this may explain their reported poorer OHRQoL. Foster Page and associates in 2008 conducted a study to evaluate OHRQoL in children five to eight years after they had restorative dental care for caries in community clinics in New Zealand. They reported that children who had experienced higher levels of caries reported poorer OHRQoL in the oral symptoms and functional limitations domains than in the other domains (Foster Page et al., 2008).

It was noted that, of the participants in the present study who had received comprehensive care under GA, around 48% currently had high caries experience (dmft > 3) in the primary dentition. They also were more likely to have caries in their permanent teeth. This might explain the worse scores they reported in the oral symptoms/functional limitations domains. This is partially supported by some participants who added additional comments at the end of the questionnaires. The comments included the problems with food getting stuck between their teeth, sensitivity to cold things and difficulty in speaking certain words (*"mostly apples stuck between the teeth"; "difficulty in saying three"; "especially cold foods hurts teeth*"). This suggests that further research is required to understand how caries including open carious lesions impact on children in their daily lives.

From COHS records it was noted that 84% of these participants after completion of treatment were followed up at COHS at six-monthly intervals for preventive care (Clark, 2017). It is not clear whether this continues throughout the mixed dentition period or only until the children are believed to have a lower caries risk. According to AAPD guidelines, children who have dental care under GA for ECC should be considered as high caries risk for at least the following 24 months (AAPD, 2014). There is a suggestion from the present study that 6-monthly recall at least in the first

year following treatment may not be effective and future research should consider what might be done to decrease the ongoing risk for these children. Also, it may be useful to consider more frequent recalls at the time of eruption of the first permanent molars as in the present study around 45% of participants had two or more carious lesions in their permanent teeth.

Previous studies have suggested that, at the time of dental treatment under GA, there is a window of opportunity where both parents and children are receptive to positive oral health messages and are willing to implement suggestions provided by their oral care team (Fuhrer et al., 2009; Amin et al., 2006; Peretz et al., 2000). It is thought that the GA experience has an intense emotional effect on parents, and this may serve as a motivator to make immediate but unfortunately short-lived changes in oral health behaviours (Amin et al., 2006). Parents and children may be more receptive to guidance related to positive oral care during the time immediately following the provision of dental treatment under GA. Therefore, a range of techniques to improve delivery of preventive services (anticipatory guidance and motivational interviewing) may serve to improve the outcomes of prevention. It would be beneficial to study the effect of different ways and times to deliver preventive services for these very high-risk children and their families in order to evaluate the strength and duration of positive oral health behaviour changes subsequent to treatment under GA. In the present study, many of the children who are treated under GA failed to attend follow up appointments. This may be due to the belief of some parents that their child's mouth is healthy and they do not need care, or due to problems of access – too far to travel or difficulty in getting time off work. These aspects do require further investigation to try and improve the long term outcomes for these children.

Fifteen participants were placed on three monthly preventive visits for the immediate period after the GA in the Paediatric Dental Clinics in the Faculty of Dentistry. This was because of medical or severe behavioural issues. This study, however, did not investigate how reliably these appointments were kept or whether there were improved outcomes with this additional service. Future prospective longer term research could investigate the impact of different preventive

approaches on children's oral health in middle childhood when they have been identified with very high risk in the early primary dentition.

There were no statistically significant differences reported in emotional and social well-being subscales scores in the present study among the four groups of participants. However, the scores for children in the CDC-GA group were worse than for children in the other three groups. This reflects the findings of D'Mello et al, who found this in 12-13-year-olds who had had treatment for severe ECC in early childhood (D'Mello et al., 2011). This may suggest that overall OHRQoL remains worse for these children throughout childhood and perhaps through adolescence. Further research should concentrate on this to provide support for these children having more targeted prevention throughout this time.

4.2 OHRQoL comparisons between the CDC-GA and Exo-GA groups

No significant differences were found in OHRQoL between the CDC-GA and Exo-GA groups. This is similar to findings of a recent study conducted in the United Kingdom, evaluated OHRQoL one month post-GA in children who had restorative care under GA and only extractions of primary teeth under GA for ECC (de Souza et al., 2017). This study evaluated the change in OHRQoL one month after treatment (de Souza et al., 2017). They reported that there is no significant difference in OHRQoL in both the groups. In the present study, oral symptoms/functional limitation scores were higher in both groups than in the control group. Because the current study was conducted several years after GA, the scores may be reflecting the current oral health which may include recurrence of caries, failure of restorations requiring replacement, malocclusion, loss of primary teeth or exfoliating primary teeth. One of the participants, reported having difficulty in a saying specific words with "th" and "rr" sounds. Difficulty in speaking has been reported in previous studies which explored the effects of early extraction of primary teeth (Ngan et al., 1999).

4.3 Quality of life association with global items

The global items considered in the current study were:

(a) *"How much does the condition of your teeth, lips, jaws or mouth affect your life overall?" (Scored on a 5-point ordinal scale ranging from 'Excellent' to 'Poor')* (Glo G H).

(b) *"Would you say the health of your teeth, lips, jaws and mouth is?" (Scored: Excellent/Very good/Good/Fair /Poor,* (Glo O H).

The children who had poorer OHRQoL among the groups reported that their oral condition had a negative impact on their lives overall, this was presented in Table 6. This might be because of a diminished quality of life, sleep disturbances, difficulty in eating, concentration problems at school and sports, and frequent visits to dental clinics. Other studies have reported similar findings as well as reporting that children may avoid smiling and laughing (Acs et al., 1992; Arora et al., 2011).

4.4 Caries and OHRQoL

The participants in the present study who had current high caries experience, reported poorer OHRQoL in all domains. They reported a negative impact on their quality of life. These findings are similar to previous reports (Foster Page et al., 2005; Locker et al., 2007). The present study has demonstrated that experience of severe caries in the primary dentition is associated with children having a poorer OHRQoL in middle childhood. In previous studies which evaluated the OHRQoL in 12-13-year-old children with caries, Foster Page et al., (2005) found that a DMFS score of four or more was associated with a negative impact on overall OHRQoL through the oral symptoms and social well-being domains (Foster Page et al., 2013), while Brown and colleagues (2006) found that a high DMFT was significantly associated only with oral symptoms (Brown et al., 2006). In the present study, almost 45% of the children who had severe caries in the primary dentition had experienced two or more carious lesions in permanent teeth. This may be an underestimate as most children are seen only yearly in the COHS and the DMFT score recorded for the study may have been up to 12 months old. It is also not clear whether these children have had

radiographic investigation regularly. This indicates that these children have an ongoing high caries experience in the middle mixed dentition which may be greater than detected in the present study.

4.5 Follow-up preventive care

Oral health care for children in New Zealand is publicly funded. In Otago, because of constraints with high numbers of patients, recall appointments are provided only every 12 months at COHS unless very high risk or need is identified and dental therapists can review children in three months. The same funding model applies to children seen in the Paediatric Dental Clinics in the Faculty of Dentistry. Following treatment under GA, some children have preventive visits three-monthly because of medical or developmental problems/risk. Some of these children remain as permanent patients because their care is outside the scope of the COHS. Their care is provided under the guidance of specialist paediatric dentists. Where possible, children are referred back to the COHS as soon as they are able to cope in the chair. In the present study, 84% of the participants were being reviewed in the COHS, whereas the remaining children were reviewed three to six-monthly in the Faculty of Dentistry. The AAPD Guidelines (2014) suggest that children with high caries risk should be reviewed every three months and should be assessed with radiographs every six months (AAPD 2014). It would be appropriate to review children until there is evidence of decreased risk of caries. It may be of benefit to tag children who have experienced severe early childhood caries so that they are able to be seen at six monthly intervals through adolescence to attempt to prevent caries in the permanent dentition. Several studies have shown that having early childhood caries is one of the strongest indicators of risk of caries in the permanent dentition in adolescence (D'Mello et al., 2011; Peretz et al., 2003; Al-Shalan et al., 1997).

ECC is a complex multifactorial, behaviour-associated disease (O'Mullane and Parnell, 2011). Children who have dental care under general anaesthesia for ECC are at higher caries risk later, especially to the permanent dentition if their dietary and oral hygiene habits do not improve (Amin et al., 2010). Improper dietary habits involving frequent consumption of high-sugar drinks and foods and inappropriate

oral hygiene practices by parents/caregivers in very young children have been shown in many studies to increase caries risk (Dye et al., 2004; Chhabra and Chhabra, 2012). Consequently, a history of ECC is a strong risk indicator for recurrence of caries, if parent/caregiver practices continue in the same way after dental care under general anaesthesia. This was shown by Amin and associates in their 2010 study, which demonstrated that children who had dental care under GA were less likely to have recurrent caries in the short term but were more likely to have new caries in the longer term if their caregivers did not maintain positive dietary and oral health behaviours (Amin et al., 2010). This indicates the need for constant reinforcement of proper dietary and oral hygiene habits as well as instigating behaviour change (Amin et al., 2015).

Another aspect to consider is the dental anxiety/fear with which some children with ECC present. Earlier, it was reported that some children who had dental care under GA for ECC maintained their dental anxiety or fear following treatment (Klaassen et al., 2009). One study recommended good follow-up care with appropriate behaviour management to manage this aspect to avoid child dental fear persisting in the future (Klaassen et al., 2009). To guide the children back to normal dental care after dental care under GA, dental fear needs to be managed, since it is strongly associated with behaviour management problems (Baier et al., 2004; Gustafsson et al., 2010). The only gentle way to treat dental fear is to re-familiarize a child to the dental environment. Furthermore, earlier studies have reported that reliably attending recall appointments after dental care under GA was associated with lower rates of caries recurrence in children (Amin et al,. 2010; Foster et al,. 2006). This suggests that behaviour management and preventive care including professional oral hygiene instruction, diet advice and fluoride treatment at follow-up appointments are important in preventing the recurrence of caries and reducing the impact on OHRQoL.

4.6 The OHRQoL instrument

Measuring oral-health-related quality of life in young children has important implications because it can enhance understanding of how oral conditions affect the lives of young children (Malden et al., 2008). Earlier studies have evaluated children's OHRQoL immediately after they had received comprehensive dental care for ECC or within six months using parental satisfaction surveys. Instruments used in earlier studies include PCQ-FIS or ECOHIS questionnaires, including their short versions (Thomson et al., 2016). Parental perception questionnaires cannot appropriately assess the social and emotional wellbeing of children (Jokovic et al., 2004a). It has been suggested that parent-reported questionnaires provide an observer's bias (Gilchrist et al., 2014). However, at this time, there are some limitations in having children respond due to age and language comprehension. The $CPQ_{11\text{-}14}$ (along with its short-form versions) remains the most commonly used instrument for measuring self-reported oral health in children (Thomson et al., 2016). In the present study, the Impact 16-item Short-Form Child Perceptions Questionnaire ($CPQ_{11\text{-}14}$) was used to evaluate the OHRQoL. This questionnaire was tested and validated in New Zealand (Foster Page et al., 2008). Moreover, in the present study, instead of using the original four factors (*oral symptoms, functional limitations, emotional wellbeing, and social wellbeing*) found in the CPQ $_{11\text{-}14}$, two factors were used: *symptoms/function and well-being subscales*. These have been reported as reliable and have been validated in measuring a large international sample (Thomson et al., 2016). In the present study, participants were eight to thirteen years of age (with a mean age of 10 years). The $CPQ_{11\text{-}14}$ has been validated in measuring OHRQoL in children aged from five to fourteen years in a study conducted in New Zealand (Foster Page et al., 2008). In the present study, the internal consistency was good with a Cronbach's alpha score of 0.8. By using the Impact 16-item Short-Form Child Perceptions Questionnaire ($CPQ_{11\text{-}14}$), it was possible to evaluate child-reported OHRQoL without having the potential for parent observer bias, as reported in the earlier studies (Eiser and Morse, 2001; Gilchrist et al., 2015).

The 16-item Short-Form Child Perceptions Questionnaire (CPQ_{11-14}) has two global questions which help in evaluating children's perception about the impact on their overall life and oral health. Earlier studies showed that global items are validated and validated that young children can report appropriately about the impact of poor oral health status on their quality of life (Foster Page et al., 2008). In the present study, the oral health of the children who had care in the dental chair for ECC had a marked greater impact on their life than for children in the other groups. It would be interesting to investigate this further in future studies to determine what aspects of the disease or the care might have influenced this response. None of the groups reported that the condition of the teeth, jaws and mouth was poor or fair. This might suggest that despite ongoing caries in the high risk children, their mouths were comfortable at this stage of their dental development.

4.7 Limitations of the study

The response rate in this study was 42%, which is lower than in previous studies including those that looked at immediate changes in OHRQoL (Anderson et al., 2004; Malden et al., 2008; Jankauskiene et al., 2017; de Souza et al., 2017). Previous studies were carried out one week to two years after treatment. Certainly, in the shorter term follow-up period, children and parents may have had more interest in commenting about what had happened and what impact it has had on the children and families. As discussed earlier, the present survey could have been sent out with an introductory letter rather than just the information sheet and the second mailing would have been better timed outside the summer Christmas holiday period when children were completing school before the summer Christmas break and parents were preoccupied with holiday preparations. A larger sample would be needed to assess differences in OHRQoL between the ethnic groups because the numbers in the present study were too small to assess representative results from children from different ethnic groups.

In this study, OHRQoL was not recorded at the time of GA for the CDC-GA and Exo-GA groups. If recorded routinely, it could provide good opportunity to measure

OHRQoL over time. This would give an improved understanding about changes in OHRQoL over longer periods of time. One issue is that the CPQ_{11-14} questionnaire has not been validated for children below five years of age. It would be worthwhile to try to develop a suitable instrument to allow a better appreciation of the longer term changes in OHRQoL. This may include parental proxy reporting or a different questionnaire using interviewing or a more visual approach to overcome language barriers.

4.8 Future research

Since many previous studies have indicated that caries in the primary dentition is a predictor for caries risk in permanent teeth, it is important to understand the long-term changes that occur following dental care under GA for ECC and the associations with OHRQoL. As many children reported poorer OHRQoL in oral symptoms and functional limitations, it is important to look in more detail at the oral health changes and the association with OHRQoL. A wide range of oral health measures could be evaluated including tooth surface changes, changes to the developing dentition, malocclusion resulting from primary teeth extraction, consistency of post-treatment follow-up, parental attitudes towards child oral health after dental care under GA and OHRQoL. Some of these aspects could be measured as part of routine dental check-ups which would allow large data-sets to be accumulated over time. Preventive care is important for these children after GA to prevent recurrent caries and reducing dental anxiety and fear. For preventive strategies, it is important to determine OHRQoL in relation to different preventive approaches and timing of follow up. The outcomes of introducing a motivational interviewing (MI) approach could be investigated. Several studies have shown that when parents of paediatric dental patients receive oral hygiene advice in an MI style, they demonstrated improved oral health behaviours and the patients had less caries (Freudenthal et al., 2010). Specific behaviour management approaches to providing care for children after GA care could also be investigated to determine whether there is an improvement in child coping skills through middle childhood. The present study had an indication that shorter follow-up periods may have better outcomes, but this

should be investigated further. Previous studies have reported that parental attitudes and knowledge about child oral health play an important role in maintaining good oral health for their children (Freudenthal et al., 2010; Berkowitz et al., 2011). In New Zealand, there has been no research conducted about parental attitudes after their children have dental care under GA for ECC. Research in this area could give a better understanding of parental beliefs and attitudes so as to develop more effective guidelines for preventive dental care for these children.

4.9 Conclusions

The present study determined that children who had dental care under general anaesthesia later had poorer OHRQoL in the middle mixed dentition period. There was no significant difference between the children who had comprehensive care under GA and children who had only tooth extractions under GA in relation to OHRQoL. For recommending preventive strategies for these high-risk children, further research is needed to understand the factors that contribute to ongoing poorer OHRQoL. Further research could be carried out to:

a) measure OHRQoL at the time of treatment to allow comparison of OHRQoL at the time of GA and later;
b) understand the factors that are contributing to ongoing poorer OHRQoL following restorative dental care under GA;
c) evaluate whether frequent preventive recall visits following dental care under GA decrease caries risk; and
d) evaluate the changes in parental attitudes to oral health care and behaviours after dental care under GA for their children.

4.10 Recommendations

With the present knowledge and understanding from this study, I suggest that:

1. Children after dental care under GA are considered as high-caries-risk and are reviewed every three months for preventive dental care, especially in the first 12 months after care and possibly during the eruption of the first permanent molars;

2. At preventive recall visits, oral health information should be communicated in an effective manner between the clinician and parent/caregiver/child (this implies having the parent present for recall appointments); and
3. Many children with S-ECC have dental care under GA because of non-coping skills for conventional restorative dental care. Reviewing these children more frequently with appropriate behaviour management will help them become familiarized with the dental environment and develop coping skills.

Chapter 5
References

5 References

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Chapter 6
Appendices

6 Appendices

Appendix 1 - The University of Otago Human Ethics Committee approval

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Appendix 4 - Information sheet for parents of study group

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Appendix 6 - Information sheet for children

Appendix 7 - Consent form for parents

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Appendix 9 - Impact 16-item Short-Form Child Perception Questionnaire (CPQ_{11-14})

Appendix 10 - SPSS syntax used for analysis

Appendix 1

16/124

Academic Services
Manager, Academic Committees, Mr Gary Witte

23 August 2016

Professor B Drummond
Sir John Walsh Research Institute
Department of Oral Diagnostic and Surgical Sciences
Faculty of Dentistry

Dear Professor Drummond,

I am again writing to you concerning your proposal entitled "**Children's oral health-related quality of life five to seven years after comprehensive care under general anaesthesia for early childhood caries**", Ethics Committee reference number **16/124**.

Thank you for your email of 22nd August 2016, with attached revised ethics application, addressing the issues raised by the Committee.

On the basis of this response, I am pleased to confirm that the proposal now has full ethical approval to proceed.

Approval is for up to three years from the date of this letter. If this project has not been completed within three years from the date of this letter, re-approval must be requested. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing.

The Human Ethics Committee asks for a Final Report to be provided upon completion of the study. The Final Report template can be found on the Human Ethics Web Page

http://www.otago.ac.nz/council/committees/committees/HumanEthicsCommittees.html

Yours sincerely,

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz

c.c. Professor R D Cannon Director Sir John Walsh Research Institute

Appendix 2

Health Research South

4/10/2016 **Project ID** 01279

Dr. Tim MacKay
Oral Health Services, Southern DHB

Dear Tim

SUBJECT: Children's oral health related quality of life, five to seven years after comprehensive dental care under general anaesthesia for early childhood caries (decay)

I am writing on behalf of Health Research South to confirm that the project mentioned above has been granted approval to proceed.

According to our records:

This project is due to commence on: 4/10/2016

It is due to be completed by: 31/12/2016

If you have any questions with regards to this process, please contact me quoting the project ID number shown above.

Yours sincerely

Ruth Sharpe
CLINICAL RESEARCH ADVISOR

C.C.: ROBERT WEST, SOUTHERN DHB
IRENE WILSON, ORAL HEALTH SERVICES, SOUTHERN DHB
PROF B. DRUMMOND, FACULTY OF DENTISTRY, UOO
MR. A. PARACHURU, FACULTY OF DENTISTRY, UOO

Health Research South, PO Box 56, Dunedin 9054
hrs@otago.ac.nz; www.otago.ac.nz/hrs

Appendix 3

NGĀI TAHU RESEARCH CONSULTATION COMMITTEE
TE KOMITI RAKAHAU KI KAI TAHU

Tuesday, 06 September 2016.

Professor Bernadette Drummond,
Faculty of Dentistry - Department of Oral Science,
DUNEDIN.

Tēnā Koe Professor Bernadette Drummond,

Children's oral health-related quality of life five to seven years after comprehensive care under general anaesthesia for early childhood caries

The Ngāi Tahu Research Consultation Committee (the committee) met on Tuesday, 06 September 2016 to discuss your research proposition.

By way of introduction, this response from The Committee is provided as part of the Memorandum of Understanding between Te Rūnanga o Ngāi Tahu and the University. In the statement of principles of the memorandum it states "Ngāi Tahu acknowledges that the consultation process outline in this policy provides no power of veto by Ngāi Tahu to research undertaken at the University of Otago". As such, this response is not "approval" or "mandate" for the research, rather it is a mandated response from a Ngāi Tahu appointed committee. This process is part of a number of requirements for researchers to undertake and does not cover other issues relating to ethics, including methodology they are separate requirements with other committees, for example the Human Ethics Committee, etc.

Within the context of the Policy for Research Consultation with Māori, the Committee base consultation on that defined by Justice McGechan:

"Consultation does not mean negotiation or agreement. It means: setting out a proposal not fully decided upon; adequately informing a party about relevant information upon which the proposal is based; listening to what the others have to say with an open mind (in that there is room to be persuaded against the proposal); undertaking that task in a genuine and not cosmetic manner. Reaching a decision that may or may not alter the original proposal."

The Committee considers the research to be of importance to Māori health.

As this study involves human participants, the Committee strongly encourage that ethnicity data be collected as part of the research project as a right to express their self-identity. That is the questions on self-identified ethnicity and descent, these questions are contained in the latest census.

The Committee suggests dissemination of the findings to relevant Māori health organisations, for example the National Māori Organisation for Dental Health, Oranga Niho and to Professor John Broughton and Malcolm Dacker, who are involved in Māori Dental Health, University of Otago.

We wish you every success in your research and the committee also requests a copy of the research findings.

This letter of suggestion, recommendation and advice is current for an 18 month period from Tuesday, 06 September 2016 to 6 March 2018.

Nāhaku noa, nā

Mark Brunton
Kaiwhakahaere Rangahau Māori
Research Manager Māori
Research Division
Te Whare Wānanga o Otāgo
Ph: +64 3 479 8738
Email: mark.brunton@otago.ac.nz
Web: www.otago.ac.nz

Appendix 4

Ethics approval No: 16/124
Date: 23.08.16

Participant Information Sheet for Parents/Guardians of Children who have had Dental Treatment under General Anaesthesia at the School of Dentistry in Dunedin

Study Title: **Investigation of the oral health related quality of life in children with and without a history of dental decay when they were pre-schoolers.**

Principal Investigators: Mr Aravind Parachuru Venkata DClinDent Student
Professor Bernadette Drummond Paediatric Dental Specialist
Department of Oral Sciences

Introduction

Thank you for showing an interest in this project. Please read this information sheet carefully. Take time to consider and, if you wish, talk with relatives or friends, before deciding whether or not to participate. If you decide to participate, we thank you. If you decide not to take part, there will be no disadvantage to you or your child and we thank you for considering our request.

What is the aim of this research project?

This study is looking at the oral health-related quality of life in children who had treatment at the School of Dentistry for dental decay when they were pre-schoolers and comparing this with children of the same age group who have not had any dental decay. Dental decay can have a significant impact on children's lives and this study is investigating if the impact of having decay and infection in the primary (baby) teeth continues into middle childhood.

Who are we seeking to participate in the project?

We are inviting parents and their children who had dental treatment under general anaesthesia at the School of Dentistry in Dunedin in 2009, 2010, or 2011 to take part in the study.

If you participate, what will you be asked to do?

Children will be asked to fill in a questionnaire looking at how their current oral health affects their lives. Parents may help the children to do this. You and your child will also be asked to agree to information about your child's dental health being recorded from their dental records at the School of Dentistry and in the Community Oral Health Service (Dental

Clinic). If you or child prefer to answer the questions by phone, you will be able to request that.

Is there any risk of discomfort or harm from participation?
There are no risks or discomfort in participating in this study.

What data or information will be collected, and how will it be used?
The information collected will include the age of the child, ethnicity, whether they live in a fluoridated area, and their dental health. The questionnaire will record information about oral symptoms, functional limitations, emotional well-being and social well-being. Any identifying data collected from the records will be removed in the data analysis and no identifying data will be used in any reports. The information collected will be reported in Mr. Parachuru's thesis as a part of the Doctor of Clinical Dentistry degree. The results will be presented at conferences, may be published in international journals, and will be available in the University of Otago Library (Dunedin, New Zealand). The reports will also be given to the Southern District Health Board who funds the care for children.

Professor Drummond will be responsible for the collected data which will be stored securely and only able to be accessed by the investigators. The data will be stored for 10 years after all the children have turned 16 years of age.

What about anonymity and confidentiality?
Any reports of the study will not have any information that could identify you or your child.

If you agree to participate, can you withdraw later?
If you and your child decide not to take part, your child will receive routine dental care as usual. You or your child may withdraw from the study at any time and this will not affect the care your child receives at the School of Dentistry or with the Southern District Health Board.

Any questions?
If you have any questions now or in the future, please feel free to contact any of the investigators:

Mr Aravind Parachuru Venkata, DClinDent student	Phone: 470 5622
Professor Bernadette Drummond	Phone: 479 7128
Mrs Alison Meldrum	Phone: 479 7075
Department of Oral Sciences	

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 64-3-479 8256 or gary.witte@otago.ac.nz). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

Appendix 5

Ethics approval No: 16/124
Date: 23.08.16

Participant Information Sheet for Parents/Guardians

Study Title: **Investigation of the oral health related quality of life in children with and without a history of dental decay when they were pre-schoolers.**

Principal Investigators: Mr Aravind Parachuru Venkata DClinDent Student
Professor Bernadette Drummond Paediatric Dental Specialist
Department of Oral Sciences

Introduction

Thank you for showing an interest in this project. Please read this information sheet carefully. Take time to consider and, if you wish, talk with relatives or friends, before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you or your child and we thank you for considering our request.

What is the aim of this research project?

Dental caries (tooth decay) is a significant problem for some preschool children. We know that this puts them at risk of decay when they are teenagers. We do not know if this risk continues during middle childhood. This study is looking at the current oral health and oral health related quality of life in children who had treatment at the School of Dentistry for dental decay when they were pre-schoolers and comparing this with children of the same age group who have had dental treatment in the Community Oral Health Service. The study is looking at how oral health affects children's lives whether or not they have had dental decay.

Who are we seeking to participate in the project?

We are inviting parents and their children aged 8 to 13 years of age who have dental care in the Community Oral Health Service.

If you participate, what will you be asked to do?

Children will be asked to fill in a questionnaire looking at how their current oral health affects their lives. Parents may help the children to do this. You and your will also be asked to agree to information about your child's dental health being recorded from their dental records in the Community oral Health Service (Dental Clinic). If you or child prefer to answer the questions by phone you will be able to request that.

Is there any risk of discomfort or harm from participation?
There are no risks or discomfort in participating in this study.

What data or information will be collected, and how will it be used?
The information collected will include the age of the child, ethnicity, whether they live in a fluoridated area, and their dental health. The questionnaire will record information about oral symptoms, functional limitations, emotional well-being and social well-being. Any identifying data collected from the records will be removed in the data analysis and no identifying data will be used in any reports. The information collected will be reported in Mr. Parachuru's thesis as a part of the Doctor of Clinical Dentistry degree. The results will be presented at conferences, may be published in international journals, and will be available in the University of Otago Library (Dunedin, New Zealand). The reports will also be given to the Southern District Health Board who funds the care for children.

What about anonymity and confidentiality?
Any reports of the study will not have any information that could identify you or your child.

If you agree to participate, can you withdraw later?
If you and your child decide not to take part, your child will receive routine dental care as usual. You or your child may withdraw from the study at any time and this will not affect the care your child receives at the School of Dentistry or with the Southern District Health Board.

Any questions?
If you have any questions now or in the future, please feel free to contact any of the investigators:

Mr Aravind Parachuru Venkata, DClinDent student	Phone: 470 5622
Professor Bernadette Drummond	Phone: 479 7128
Mrs Alison Meldrum	Phone: 479 7075
Department of Oral Sciences	

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 64-3-479 8256 or gary.witte@otago.ac.nz). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

Appendix 6

Ethics approval No: 16/124

Date: 23.08.16

University of Otago Te Whare Wānanga o Otāgo New Zealand | Faculty of Dentistry
Te Kaupeka Pūniho
New Zealand's National Centre for Dentistry

What children think about their teeth and mouths

We are inviting you to help us in a study looking at how healthy and bad teeth affect children's lives.

What is this study about?

We are studying what children think about how their teeth and mouths affect their lives every day. We would like to know if children who have healthy teeth have a different opinion to children who have had fillings with the dental therapist or dentist.

When we are finished we will write a report about what children think and this will help us and other dentists to understand children's ideas about their teeth. No names will be put in the story so no one will know what you said.

If you would like to help us this is what you need to do

We will ask you and your mum or dad or caregiver to agree to help and then we will ask you to answer some questions. We want you to give the answers but your Mum or Dad can help read the questions if you want. Then you can post the questionnaire back to us. We would also like to find out what you have had done at the dental clinic.

If you don't want to take part there will not be any problem and we thank you for thinking about it. If you have any questions, please ask your Mum or Dad to call Bernadette or Alison.

Who are the people involved in the study?

Mr. Aravind Parachuru Venkata Tel: 470 5622
Professor Bernadette Drummond Tel: 479 7128
Mrs. Alison Meldrum Tel: 479 7075

Appendix 7

Ethics approval No: 16/124

Date: 23.08.16

ID no:

Investigation of the oral health related quality of life in children with and without a history of severe dental decay when they were pre-schoolers

CONSENT FORM FOR PARENTS

I have read the Information Sheet about this project and understand what it is about. Any questions have been answered to my satisfaction. I understand we are free to request further information at any stage.

We know that:-

1. My child's participation in the project is entirely voluntary;
2. I am free to withdraw my child from the project at any time without any disadvantage;
3. Personal identifying information in the questionnaire may be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for 10 years after the children turn 16 years-of-age;
4. This project involves questions that focus on oral symptoms, functional limitations, emotional well-being and social well-being of children. If I or my child feel hesitant or uncomfortable he/she may decline to answer any particular question(s) and/or may withdraw from the project without any disadvantage of any kind.
5. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve my child's anonymity.

I agree for my child to take part in this project and for the researchers to record the health of my child's mouth.

Name of Parent Guardian: _____ Signature: _____

Name of Child: _____ Date of Birth: _____

School Child Attends: _____

Contact email: _____ or Contact telephone number: _____

(If you wish to go in the draw for a $100.00 voucher and to receive a summary of the results of the study)

INSTRUCTIONS

Your child may need your help to complete the questionnaire but please ask your child to make the choice of box to tick.

If you fill the questionnaire out for your child, please indicate that at the end of the questionnaire.

Please return all the completed blue forms in the stamped addressed envelope provided.

Appendix 8

Ethics approval No: 16/124

Date: 23.08.16

ID no:

University of Otago Te Whare Wānanga o Otāgo New Zealand | Faculty of Dentistry Te Kaupeka Pūniho New Zealand's National Centre for Dentistry

What children think about their teeth and mouths

Consent Form

I have been told about this study and understand what it is about. All my questions have been answered in a way that makes sense.

I know that:

1. Participation in this study is my choice, which means that I do not have to take part if I don't want to and nothing will happen to me. I can also stop taking part at any time and don't have to give a reason.

2. Anytime I want to stop, that's okay.

3. If I don't want to answer some of the questions, that's fine.

5. If I have any worries or if I have any other questions, then I can talk about these with Bernadette or Alison or Aravind.

6. My answers will only be seen by Aravind and the people he is working with. They will keep whatever I say private.

7. Aravind will write a report about this study for his university study and he will talk about it at a conference. My name will not be on anything Aravind writes about.

I agree to take part in the study.

Name: _____

Signature: _____ Date: _____

Appendix 9

Impact 16-item Short-form Child Perceptions Questionnaire

(CPQ_{11-14})

ID no: ☐☐☐☐

These next few questions are about how you feel about your teeth. There are no "right" or "wrong" answers- please answer as best you can. Please tick the box which applies to you.

In the <u>past 3 months</u>, how often have you had:

1. Sores in your mouth?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

2. Bad Breath?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

3. Food stuck in between your teeth?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

4. Difficulty biting or chewing food like apples, corn on the cob or steak?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

5. Difficult to drink or eat hot or cold foods?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

6. Difficulty saying any words?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

7. Pain in your teeth, lips, jaws or mouth?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

8. Taken longer than others to eat a meal?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

In the <u>past 3 months</u>, how often have you:

9. Felt irritable or frustrated?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

10. Felt shy or embarrassed?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

11. Been upset?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

12. Been concerned what other people think about your teeth, lips, mouth or jaws?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

13. Avoided smiling or laughing when around other children?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

14. Other children teased you or called you names?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

15. Had other children ask you questions about your teeth, lips, jaws or mouth?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

16. Argued with other children or your family?

☐ Never ☐ Once or twice ☐ Sometimes ☐ Often ☐ Every day or almost every day

17. Would you say the <u>health</u> of your teeth, lips, jaws and mouth is:

☐ Excellent ☐ Very Good ☐ Good ☐ Fair ☐ Poor

18. How much does the condition of your teeth, lips, jaws or mouth affect your <u>life overall?</u>

☐ Not at all ☐ Very little ☐ Some ☐ A lot ☐ Very much

Thank you for having taken the time to complete the Questionnaire

Appendix 10

SPSS syntax used for analysis

```
.

VARIABLE LABEL ethnicgrp 'Ethnicity group based on being maori'.
VALUE LABELS ethnicgrp  2 'Maori' 1 'nonmaori' 3 'Pacific' 5 'other' .
EXECUTE .

GA comprehensive + GAexo, Chair treatment, no caries (3 groups)

RECODE GAgrp (1 thru 2=1) (3 =3)  (4=4)
        INTO GAgrp .

RECODE SES (1 thru 3 = 1) (4 thru 7 = 2)  (8 thru  10 = 3)
        INTO decilegrp .

VARIABLE LABEL decilegrp 'Decile  group '.
VALUE LABELS decilegrp  3 'high' 2 'medium' 1 'low' .
EXECUTE .

FREQUENCIES VARIABLES=Group Age sex ethnicgrp SES decilegrp
  /ORDER=ANALYSIS.

Global 17 + 18
RECODE Ggrptotal (1 thru 2=1)
        INTO Ggrptotal .

MEANS TABLES dmft BY Group
  /CELLS=MEAN COUNT STDDEV MIN MAX
  /STATISTICS ANOVA.

RECODE dmft (0=1) (1 thru 3=2) (4 thru Highest=3) INTO dmftgrp.
EXECUTE.

RECODE preDMFTgrp (0=1) (1 thru 3=2) (4 thru Highest=3) INTO preDMFTgrp.
EXECUTE.

RECODE dmftGA (0=1) (1 thru 3=2) (4 thru Highest=3) INTO dmftGA.
EXECUTE.

COMPUTE symp = CPQ1 + CPQ2 + CPQ3 + CPQ4 + CPQ5  + CPQ6 + CPQ7 + CPQ8 .

COMPUTE welb = CPQ9 + CPQ10 +CPQ11 + CPQ12 + CPQ13 + CPQ14 + CPQ15+ CPQ16  .

COMPUTE cpqtotal = CPQ3 + CPQ4 + CPQ5 + CPQ9 + CPQ6 + CPQ7 + CPQ8 + CPQ10 + CPQ11
+ CPQ12 + CPQ13 + CPQ14 + CPQ15 + CPQ16+ CPQ1 + CPQ2 .
```

```
RELIABILITY
  /VARIABLES= CPQ1 CPQ2 CPQ3 CPQ4 CPQ5 CPQ6  CPQ7  CPQ8
  /FORMAT=NOLABELS
  /SCALE(ALPHA)=ALL/MODEL=ALPHA .

RELIABILITY
  /VARIABLES=  CPQ9  CPQ10 CPQ11  CPQ12 CPQ13  CPQ14 CPQ15 CPQ16
  /FORMAT=NOLABELS
  /SCALE(ALPHA)=ALL/MODEL=ALPHA .

FREQUENCIES VARIABLES=GH17 GLO18
  /ORDER=ANALYSIS.

MEANS TABLES=cpqtotal symp welb BY GH17grp GLO18grp
  /CELLS=MEAN COUNT STDDEV
  /STATISTICS ANOVA.

FREQUENCIES VARIABLES=GH17 GLO18
  /ORDER=ANALYSIS.

RECODE GH17 (1 =1) (2=2) (3=3 ) (4 thru 5=4)  INTO GH17grp .
VARIABLE LABELS GH17grp 'Global selfrated health question, combined for stat power' .
VALUE LABELS GH17grp 1 'Excellent' 2 'verygood'  3 'Good' 4 'FairP'.

FREQUENCIES
  VARIABLES= GH17grp
  /ORDER=  ANALYSIS .

RECODE GLO18 (3 thru 5=3) (ELSE=COPY)  INTO GLO18grp .
VARIABLE LABELS GLO18grp 'Global oral health question,  for stat power' .
VALUE LABELS  GLO18grp 1 'Not at all' 2 'Very little' 3 'Some/A lot/Verymuch' .

FREQUENCIES
  VARIABLES= GLO18grp
  /ORDER=  ANALYSIS .

MEANS TABLES=cpqtotal symp welb GH17grp GLO18grp BY dmftgrp
  /CELLS=MEAN COUNT STDDEV
  /STATISTICS ANOVA.

CROSSTABS
  /TABLES=Age sex Fluoridestatus ethnicgrp decilegrp BY Group
  /FORMAT=AVALUE TABLES
  /CELLS=COUNT
  /COUNT ROUND CELL.

CROSSTABS
  /TABLES=dmftgrp BY Group
  /FORMAT=AVALUE TABLES
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

```
CROSSTABS
  /TABLES=preDMFTgrp BY Group
  /FORMAT=AVALUE TABLES
  /CELLS=COUNT
  /COUNT ROUND CELL.

MEANS TABLES=preDMFTgrp BY Group
  /CELLS=MEAN COUNT STDDEV.

CROSSTABS
  /TABLES=dmftGA BY Group
  /FORMAT=AVALUE TABLES
  /CELLS=COUNT
  /COUNT ROUND CELL.

MEANS TABLES=symp BY Group
  /CELLS=MEAN COUNT STDDEV SUM SPCT.

MEANS TABLES=welb BY Group
  /CELLS=MEAN COUNT STDDEV SUM SPCT.

MEANS TABLES= cpqtotal welb symp GH17 GLO18  BY GAgrp
  /CELLS=MEAN COUNT STDDEV
  /STATISTICS ANOVA.

MEANS TABLES=cpqtotal symp welb BY dmftgrp
  /CELLS=MEAN COUNT STDDEV
  /STATISTICS ANOVA.

ONEWAY cpqtotal symp welb BY Group
  /MISSING ANALYSIS.

ONEWAY cpqtotal BY Group
  /MISSING ANALYSIS.

MEANS TABLES=Ggrptotal BY Group
  /CELLS=MEAN COUNT STDDEV SPCT.

.MEANS TABLES=cpqtotal BY dmftgrp preDMFTgrp dmftGA
  /CELLS=MEAN COUNT STDDEV SPCT.

MEANS TABLES=dmftgrp preDMFTgrp dmftGA BY GAgrp
  /CELLS=MEAN COUNT STDDEV NPCT SPCT
  /STATISTICS ANOVA.

MEANS TABLES=dmftgrp preDMFTgrp BY GAgrp
  /CELLS=MEAN COUNT STDDEV NPCT SPCT
  /STATISTICS ANOVA.
```

```
MEANS TABLES=decilegrp BY cpqtotal symp welb GH17grp
  /CELLS=MEAN COUNT STDDEV NPCT
  /STATISTICS ANOVA.

MEANS TABLES=ethnicgrp BY cpqtotal symp welb GH17grp
  /CELLS=MEAN COUNT STDDEV NPCT
  /STATISTICS ANOVA.

CROSSTABS
  /TABLES=Ggrptotal GH17grp GLO18grp BY cpqtotal symp welb
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT ROW COLUMN
  /COUNT ROUND CELL.

CROSSTABS
  /TABLES=symp welb cpqtotal Ggrptotal GH17grp GLO18grp BY GAgrp
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT ROW COLUMN
  /COUNT ROUND CELL.

MEANS TABLES=cpqtotal symp welb Ggrptotal GLO18grp GH

CROSSTABS
  /TABLES=GAgrp ethnicgrp decilegrp Fluoridestatus BY cpqtotal symp welb Ggrptotal
GH17grp GLO18grp
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT ROW COLUMN
  /COUNT ROUND CELL.

17grp BY GAgrp dmftgrp preDMFTgrp dmftGA
  /CELLS=MEAN COUNT STDDEV NPCT
  /STATISTICS ANOVA.

MEANS TABLES=dmftgrp preDMFTgrp dmftGA BY Group
  /CELLS=MEAN COUNT STDDEV NPCT
  /STATISTICS ANOVA.

MEANS TABLES=dmftgrp BY Group
  /CELLS=MEAN COUNT STDDEV NPCT
  /STATISTICS ANOVA.

MEANS TABLES=preDMFTgrp BY Group
  /CELLS=MEAN COUNT STDDEV NPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal BY Group
  /CELLS=MEAN COUNT STDDEV NPCT
  /STATISTICS ANOVA.
```

```
MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal BY Group
  /CELLS=MEAN COUNT STDDEV NPCT SPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal BY sex
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal BY ethnicgrp
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal BY decilegrp
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal BY Fluoridestatus
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal BY dmft
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal BY dmftgrp
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal BY sex ethnicgrp
decilegrp Fluoridestatus
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal BY preDMFTgrp
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal BY dmftGA
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.

MEANS TABLES=symp welb cpqtotal GH17grp GLO18grp Ggrptotal BY Group
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.
```

```
MEANS TABLES=POC dmftgrp dmftGA BY Group
  /CELLS=MEAN COUNT STDDEV SPCT
  /STATISTICS ANOVA.

FREQUENCIES VARIABLES=GH17grp GLO18grp
  /ORDER=ANALYSIS.

MEANS TABLES=GH17grp GLO18grp BY Group
  /CELLS=MEAN COUNT STDDEV NPCT SPCT
  /STATISTICS ANOVA.
ONEWAY
  cpqtotal BY Group
  /MISSING ANALYSIS
  /POSTHOC = LSD ALPHA(.05).

TABLES=  cpqtotal BY GH17grp
  /CELLS MEAN COUNT STDDEV
  /STATISTICS ANOVA .

 MEANS TABLES=Group BY GH17grp GLO18grp cpqtotal
  /CELLS=MEAN STDDEV NPCT
  /STATISTICS ANOVA.

MEANS TABLES=cpqtotal BY GH17grp GLO18grp Group
  /CELLS=MEAN STDDEV NPCT
  /STATISTICS ANOVA.
```