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Social gradient in child oral health: individual, school and area variation.

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LIST OF ABBREVIATIONS

ABS	Australian Bureau of Statistics
ACARA	Australian Curriculum, Assessment and Reporting Authority
ACORN	Acorn is a Geo-demographic Index used in the UK
AIHW	Australian Institute Health and Welfare
AHS	Area Health Service
AIC	Akaike Information Criterion
ARCPOH	Australian Research Centre for Population Oral Health
CDBS	Child Dental Benefits Schedule
CDHS	Child Dental Benefits Schedule
CI	Confidence Interval
COHS	Centre for Oral Health Strategy
DAG	Diagrammatic Acyclical Graph
DMFS	Decayed Missing Filled Surfaces
DMFT	Decayed Missing Filled Teeth
NSW	New South Wales
ICC	Intra-Class Correlation
ICSEA	Index of Community Socio-Educational Advantage
IRSAD	Index of Relative Socio-economic Advantage and Disadvantage
LHD	Local Health District
LIFESTYLE	LIFESTYLE is a demographic Index used in Canada
NT	Northern Territory
OHE	Oral Health Education
OMR	Optical Mark Reader
OR	Odds Ratio
PAF	Population Attributable Fraction
PAS	Priority Action Schools
PR	Prevalence ratio
PSP	Priority Schools Program
QLD	Queensland
RR	Rate Ratio
SA	South Australia
SAP	School Assessment Program
SCUDS	Study into the Child Use of Dental Services

SEIFA	Socio-economic Indexes for Areas
SES	Socio-economic Status
SiC	Significant Caries Index
SOKS	Save Our Kids Smiles
TAS	Tasmania
VIC	Victoria
VIF	Variance Inflation Factor
WA	Western Australia
WHO	World Health Organisation

ABSTRACT

This thesis describes the oral health of New South Wales (NSW) children aged 5-12 years by socioeconomic (SES) characteristics utilising the individual-, school- and area-level socioeconomic indicators. It also quantifies the usefulness of SES indicators for targeting of dental services.

Methods

A cross-sectional study of NSW 5–12 year-olds was conducted in 2007 using a multi-stage, stratified, cluster sample approach. Explanatory SES variables were explored at three levels: individual, school and area. Caries prevalence, caries severity and significant caries were calculated. Bivariate analysis was undertaken. Prevalence ratios (PR) of caries prevalence and SiC_{10} were modelled by Poisson regression (PROC LOGLINK, SUDAAN 10.0). Rate ratios (RR) of caries severity were modelled using Poisson regression (PROC GENMOD, SAS 9.2). Multi-level analysis (SAS PROC GLIMMIX) was undertaken accounting for the nested structure. Use of SES variables to target dental services was examined using number of cases, relative risk and population attributable fraction (PAF%).

Results

Just under 40% of NSW children had a prevalence of deciduous caries with mean dmfs of 3.18 surfaces and just over 22% had experienced permanent caries with mean DMFS of 0.61 surfaces.

Variation in oral health by SES indicators

There was significant variation in caries prevalence, caries severity and SiC_{10} by socioeconomic characteristics; children from the lowest SES category had significantly higher caries prevalence and severity compared to the highest SES category for all SES indicators in both the deciduous and permanent dentition. Membership of the SiC_{10} group showed lower SES groups had a higher proportion of children who formed part of the SiC_{10} group.

Associations across individual, school and area-level SES indicators

In the final models, income was significant for all three caries measures for both dentitions. The children from the lowest income category had significantly higher odds of caries, more severe caries and membership of the SiC_{10} group. School type as an explanatory factor was not significant for caries prevalence and SiC_{10} in the multi-level model, although the

children attending a disadvantaged public school had significantly higher odds of permanent caries severity.

Effectiveness of targeting by SES indicators

In both the deciduous and permanent dentition there were fewer cases of caries and SiC_{10} cases in the designated SES target group, the lowest SES group, than outside the designated target group. SES demonstrated a low population attributable fraction for deciduous and permanent caries prevalence, caries severity and significant caries.

Conclusions

The study demonstrated that caries was higher among lower SES groups whether measured by individual, school or area characteristics. In many instances there were three and five-fold differences among those in the lowest SES categories providing a consistent association with poor oral health. Income was independently associated with variation in child oral health when adjusting for the nested structure. Low SES categories did not identify the majority of those with caries or the highest levels of caries and would therefore be limited as a basis for a targeted oral health strategy and a population health focus that uses a social determinants approach would be more appropriate.

SIGNED STATEMENT

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THESIS FORMAT

This thesis presents an introductory chapter that provides background information on child oral health in Australia, literature on social gradients in oral health and the various indicators of SES and the association of socioeconomic factors with oral health. It highlights the provision of dental services for children and the variation across Australian states and territories. It also introduces the rationale and conceptual framework, aims, study objectives, hypotheses and rationale. The second chapter describes the study design, sampling procedures and requirements, data collection methods, including details of mail questionnaire SES indicators and oral epidemiological examinations. Data management incorporates data linkage, data weighting, analysis plan and the conceptual model. The third chapter includes responses from the schools in the sampling frame, including the examination and questionnaire phase. The results are described using three caries measures in relation to individual-, school- and area-level characteristics. The fourth chapter discusses the major findings of the study on the associations of SES indicators at an individual-, school- and area-level with caries measures and compares those findings with the available literature. It also includes limitations of the data and further research. The final chapter concludes with the major themes, implications of the findings and principal conclusions.

Tables and figures are presented together with their corresponding text where possible. References to published work are in the text with the author name(s) and the year of publication in parenthesis. Where there were three or more authors, the first author is listed, followed by et. al., in the text. The complete list of authors is listed in the reference list at the end. Where there were multiple references for an author, references are listed in the bibliography in alphabetical order of authors and then by year of publication. The appendices include: consent form; primary approach letter to study participants with the enclosed questionnaire; reminder card and follow-up letters; oral epidemiological examination form; letters for ethical approval of the study; Diagrammatic Acyclical Graphs; and, model selection tables (Appendices 1-8).

CHAPTER 1 INTRODUCTION

This thesis describes the oral health of New South Wales (NSW) children aged 5-12 years. It examines the social gradient in oral health with a focus on individual-, school- and area-level socioeconomic indicators associated with caries. The examination of pairs of SES indicators at each of the three levels was undertaken to determine if one had a stronger association with variation in child oral health. The identification of independent associations of socioeconomic indicators at different levels is of particular interest for an understanding of the social determinants of child oral health and the potential use of socioeconomic factors to target care to those supposedly in greatest need. Therefore the usefulness of targeting dental services is explored.

The research for this thesis is a supplementary study of the 'NSW Child Dental Health Survey' (NSW CDHS) conducted in 2007 (COHS, 2009). There are two components to this thesis. The first component of this thesis involved using the oral epidemiological data collection from the 2007 NSW CDHS to describe the dental caries outcomes of NSW children aged 5-12 years. The second component of this thesis involved using data collected from a parent-complete questionnaire to describe sociodemographic and socioeconomic characteristics of NSW children aged 5-12 years. Then individual-level data were enhanced to include school and area socioeconomic rankings accessed from the 'MySchools' database (ACARA) and Australian Bureau of Statistics (ABS) Census data (ABS, 2008) and all data from both components were linked.

This chapter provides an overview of the oral health of children, inequalities in oral health, population health policy and service provision, a description of the problem(s) to be investigated, the rationale for studying the problem(s), an outline of the framework to explain socioeconomic differences utilising individual-, school- and area-level indicators and specific objectives and the conceptual model.

1.1 CHILD ORAL HEALTH

Dental caries is one of the most common chronic diseases (Daly, 2002, Selwitz et al., 2007) and can have a significant impact on an individual's health and well-being. Although seen as a largely preventable disease, decay, new and recurrent, continues to be one of the most prevalent health conditions. Dental caries can be categorised into pit and fissure caries, smooth surface caries, root caries and secondary caries (Featherstone, 2004, Kidd, 2005) and occurs at varying rates in both the deciduous and permanent dentitions (Slade et al., 1996). The basic mechanism of caries is similar. However, the management of caries

on different surfaces of different teeth in the two dentitions may vary. Dental caries is a multifactoral disease that is characterised by a biological process and influenced by a range of behavioural, psychological and social factors that in turn are influenced by broader social, economic and cultural factors (Selwitz et al., 2007). Individuals remain susceptible to caries throughout their lifetime (Selwitz et al., 2007). Research has shown that dental caries can result in a range of health impacts, including pain, infection and tooth loss, as well as psychosocial impacts such as poor or lowered self-esteem. Although there has generally been a decline in the prevalence and severity of caries in children over the last 30 years in western countries, some of these countries have found a slight increase in caries prevalence in the last decade (Bagramian et al., 2009) which may be due to increased consumption of dietary carbohydrates (AIHW, 2002) and decreased exposure to fluoridated water or fluoridated toothpaste (Armfield and Spencer, 2004b).

1.1.1 Basic mechanism of caries

The basic mechanism of caries is characterised by mineral loss from the tooth as a result of acid-induced challenges in the presence of bacteria and host factors (Mount and Hume, 2005, Selwitz et al., 2007). A key element of the process is the dynamic equilibrium between cycles of demineralisation and remineralisation that occurs many times daily (Mount and Hume, 2005). Dental caries occurs when the demineralisation outweighs the remineralisation and there is a net loss of minerals from the tooth structure (Kidd, 2005). As demineralisation proceeds, the loss of minerals leads to cavitation and the invasion of bacteria where the tooth structure is progressively destroyed. The demineralisation can be halted or reversed in the early stages as part of the remineralisation phase. Demineralisation can be moderated by the presence of fluoride and improvements in diet or enhanced by acidogenic bacteria, inhibition of saliva function or frequent consumption of fermentable carbohydrates (Featherstone, 2004). If demineralisation progresses to the stage of a cavitated lesion involving dentine or the pulp then discomfort or pain may occur.

The direct consequences of dental caries have been well documented. Individuals can experience significant loss of tooth structure with associated discomfort and pain. Such lesions require restoration, ongoing maintenance and in some cases tooth extraction (Fejerskov and Kidd, 2008). In addition, as tooth extraction has decreased in frequency, there is an increased burden of disease to treat by the provision of ‘conservative’ services (Selwitz et al., 2007). Slade et. al. (2005) highlights the oral health impacts, including psychosocial and functional status. These oral health impacts include, eating, sleeping,

communicating, social embarrassment and impact on work or lifestyle (Brennan et al., 2008). The biological factors explain the caries process but do not explain the occurrence of caries in a population (Holst, 2005).

1.1.2 Social determinants

Traditionally proximal risk factors and biological markers have been the focus of research on oral diseases. Differences in oral health are often seen as material, behavioural or lifestyle factors. More recently, social determinants have been investigated; the upstream, distal determinants of those risk factors and biological markers (Marmot and Wilkinson, 2006). For example, what are the social determinants of risk factors such as smoking or a diet high in carbohydrates? It is known that smoking rates and consumption of foods high in saturated fats are higher in those groups whose social position or employment is of lower status or position in society.

Social determinants can be defined as 'the conditions in which people are born, live, work and age' (WHO, 2012). These have often been termed the 'causes of the causes'. Research has demonstrated the relationship between social factors and health (Reisine and Psoter, 2001) and oral health, including socioeconomic status, social support, social environment, social and health policies (Holst, 2005). Conditions in which people live and work can be shaped by circumstances of money, education, resources, power as well as the health system and political environment (WHO, 2012). 'Social, environmental and political factors greatly determine behaviour' (Watt, 2002) where biological risk interacts with social and economic factors to influence oral health status. Factors such as, living conditions, childhood environment, areas where people live and work, all influence behaviours and attitudes and subsequently oral health (Holst, 2005). For example, a person who has low income is likely to live in an area with fewer services and poorer access to healthy foods. Life chances, social power and distribution of resources all have an effect on health (Newton and Bower, 2005) where individual practices may be shaped by social norms and culture.

Psychosocial factors have also been linked to levels of 'control' at work, home or in the life environment. Coronary heart disease and depression have been linked to activities in the work place or in the home environment that have lower levels of control or low status (Marmot and Wilkinson, 2006). This can be extended to the life environment where communities may have limited access to services or amenities, poor access to healthy foods at a reasonable cost, limited access to social support and increased levels of crime

(Marmot, 2001). Thus it can be seen that there are a number of factors that influence the prevalence and distribution of disease within the community.

1.1.3 Distribution

It is important to understand the distribution of child oral health, including the socioeconomic variation that in turn provides vital information for oral health services planning and funding. In the United States, caries is one of the most common chronic conditions where 42% of 2-11 year old children have experienced deciduous caries and 59% of 12-19 year old children have experienced permanent caries (Bramlett et al., 2010). In Australia, dental caries in children has reduced significantly since the 1970's with Australia ranked 8th lowest in caries experience for 12 year old children across 35 countries (Armfield et al., 2009). The substantial decline in permanent caries has resulted in a positively skewed distribution with a high proportion of children recorded as without clinical caries experience (Davies et al., 1997). In 1978 the mean dmft for six year-old children was 3.2 with a reduction to 1.58 by 1996. For the permanent dentition a decline in caries experience has been observed with a mean DMFT of 4.51 in 1978 reducing to 1.58 by 1989 (Armfield and Spencer, 2008). Through the later 1990s there has been an absence of decline and in more recent years a slight increase in caries experience in Australian children (Armfield and Spencer, 2004a). However, there still remains a proportion of the child population who experience a significant level of dental caries or a higher proportion of untreated disease. The deciduous caries experience for 6 year olds has also declined since 1977 and demonstrated a skewed distribution. However, the proportion of children with deciduous caries has remained at higher levels than the permanent caries experience. In the deciduous dentition 61.4% of 6 year old children attending school dental services had experienced caries with a mean dmft of 2.47 (Ha et al., 2011). The majority of children are still caries free at 6 years of age but this has levelled out at 60% (Ha et al., 2011, Armfield and Spencer, 2004a). In 2006, 9.9% of 6 year olds who attended school dental services had experienced caries in the permanent dentition while the mean caries experience was 0.14 for 6 year old children, and 47.6% of 12 year olds had experienced caries in the permanent dentition while the mean caries experience was 1.24 for 12 year old children. It is clear that decay experience is still relatively common in children and adolescents in Australia with a minority of children experiencing high levels of dental caries.

New South Wales, which comprises one third of the Australian population, had been excluded from Australian CDHS data since 2001 due to changes in service provision which saw limited data on dental caries collected from only those children screened as needing treatment and selecting to receive that treatment from public dental service. The 2007 NSW CDHS was the first random sample survey of children in NSW since the 1987/88 and provided an opportunity to explore the distribution of dental caries across the NSW child population. Results showed that there was high proportion of children who had never experienced caries (40% 5-6 year old children in the deciduous dentition; 35% 11-12 year old children in permanent dentition). The children more likely to have experienced caries or significant levels of caries were; those from lowest socioeconomic area, rural and remote areas, Aboriginal children; dependents of Centrelink concession cardholders, children whose mothers were born in a country with an official language other than English, and children who resided in a non-fluoridated area (COHS, 2009).

The 2007 NSW CDHS delivered an accurate description of the oral health of children aged 5-12 years and provided an opportunity to utilise the data to inform strategies for health promotion, intervention and prevention. However, research has shown a significant variation between sub-groups of the population (Thomson and Mackay, 2004, Locker and Ford, 1994). There is an uneven distribution in oral health across sociodemographic and socioeconomic subgroups where these sub-groups of the population may experience significantly higher prevalence of caries and severity. For example, there is a three-fold difference in decayed teeth and a two-fold difference in mean caries experience between high area and low socioeconomic areas in NSW (COHS, 2009). A two-fold difference can be seen in the prevalence of untreated decay between Indigenous and non-Indigenous Australians (Endean et al., 2004, Jamieson et al., 2006) and NSW children (COHS, 2009). In addition, caries levels among Indigenous children have increased (Davies et al., 1997). Identification of sub-groups with higher prevalence and greater severity of caries may better inform health service planning and policy development.

1.2 INEQUALITIES IN ORAL HEALTH

Health inequalities result from social inequalities (Marmot and Bell, 2010) where the social inequalities relate to the health differences that are caused by social, economic and political factors that may affect some subgroups of the population more than others (Daly, 2002). These health inequalities are unjust and unacceptable and affect people's quality of life. Numerous studies in the United States and United Kingdom highlight the health

inequalities between the wealthy and the poor with health differences in mortality, morbidity, infectious diseases, rating of health and cardiovascular disease (Deaton, 2002). The literature also provides evidence that there is a social gradient in oral health with an 'inverse relationship' between socioeconomic status and oral health (Locker and Ford, 1996, Reisine and Psoter, 2001, Polk et al., 2010, Sanders et al., 2006a) where lower income groups have poorer oral health (Locker, 1993, Reisine and Psoter, 2001, Polk et al., 2010), more irregular visiting patterns (Locker and Ford, 1996, Reisine and Psoter, 2001, Polk et al., 2010, Sanders et al., 2006a) and lower self-rated oral health (Locker and Ford, 1994, Sanders et al., 2006b) than the higher income groups.

Similar SES differences exist in both adults and children. When considering adults it has been found that the prevalence of periodontitis is highest in the lowest income groups while the lowest prevalence is in the highest income group. The lowest income group recorded a rate nearly twice that of the highest income group (AIHW, 2010). In relation to children, previous studies have found social inequalities in unmet needs (Vargas and Ronzio, 2006), prevalence of caries (Polk et al., 2010, Locker, 1993), severity of caries and visiting patterns (Donaldson et al., 2008). Defining and understanding the role of the social factors that contribute to oral health differences is challenging, with a complex context where the social environment may influence individuals differently (Reisine and Psoter, 2001).

A range of factors have been proposed to explain the inequalities in oral health including material deprivation, individual lifestyle choices, behavioural and psychosocial factors (Nicolau et al., 2007, Marmot and Wilkinson, 2006, Sisson, 2007). The materialist view holds that factors related to position in social strata are important rather than the direct influence of income or education. Life satisfaction is determined and influenced by social comparisons of work, income and the material standards of living. The behavioural explanation incorporates an individual's lifestyle choices and proposes that the socioeconomic status will influence the risky or damaging behaviours. The psychosocial perspective argues that psychological stress varies across socioeconomic groups and leads to an increase in poor behavioural choices (Sisson, 2007). The lifecourse perspective combines the material, behavioural and psychosocial perspectives and proposes an accumulation of risk model where events throughout life influence health (Nicolau et al., 2007, Marmot and Wilkinson, 2006, Sisson, 2007).

It has often been proposed that it is the health behaviours that are SES related (Nicolau et al., 2003) and therefore they explain the SES gradient rather than SES alone. However other authors (Polk et al., 2010, Slade et al., 2006, Sanders et al., 2006b) found that adjusting for behavioural risk factors did not attenuate the SES difference in oral health. Such findings do not belie the fact that health behaviours are a risk factor for dental caries, but support the concept that SES also has an independent relationship with oral health. Studies of oral health inequalities usually divide the population into subgroups on the basis of individual characteristics such as, income, occupation and education. However there is an increasing move to consider a more ecological or contextual approach using area-based indicators. The amenities and economic conditions of an area may influence the well-being of the area (Ratcliffe, 2012). Factors such as local services and amenities, unemployment rates, community engagement, social cohesion and neighbourhood problems have been associated with poorer health, independent of the individual-level factors (Echeverria et al., 2008, Neckerman et al., 2009). Quality of the schools in an area, transport options and level of crime have been linked to house prices and employment opportunities in an area (Gibbons and Machin, 2008). These contextual factors have been related to health outcomes, including; depression (Echeverria et al., 2008), mental health outcomes (Gibbons and Machin, 2008) and obesity (Lovasi et al., 2009). The range of individual and contextual factors that have been associated with health outcomes highlight the different levels of influence on individuals, families, behaviours and choices. The relative contributions of the determinants at an individual-, school- and area-level for child oral health have not been fully clarified.

1.3 MEASURING THE SOCIAL GRADIENT IN ORAL HEALTH

A range of different SES indicators has been used to assess the social gradient or inequalities in oral health at an individual-, school- and area- or neighbourhood-level. Individual indicators include income (Piovesan et al., 2010, Locker, 1993, Donaldson et al., 2008), education (Piovesan et al., 2010, Borrell et al., 2006b) and occupation (Kallestal and Wall, 2002, Zurriaga et al., 2004) while neighbourhood indicators generally use composite indicators. Composite indicators are a social classification that has been used to reflect multiple socioeconomic factors, and are based on a range of variables incorporating age structure, employment, education, family structure, and housing. The composite indicators have been shown to identify groups that differ in morbidity, mortality and service use. The UK uses ACORN, Canada uses the LIFESTYLE system (Locker, 2000)

and Australia uses the SEIFA index (Sanders et al., 2006a, Sanders et al., 2006b). Minimal research has explored a school SES indicator, although Enjary (2006) utilised school type.

1.3.1 Social gradient in oral health using individual SES indicators

Extensive studies have shown that lower SES individuals have poorer oral health compared to those of higher SES. This has often been attributed to differences in material standards of living (Locker, 2000). Traditionally SES indicators have been individually based, using individual household income, education or occupation of the individual or parent. Single item individual indicators such as these have demonstrated significant relationships with caries experience, untreated decay, and self-rated general and oral health (Enjary et al., 2006).

Associations between oral health status and individual SES have been documented in a range of international studies. Thomson et. al. (2004) explored the social gradient in dental caries for 9 year old children in New Zealand and found higher levels of dental caries in the lower socioeconomic groups based on highest parent occupation. This was evident in both the deciduous and permanent dentition. Borrell et. al. (2006) found that income and education were associated with severe periodontitis in adults. While in Sweden, Källestål and Wall (2002) used highest parent occupation to highlight that there was higher caries rates for those children who were from workers' homes compared to those from affluent homes although this was only evident in urban areas. In a Danish study of 5 to 15 year olds, mothers education, family income, family structure were associated with caries prevalence and severity (Christensen et al., 2010), although mother's educational attainment seemed to be the main determinant. Inequalities were evident in all age groups. However, the association of these factors was greater in younger children than in the teenagers. In Australia, higher deciduous and permanent caries was evident for children from low SES when using both household income and parental education (Slade et al., 1996). Overall, research has demonstrated there are significant differences in oral health status, whether it is deciduous or permanent caries prevalence or caries severity, and that it is correlated with a number of individual SES indicators.

Although individual-level indicators have been associated with health outcomes there are also weaknesses in such an approach. A single SES factor of an individual may not account for the multidimensional factors that influence an individual's health in that it may measure the material deprivation or lack of access to services, without accounting for social participation or contextual effect or community characteristics (Locker, 2000). In

addition, the collection of information at an individual-level can be time consuming and difficult to collect: household-level rather than individual data may be required when classifying education, occupation and income; 'mothers' not in the workforce; individuals may be reluctant to disclose personal information or it may be precluded from collection (Enjary et al., 2006) with higher levels of missing data.

1.3.2 Social gradient in oral health using school SES indicators

School-based SES indicators have been used to measure the oral health status of children to overcome difficulties in collecting individual-level data such as income and education as well as to explore the contextual effect of a school. In some countries, school-based indicators can be relatively easy to collect using school type or academic level to attribute an SES classification. The school SES indicator may be easily classified and can then be useful for targeted programs to schools with the highest risk or need.

Evidence has emerged exploring the association between school socioeconomic status and the oral health of children. Enjary, Tubert-Jeannin et. al.(2006) found that children who attended a deprived school had poorer oral health, more untreated decay and received less dental care, even though these children had access to insurance schemes. Sagheri, Hahn and Hellwig (2008) used both educational attainment of parents and enrolment in school type to compare oral health of adolescents where parent education had a moderate correlation with school strata (Spearman rank 0.54). The authors found a gradient in caries prevalence, mean caries, median caries scores and proportion of children in SiC_{10} group by educational attainment of parents. They also found differences in oral health of the children when analysed by school strata (high, medium and basic academic level) although there appeared to be a threshold effect where the highest academic school had the lowest proportion of children in the SiC_{10} group (25%) compared to the medium (41%) and basic (40%) academic schools. Gillcrist, Brumley et. al.(2001) utilised school lunch eligibility as a measure of the school community SES for examining socioeconomic differences in oral health of children. The study found that the school communities with higher proportion of school lunch eligibility had poorer oral health across both dentitions on a range of oral health measures including; caries severity, proportion of untreated dental caries, treatment needs, urgent treatment needs, sealant status and prevalence of incisal trauma. The association between school SES and oral health has supported the consideration of a targeted school population approach to tackle inequalities in the oral health of school children, in a 'directed population approach' as a re-orientation of the universal school-

based approach. The aim would be to target 'at risk' schools with preventive or service programs. However, potential misclassification of individuals in a school measure focuses attention on the difficulties in translating knowledge of social inequalities in oral health into effective strategies.

1.3.3 Social gradient in oral health using area SES indicators

Area-based SES indicators have also been used to measure the oral health status of the population. The use of an area-based measure has developed for two reasons: to reduce the limitations of individual indicators such as income and occupation; and to explore the contextual effect of an area or neighbourhood on an individual's health (Locker and Ford, 1996, Thomson and Mackay, 2004). Area-based indicators can be relatively easy to collect (Locker and Ford, 1996) using residential postcode and attributing census-collected data to attribute an SES classification. Area-based indicators are generally composite measures and are often derived from census data that incorporate a number of variables including: family structure; household type; economic indicators; and ethnic composition. Locker (2000) also proposed that area-based indicators may provide more variation in oral health than individual indicators. The area measure is readily classified and can then be useful for planning and delivering targeted programs to areas or communities with the highest risk or need.

Since the 1990's research has developed measuring the influence of area or neighbourhood SES on an individual's oral health and found associations with health and health behaviours independent of the individual SES (Locker and Ford, 1996). Area-based SES indicators measure the 'broader social and material context' where the area influences may relate to the physical, material and social environment (Locker, 2000, Sisson, 2007) as well as the availability and use of health services (Labonte, 1993, Donaldson et al., 2008). Studies exploring the area effects for adults found that there was an association between those from a deprived area in relation to oro-facial pain (Riley et al., 2003), edentulism (Jamieson and Thomson, 2006), self-reported oral health status (Sanders et al., 2006a, Locker and Ford, 1996, Jamieson and Thomson, 2006), social impact of oral conditions and dental visiting patterns (Jamieson and Thomson, 2006, Sanders et al., 2006a). However, Richards (2002) did not observe differences in oral health between area deprivation groups when oral health was measured by number of teeth and the Subjective Oral Health Status Indicators.

Area-based SES differences in oral health can also be found in children. Several studies have shown that composite indicators of small area SES have an association with poorer oral health in children. In Brazil, those living in lower SES areas are reported to have higher odds of untreated decay (Antunes et al., 2006) and higher caries prevalence (Pattussi et al., 2001). In the United Kingdom, those in lower SES areas reported higher caries prevalence (Tickle et al., 2000, Monaghan et al., 2014) and more severe caries (Morgan and Treasure, 2001). Thomson et. al. (2004) explored the social variation in dental caries for 9 year old children from New Zealand using an area-based based measure, Index of Deprivation for a Census meshblock, which used nine variables including eligibility for benefits, unemployment, access to car and telephone, family composition and home ownership. Results showed that children from a lower area SES had poorer oral health in both the deciduous and permanent dentition. From an Australian perspective, Armfield et. al. (2007) explored the use of both discrete and composite area-based SES indicators to measure the variation in child oral health status and found that both the six discrete area SES indicators and the composite area SES indicators were able to account for a significant amount of the variation in caries prevalence and severity of caries. In addition, the discrete indicators were able to measure variation beyond that of the composite measure.

1.3.4 Inter-relatedness of SES indicators

It is clear that there are variations in oral health between 'deprived' and 'non-deprived' individuals, schools and communities. Over the last 30 years individual SES has been linked with health outcomes. More recently research has indicated associations between individual and area SES for both health and health behaviours (Kamphuis et al., 2008, Brennan and Turrell, 2012, Bramlett et al., 2010), self-reported oral health (Turrell et al., 2007a) and periodontitis (Borrell et al., 2006a). Both Locker (2000) and Enjary (2006) highlight the fact that many studies explore the SES variation in oral health but do not compare the conventional indicators and their relative ability to identify the variation in oral health. Limited information is available to determine whether different level SES indicators measure similar oral health inequalities, or whether one may be superior to another, or if there is an inter-relatedness between the different SES indicators. Individual and area based indicators have often been used interchangeably with an assumption that areas are homogenous in relation to SES. In order to understand the factors that influence

the variation in oral health there is a need to go beyond a single dimension to include multi-dimensional aspects of health.

Despite evidence that dental disease occurs in a social context, it is only more recently that studies have used multi-level analysis to explore independent effects at different levels. Recent contributions provide evidence of the impact of both individual and contextual factors on self-rated oral health of adults (Cremonese et al., 2010, Turrell et al., 2007b) and parent rating of oral health on children aged 1-5 years (Bramlett et al., 2010, Guedes et al., 2014) exploring the independent effects using a multi-level approach.

Turrell, Kavanagh et. al.(2007a) explored the possibility of an interaction between individual- and area-level SES for mortality and found independent effects but no significant effect for an interaction. Diez-Roux, Kiefe et. al. (2001) compared individual- and area-level SES indicators across three epidemiologic studies and found that there was moderate correlation between the three area-level indicators. In addition, these authors found associations between the individual-level and area-level indicators although there was evidence of heterogeneity in residential areas. Thomson et. al. (2004) also demonstrated lack of concordance between these two indicators and highlighted the fact that significant variation was found within areas. Bower, Gulliford et. al.(2007) explored the association between area deprivation and adult oral health in Scotland, using multi-level modelling to account for both individual and contextual effects. The authors found that some of the area variation was associated with individual or household characteristics for the clinical outcomes: number of sound teeth, having one or more unsound teeth and odds of having periodontal pocketing of 4mm or more. No clear relationship was found between area-level deprivation and adult oral health.

There is little evidence exploring the individual and contextual factors for the school-aged children for deciduous and permanent caries in a multi-level approach. It is important to note that debate continues on whether the school and area socioeconomic effects are independent of the individual socioeconomic characteristics. There remains an issue of correlation and the mechanism of association between individual and area-based indicators (Locker, 2000) where it is difficult to unravel the effects of different levels of SES influence (Greenland, 2001). Enjary (2006) used school and individual SES and found associations with oral health but also found that school SES influenced oral health even when individual SES factors were considered.

School-aged children have different contextual influences that include individual/family, school and area factors. It is a challenge to determine the impact and relative strength of the association of SES across three levels with variation in child oral health. However, it has implications for understanding health needs, policy and dental service delivery related to children, schools and areas. The different indicators of SES provide complementary information that may contribute to understanding of child oral health variation. If there are independent and interactive effects of individual-, school- and area-level SES on oral health status then different strategies to improve health may be required.

The research has demonstrated an important relationship between disease and the structure of society, including income distribution, resource allocation and service provision. In addition the change in distribution of caries over time has implications for health services planning where there may be considerations for both whole population approaches and targeted interventions for those vulnerable groups who have the majority of the disease (Davies et al., 1997).

1.4 POPULATION HEALTH POLICY AND HEALTH SERVICE PROVISION

Given the prevalence and chronic nature of dental caries in adults and children, caries continues to be a public health issue. As outlined in the research, there is considerable impact on individuals and families, as a result of pain, impairment and reduced quality of life.

> "Oral diseases qualify as major public health problems owing to their high prevalence and incidence in all regions of the world, as for all diseases, the greatest burden of oral diseases is on disadvantaged and socially marginalized populations." (Petersen, 2004 p 329)

It is important to match health services to the needs of the population. Factors such as, community expectations, government priorities, increasing demands on the public health system, age profile, diversity of the population, disease prevalence, preventive and treatment options, all influence the type of service that would be deemed most appropriate. In addition, oral health services can be an expensive process for both the individual and society (Daly, 2002). However it must be recognised that resources are limited, either with funding or infrastructure, and therefore resources often should be prioritised and directed to the areas or groups of greatest need (Green, 2007).

Public health has been described as publicly funded health services, or a set of programs, focusing on disease prevention (Lin et al., 2007). However, a more accurate definition of dental public health would be the 'science and practice of preventing oral diseases,

promoting oral health, and improving quality of life through the organised efforts of society' (Daly, 2002 p 5). It encompasses legislation, guidelines, public policies, health services and health activities (Lin et al., 2007). Public health philosophies should drive public health policies, which will in turn impact on health services. Health service planning is an important element in the alignment of health service delivery with disease prevalence, distribution and proposed health targets (Eagar et al., 2001). Health service planning enacts policy development and directions that are designed to meet needs and aim to improve population health. Public health research has established the health impact of poverty, poor living conditions, unemployment and social isolation (Daly, 2002, Marmot and Wilkinson, 2006). Addressing the determinants of health is an important aspect of public health and should be a focus for health policy development.

Key aspects of dental public health are, to identify oral health problems, establish causes, risk factors and associations with oral health problems at a population level, and plan and evaluate effective interventions. It is essential to understand the disease and management options in order to determine the best approach to improve oral health. It is important to seek answers to a range of questions. *What is the disease prevalence and severity? What are the factors associated with poor health? Who has the greatest burden of ill-health? Can those people be easily identified? Are there effective preventive or health promotion options available? Are there service options available that optimise the effectiveness and efficiency of delivery of care?* Health service provision should be based on strong evidence that makes efficient and effective use of resources. Lin et. al. (2007) draw attention to the organisational framework of public health that should 'encompass both activities undertaken within the formal structure of government and the associated efforts of private and voluntary organisations and individuals'. In addition the full continuum of health should be considered, not just treatment of disease, therefore considering health promotion, different service settings and the range of health providers, reorienting services towards preventive rather than therapeutic and exploring partnerships.

As highlighted, a public health problem relates to prevalence of the condition, the impact at the individual and community level, as well as the availability of effective treatments. In oral health, many assume that clinically based treatment and prevention would achieve better oral health and that sufficient resources are available to meet the needs of the community. However it is important to be aware that prevention can occur at the population-level as well as the individual-level. Public health is focussed on the health of

populations (Pine and Harris, 2007) where the challenge for the healthcare system is to meet health needs of the population with the available resources. An element in improving the health of the population is to identify and prioritise the health service needs then determine benchmarks and establish approaches and strategies to achieve those targets. The foundation for developing policies, determining health needs and establishing strategies and benchmarks, is the epidemiological, behavioural and social knowledge base.

1.4.1 Epidemiology and surveillance data in oral health

Epidemiology could be considered the 'science' of public health. A principle aim of epidemiology is to ensure valid, reliable and unbiased data that explores patterns of disease and determinants of health in the population. Changes and trends over time can be identified and differences examined. This enables researchers to make comparisons between the oral health of subgroups of the population linked with social characteristics and their positive influences and effects. The increased emphasis on evidenced-based dentistry also requires an increasing need for epidemiological data to support health service management and planning. Epidemiology in dentistry incorporates three key principles related to:

1. The measurement of dental disease among groups within the population in order to understand factors that are associated with the distribution
2. Evaluation of effectiveness of new materials and treatment in clinical trials and assessment of needs and requirements for dental services within the community
3. Facilitation of informed decision-making on the application of research evidence and to explore, understand and evaluate population-level interventions. (Daly, 2002, O'Connor-Fleming and Parker, 2009)

Improved knowledge can be achieved by studying oral health patterns in sub-groups describing whether different sections of the community have different disease patterns and determine what their impact is on the individual and the community. Knowledge of the epidemiology of disease facilitates understanding of the extent and impacts of dental diseases. The focus is on communities and populations (O'Connor-Fleming and Parker, 2009), investigating differences between subgroups and associated factors that can identify disease indicators and assist in the development of preventive and treatment programs. Findings can then inform decision-makers, including health policy-makers, and subsequent action. The practice of dentistry has been influenced by changing patterns of disease and

emergence of evidence of oral health inequalities, ageing population and oral health services policies (Daly, 2002).

Ongoing surveillance of oral disease and patterns of disease indicators is important in planning and evaluating health service delivery, prevention and oral health promotion (Petersen, 2005). A lack of ongoing, reliable and representative data, may contribute to marginalisation of sub-groups of the population. Epidemiology plays a key role in providing evidence that underpins health practice and health service delivery that will ultimately contribute to the reduction of the 'burden of a health problem in a population' and the prevention of oral disease and the resultant health and life impacts (O'Connor-Fleming and Parker, 2009). Epidemiology can evaluate public health interventions and strategies to determine if they have been effective at reducing occurrence of the disease at both a local and a global level. Locker (2000) believed that it is unnecessary to further explore the social inequalities in oral health but to consider research that identifies factors involved in maintaining inequalities or SES indicators that can better predict those with a high burden of disease and may play an important role in health policy with implications for service provision (Enjary et al., 2006).

1.4.2 Public health approaches

The translation of the science into public health practice, strategies and approaches could be considered the practice of public health. The World Health Organisation (WHO) aims to promote oral health research on the burden of oral disease that will ultimately improve oral health systems and community programs (Petersen, 2005). The WHO has established strategic directions to build healthy populations:

1. Reducing the burden of oral disease and disability, especially in poor and marginalized populations
2. Promoting healthy lifestyles and reducing risk factors to oral health that arise from environmental, economic, social and behavioural causes
3. Developing oral health systems that equitably improve oral health outcomes, respond to people's legitimate demands, and are financially fair
4. Framing policies in oral health, based on integration of oral health into national and community health programs, and promoting oral health as an effective dimension for development of society.

(WHO, 2011)

A major challenge is to translate the knowledge of oral disease and prevention into oral health programs in an environment of an increasing cost of healthcare. How should 'public resources be allocated to most effectively improve the health of the population as a whole' (Schneider, 2006 p550). Social, economic and cultural factors all impact the planning and delivery of oral health services. Bramlett et. al. (2010) highlight the fact that with decreased and skewed caries experience there is a diminished return from individual-level approaches to improving oral health. Public health and population health approaches emphasise population health improvement rather than individual improvement. Therefore a focus on population prevention and health promotion with comprehensive primary healthcare strategies is essential. A health system should be structured around a fair distribution of resources, with equitable access that aims to achieve health for the majority of the population (Lin et al., 2007). There is a need to translate research and knowledge into contemporary practice, health service planning and delivery, and health policy to improve population health.

The seminal paper 'Sick individuals and sick populations' (Rose, 1985) outlined two key strategies. The first was a high-risk approach that focuses on the identification and management of the individual. The second was the population approach that aims to prevent disease for the population as a whole. Public health should focus on the population as a whole, or sub-groups within it, as well as the management of risk factors and their social determinants associated with health and illness (Lin et al., 2007). Approaches to populations should consider the following public health principles:

- A commitment to social justice and fair distribution
- Equity of access to health resources
- Equity in health outcomes
- Focus on improving the health of vulnerable population groups
- A focus on prevention
- An understanding of the need to balance science and society.

(Lin et al., 2007)

Three key population health approaches have been identified and incorporate many of these principles. They are a whole population approach, common risk factor approach and the high-risk (targeted) population approach (Daly, 2002). The approach selected will depend on the identified health needs, identification of risk factors, available interventions or mix of interventions, program goals and appropriateness for population groups. Health

systems and methods of delivery are also an element within these three approaches – the health system and the health policy that informs the approach are integral to the concept and the way the services are organised (Lin et al., 2007, Naidoo and Wills, 2005, O'Connor-Fleming and Parker, 2009). It is important to consider equity of access, population health gain and cost effectiveness when determining the most appropriate approach to adopt.

1.4.2.1 Whole population approach

The population approach attempts to change the incidence of disease in the whole population by removing or modifying the underlying causes or providing protective interventions to the whole population (Pine and Harris, 2007). Traditionally this has included clean water and food, immunisation and water fluoridation. Effective prevention requires change for the whole population using 'contemporary concepts of health promotion' where there is a change in the environment in which people live. Public health has 'highlighted the significance of social, economic and environmental factors in determining health status' (Daly, 2002 p 14). A population approach can change the social norms, for example making smoking less acceptable, moving toward widespread seatbelt usage and adoption of regular toothbrushing. When social campaigning and the environment, policies and legislation support health promotion strategies, it makes the healthy choices the more acceptable and easier choices, and the unhealthy choices more difficult (Naidoo and Wills, 2005). Such an approach often means a small reduction for an individual but a large effect on the overall incidence of disease in the population (Rose, 2001).

The whole population approach includes health promotion, prevention and service organisation. Dental services that provide universal coverage, incorporating access, prevention and management, result in a population oral health status that is likely to be more equal. Furthermore, Tickle and Milsom (2008), propose a whole population strategy where all children receive 'active preventive care' such as fluoride varnish and fluoride toothpaste based on the premise that caries risk assessment is not sufficiently accurate or reliable and is primarily based on past caries. The principle of a universal health system, where government and health policies aim to uniformly distribute resources and services, has the potential to influence health status of the population and reduce health inequalities.

1.4.2.2 Common risk factor approach

The common risk factor approach incorporates a multisectoral approach where oral health does not occur in isolation from general health, but with an integrated and consistent purpose. This should also occur at the population level by tackling causes that are common to a range of chronic health conditions. Lifestyle influences, such as nutrition, smoking, hygiene, alcohol and stress, are common to a range of chronic health conditions, including oral health (Petersen, 2009). A collaborative common risk factor approach has the potential to improve cost-effectiveness, reduce duplication and increase acceptance by the general population and the policy-makers (Pine and Harris, 2007, Sheiham and Watt, 2000). Strategies that link oral and general health risk factors can be incorporated into a health promotion approach that can operate in a range of settings outside the dental practice. This then expands the concept of oral health into the context of general health, thereby improving the opportunities for a range of interventions and the adoption of changes within the population.

The lifestyle factors that influence oral and general health occur in a person's life, work, social or school environment (Sheiham and Watt, 2000). Traditionally a behaviour change approach is adopted. However, these individual approaches generally make only small changes. Specific dental programs are also less likely to attract funding and achieve sustainable outcomes without a multisectoral model. The integrated approach aims to promote health, create supportive environments and facilitate behaviour change that will cover a range on chronic conditions for both the whole population as well as those that are high-risk (Sheiham and Watt, 2000). In addition, it is noted that many of the common risk factors such as alcohol, smoking, nutrition and exercise, cluster in the same individuals and therefore a common risk factor approach can have a high impact (Sanders et al., 2006a, Selwitz et al., 2007).

Health promotion strategies that are comprehensive, sustainable and incorporate multiple stakeholders have more opportunity for funding and positive outcomes. Examples include the smoking cessation programs, health promoting schools, health promoting hospitals and food policy approaches. Each of these incorporates aspects of health policy, supportive environment, community involvement and intersectoral collaboration, and provides consistent and sustainable strategies and messages (Naidoo and Wills, 2005, Naidoo and Wills, 2000). In addition, they operate in both dental and general health environments as well as the places that people live, work and socialise.

1.4.2.3 Targeted care approach

A targeted high-risk group approach can be considered as an alternative or an adjunct to a whole population approach. It has been suggested that targeting high-risk groups may be an effective modified population approach for reducing inequalities and maximising effective use of resources for oral health programs (Locker et al., 2004, Enjary et al., 2006, Pine and Harris, 2007). Some authors advocate targeted sealant use for high-risk groups or communities while others recommend community interventions such as fluoride varnish (Weintraub et al., 2006, Reisine and Psoter, 2001, Sagheri et al., 2008). Siegal and Detty (2010) conducted a study that explored oral health benefits when prevention was targeted at a high-risk sub-group based on SES as determined by school lunch enrolment and access indicators and found that targeted sealant programs based on school SES criteria was effective in reaching children at higher risk of caries. School based screening has been suggested as an approach to identify children in need of treatment, where the screening may be targeted at high-risk schools or areas. Sagheri and Hahn (2007) support a targeted high-risk school approach with a combination of annual screening for all schools and fluoride varnish application at schools that are considered high risk.

School dental screening aims to select the 'right' individuals or schools and to encourage attendance for those with treatment requirements and to improve oral health (Donaldson and Kinirons, 2001, Milsom, 2007). A screening approach is based on a population-based philosophy to identify a specific condition in targeted groups before they appear (Lin et al., 2007). Unfortunately the best predictor of future disease is the presence of existing disease and where disease is absent the ability to detect future disease is poor (Beck et al., 1992, Ha et al., 2014, Pine and Harris, 2007). The uneven distribution of caries also means that identifying or targeting high-risk groups or areas means that high-risk individuals in low-risk areas are missed. In 1997/98 in the Canadian province of Ontario, a mandatory universal screening approach changed to a targeted approach with the aim to reduce resource requirements and focus screening on those schools most likely to contain high-risk children. Schools were classified by risk based on screening at kindergarten years, where high-risk schools (≥ 14% had 2 or more decayed teeth) were then targeted for screening in grade 2, 4, 6, 8 (Locker et al., 2004). Children who were screened and identified with selected dental care needs and urgent dental care needs were provided with appropriate clinical and preventive care. An evaluation was conducted where the aim was to assess the effectiveness of the targeted screening program based on school risk status

(Locker et al., 2004). The key outcome was the proportion of children that were identified utilising this approach. Less than half of the children with dental care needs were identified by the targeted approach, and 42% of those with urgent dental care needs would not have been identified. In addition those children who were from lower SES background were least likely to seek regular dental care. The effectiveness of the screening approach has been questioned (Pine and Harris, 2007) as it often fails to identify the majority of the high risk group (Batchelor and Sheiham, 2002, Batchelor and Sheiham, 2006), does not improve attendance (Milsom, 2007), results in misclassifications of risk (Pine and Harris, 2007) and therefore does not improve population oral health (Milsom, 2007).

Although risk groups have been targeted for prevention, screening and management, it is important that surveillance and care should be available for all patients as all risk groups experience dental caries (Batchelor and Sheiham, 2002, Batchelor and Sheiham, 2006) and caries continues to occur throughout an individual's lifetime. Targeting groups of the population has been utilised as a health services approach that may maximise the cost-effectiveness of dental services. However, the difficulty in correctly identifying high-risk children and the misclassification of individuals within an area-level measure raises questions on the viability of such an approach.

1.4.2.4 Health care organisation

Population and public health face a challenge to match the needs of the population with equitable resource allocation that will impact on health. Public health policymakers and service organisations are often required to prioritise and allocate effectively, including the type and extent of services, based on the resources within the oral healthcare system (Pine and Harris, 2007). Reducing the inequalities in oral health is a matter of social justice that addresses the determinants of health, but also includes access to appropriate, affordable and effective services (Pine and Harris, 2007). Furthermore services should be oriented to disease prevention and health promotion rather than curative interventions.

> "Quantification and comparison of the costs and health consequences of alternative programmes are critical elements to ensure that individuals and communities are receiving appropriate, effective and cost-effective health services." (White and Antczak-Bouckoms in Pine, 1997 p163)

This is of great importance for oral health professionals and policy-makers who make decisions on the allocation of limited funds for services and strategies for improving the

oral health of the population. It is clear that the organisation of dental services influences access, oral health related quality of life and oral health outcomes for the population.

1.5 PROBLEM TO BE INVESTIGATED

Having highlighted the oral health status of children, the inter-relationships between individual and contextual factors and provided an overview of population oral health approaches, this section focuses on the child oral health services in Australia, as well as the specific New South Wales (NSW) programs that incorporate a targeting approach.

1.5.1 School dental services in Australia

In Australia, dental care for adults has largely been provided by general dentists working in private practices, with supplementary care for eligible adults through the public oral health services. Children and adolescents have a separate system with public health programs that are funded by state and territory governments and vary across the states and territories; that is an example of a social policy that aims to protect the dental welfare of children through equal access to oral healthcare (Lin et al., 2007). The school dental programs originally offered free preventive and clinical services with universal coverage, on the premise of no financial barriers. However, some states later introduced co-payments as funding pressures increased. This then undermines the social policy principle where there may be incapacity to pay and reduced access for vulnerable population groups. There are also differences in service provision between children and adolescents, where most children are covered by school dental services at primary school while adolescents are generally not covered, or have considerably reduced coverage, by school dental services in secondary school (Armfield et al., 2009).

It is important to note that more recently the Commonwealth Government introduced a new child oral health initiative. From January 2014, the Medicare Child Dental Benefits Schedule (CDBS) provides financial support for basic dental services for children aged between 2 and 17 years who meet eligibility requirements. CDBS focuses on basic services and targeting expenditure on dental services for children in greater financial need Eligibility includes children who receive, or their family, guardian or carer receives, certain government benefits such as Family Tax Benefit Part A (AustGovernment, 2014). Dental care can be accessed through either private dental providers or school dental services. Those children who are not eligible for CDBS but who are under 18 and who are eligible for Medicare, can access the public dental service (COHS, 2014). Public dental programs continue to incorporate policies and guidelines on the types and range of services

that would be offered to children; prioritising patients based on SES and risk as well as dental assessment and treatment needs as an approach to reduce inequalities and provide equitable access to services.

At the time the supplementary study was undertaken, the dental division of the Australian state of NSW was divided into 8 Area Health Service Regions who would provide the child oral health programs. Since the supplementary study was undertaken, NSW public oral health care to eligible clients is delivered across 15 Local Health Districts (LHDs).These programs were delivered to children aged 5 to 12 years and include screening, referral, preventive and clinical care. Historically, NSW offered universal coverage for primary school children that provided check-ups for children and subsequent treatment every other year. However, there were low rates of coverage (AIHW, 2006). In 1996, NSW implemented a program entitled 'Save Our Kids Smiles' (SOKS) which offered school dental screening at primary schools. The 'School Assessment Program' (SAP) was then introduced in 2001 as a method of targeting screening for children at higher risk of dental disease, as SOKS was not seen as cost-effective due to high proportion of children who were caries-free.

1.5.2 NSW 'Save Our Kids Smiles' Program (SOKS)

The SOKS program was based on a whole population screening approach which incorporated three elements; oral health education, risk assessment and clinical care. The aims of the SOKS program were to: find and treat children with decay, and facilitate care for those children who required dental treatment (NSWHealth, 2001). All NSW schools were approached to participate in the education and risk assessment sessions, although the higher fee-paying private schools did not generally participate. A key aspect of the program was the school-based screening to determine risk status in the schools and to identify those children who had dental treatment needs.

Usually one 30-minute oral health education (OHE) session was provided to children in the grades K, 2, 4, 6 and 8 in either class or whole grade groups. The NSW Oral Health Branch provided oral health promotion packages including a range of resources that were available for the sessions. The OHE sessions were generally conducted 2 weeks prior to the scheduled risk screening at the school. At this session children were provided with information and consent letters to provide to parents.

SOKS screenings were based on a biennial cycle where consenting children in grades K, 2, 4, 6 and 8 were provided with a brief oral assessment of approximately 1-minute duration.

These assessments were undertaken in either a classroom or school hall using portable chair and lighting. The children were classified into 3 categories: immediate care required, routine care, or no treatment required; and then provided with letters outlining the treatment needs to the parents.

Clinical care was available for those coded as immediate care and routine care, although this was prioritised based on need. Generally children with immediate care were seen within a month or followed up if they had not contacted the clinic. Children with routine care needs required parents to make appointment and were placed on a waiting list until appointments were available. Once the child had an appointment a full dental examination was undertaken and a managed care program developed based on need. Relief of pain and emergency care was still available for all children although only the cause of the emergency was treated and then the child was put on a waiting list.

In 1999 NSW Health reviewed the SOKS program, incorporating an assessment of the reliability and validity of the SOKS oral health risk assessment compared to clinical dental examination. The review (NSWHealth, 2001) found that the SOKS program was not cost effective due to the high number of caries free children. The SAP program was then implemented.

1.5.3 NSW 'School Assessment Program' (SAP)

In 2001, NSW moved to the School Assessment Program (SAP), which provided a targeted screening check for children attending disadvantaged public schools based on a high-risk approach. The aim of the SAP program was to identify those children who were more likely to require dental services, facilitate dental care for high-risk children and eliminate the costs associated with screening children who were at low risk of needing care (NSWHealth, 2001). The targeted screening at potentially high-risk, disadvantaged schools identified those children requiring care and facilitated the process of delivering clinical and preventive care. The school dental service then provided clinical and preventive care to all referred children free of charge. Area Health Service regions continued to provide oral health promotion or education programs based on the needs of the specific population.

Under the terms of the targeted SAP program, public schools were classified as an eligible 'disadvantaged' school if they were registered for the Priority Schools Program (PSP) or the Priority Action School (PAS) funding through the NSW Department of Education and Training. Independent schools and Catholic Schools were not included in the classification of disadvantage. Screening in disadvantaged schools occurred every year for children from

years K, 2, 4 and 6. Children were provided with a screening check-up within the school using a standard chair, light, mirror and periodontal probe (Chong et al., 2011). The parents of children identified as requiring care were informed, and clinical care was offered at local public school dental clinics (Armfield et al., 2006). The SAP program represented a step toward establishing different oral health opportunities for different social groups, where the goal was to reduce socioeconomic inequalities by health promotion, primary prevention and timely care. Although child oral data have shown social inequalities in oral health, the effectiveness of using school disadvantage as a tool for determining screening and service provision has yet to be evaluated in Australia.

The research problem therefore was to investigate the variation in child oral health across three SES indicators and whether these can be used to predict those who are more likely to have poorer oral health and/or greater dental treatment needs and ultimately assist in oral health services planning.

1.6 RATIONALE FOR STUDYING THE PROBLEM

Since 1975 school dental services have provided free or subsidised dental care for children of primary school age. The provision of care has changed over time as funding and subsequent policy changes have influenced availability of services and changes implemented to attempt to cater more effectively for those most disadvantaged. Such policy changes have been most acute in states with low percentage coverage of the target population. NSW has consistently been at the lower end of the ranking of states by coverage. For instance in 2001, NSW school dental services were used by 38% of children aged 5-11 years old. This compared unfavourably with NT (87%), WA (78%), QLD (72%), SA (69%) and VIC (45%) (AIHW, 2006).

One result of low coverage has been the introduction of policies aiming at targeting only a sub-group of the child population. In principle the targeted group consists of those in poorest oral health. In practice, the targeted group consists of those children attending ‘disadvantaged’ schools. While indices of the level of socioeconomic disadvantage of schools are well developed for educational support, there has been little attention to the question of how well the aggregate summary indices for a school predict the oral health of children.

The rationale for studying the problem was based on the need to understand how socioeconomic characteristics predict child oral health. Locker and Ford (1994) nearly 20 years ago reported on the association of area-based indicators and individual indicators of

socioeconomic status and adult oral health. Thomson and Mackay (2004) examined such relationships among New Zealand children. Despite the application of socioeconomic indicators at the level of school for targeting of school dental services, no recent research has tested the significant association of these indicators in terms of poor child oral health. Research was needed to better understand the social gradient in child oral health described by socioeconomic characteristics of the household, school and area where these could be used to underpin targeting of dental services.

While there is some research evidence on the relationship of SES indicators and child oral health, particularly individual indicators, there is little evidence on the comparison of different individual, school or area indicators to identify children at risk of disease in order to target services. Thus, understanding the effectiveness of each level of SES indicator to predict children in poor oral health is important. Comparison of the indicators would provide a more detailed understanding of the social gradient in dental caries and a more in depth analysis for oral health service planning purposes.

In this thesis data are presented for dental caries in primary teeth in children aged 5-8 years and in permanent teeth in children aged 6-12 years. This study explores the socioeconomic distribution of the extent and severity of oral disease in children using three measures of oral disease; caries prevalence, caries experience and high disease experience (SiC_{10} group) for both deciduous and permanent dentition. This research will focus on three different levels of SES indicators, at the individual-, school- and area-level. Pairs of SES indicators at each level will be investigated to determine correlations between pairs at each level and determine whether one of the pairs has stronger associations with caries and severity of caries. The research will explore each SES indicators contribution to explaining social inequalities using multi-level analysis to assess the independent associations after adjusting for the hierarchical structure of children within schools and schools within areas. In addition, the study will examine the use of these SES indicators as a tool for targeting oral health services.

1.7 RESEARCH FRAMEWORK

This thesis addresses the hypothesis that the social gradient in child oral health varies by individual-, school- and area-level socioeconomic characteristics. In addressing this hypothesis, this research examined 1) the variation in oral health across the three SES indicators, 2) the association of the SES indicators across different levels, and 3) the usefulness of the SES indicators in targeting dental services.

Traditionally the caries process was described at the biological level incorporating components that include host characteristics, dietary substrate and biofilm. Over the last 20 years the role of ecological variables in the caries process has been acknowledged (Elderton and Mjor, 1992, Locker and Ford, 1996, Sisson, 2007). Ecological factors can include; individual socioeconomic factors, school community and neighbourhood deprivation and social cohesion, social support, attitudes and beliefs.

More recently Fisher-Owens and Gansky et. al. (2007) have developed a conceptual model that illustrates three levels of influence on the biological caries process for children that include individual, family and community levels. These three levels account for the 'complex and interactive causes' of child dental caries. The model also integrates 5 key domains of determinants of health from social epidemiology: genetic and biological factors, the social environment, the physical environment, health behaviours, and dental and medical care. These domains, embedded in a multi-level approach, acknowledge the multiple pathways and interactions, as well as the variety of protective/destructive factors and dental services policies that have been related to oral health outcomes of children. Table 1 categorises the various influential factors for the different levels of SES, as well as the screening policy and oral health outcomes. Thus the framework comprises five components:

(1) **Individual and family characteristics** – a range of sociodemographic characteristics and two key SES factors, income and education, which have been widely researched and influence oral health through a range of pathways that include affordability, access, knowledge, beliefs, attitudes and health behaviours;
(2) **School characteristics** – two school SES factors, a school SES ranking and school education type, which may influence social norms, supportive environment, access, knowledge, attitudes and beliefs;
(3) **Area characteristics** – incorporate aspects of neighbourhood deprivation, access to services and social support;
(4) **Dental visiting** – government health policy that influences availability and access to services, a supportive environment and affordability;
(5) **Oral health** – three different indicators of disease experience that explore different aspects of child oral health.

Table 1: Research framework in relation to NSW survey

Individual and family characteristics	***School characteristics***	***Area characteristics***	***Dental visiting***	***Oral Health***
Age ATSI Aust born Country of birth Household arrangements Parents' Education Work status Occupation Income Dental insurance	School SES – ICSEA ranking School type	Area SES – SEIFA IRSAD	Government screening availability	Caries prevalence – deciduous and permanent Caries severity – deciduous and permanent Significant Caries Index – deciduous and permanent

Adapted from Fisher-Owens et al. 2007 Domains of determinants of oral health according to level of influence. (Fisher-Owens et al., 2007)

Such a framework attempts to explore the influence of different levels of SES on oral health, as well as the potential for an oral health screening policy to modify the social variation in oral health. Figure 1 demonstrates the conceptual model incorporating the three levels of SES, sociodemographic characteristics, social, behavioural and biological variables and health policy that may influence oral health status.

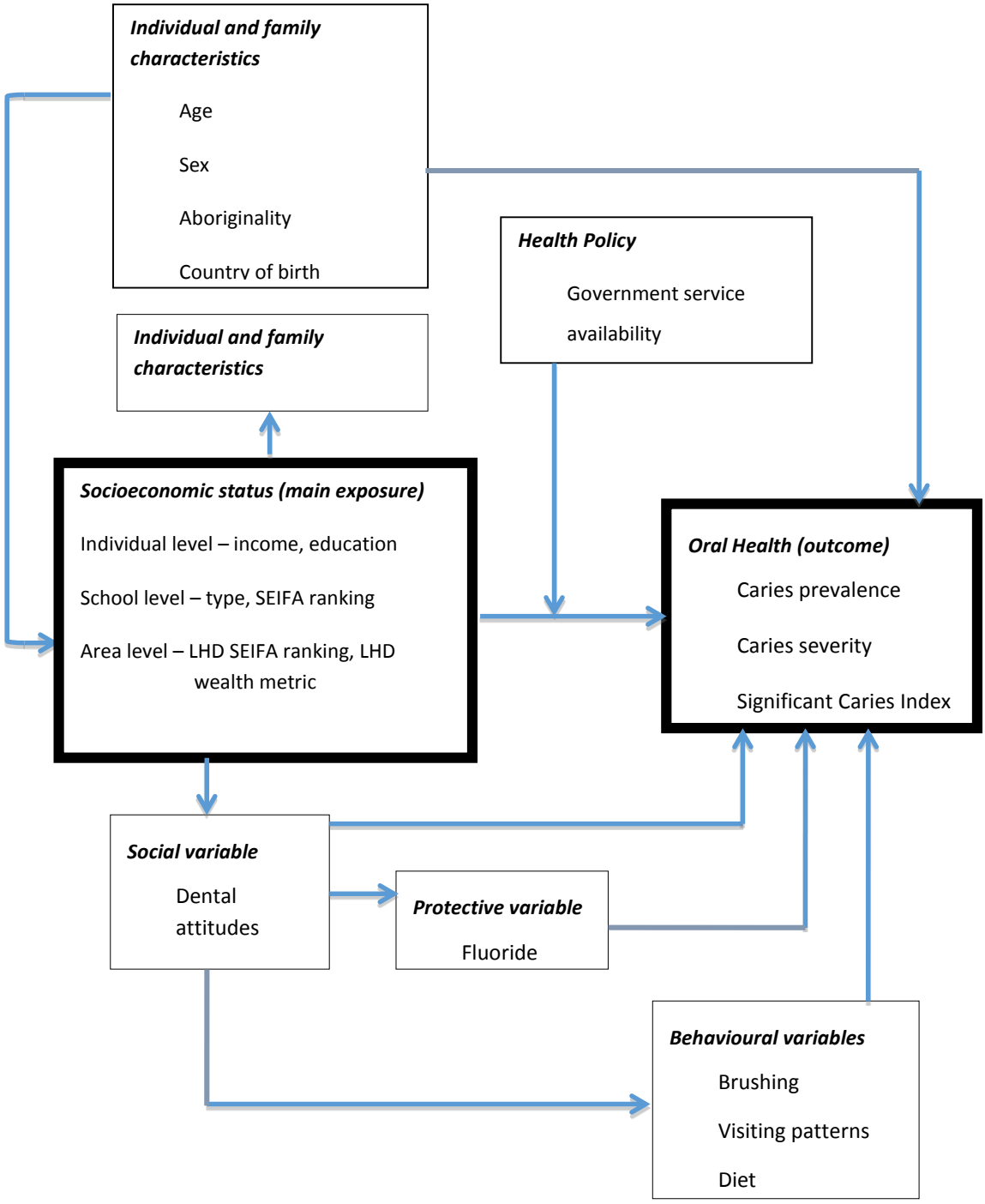

Figure 1: Conceptual Model for NSW survey

1.8 OBJECTIVES

The purpose of the research project was to examine the oral health status of children aged 5-12 years in New South Wales and relate these to the socioeconomic characteristics of the individual-, school- and area-level and assess the effectiveness of targeting of dental services based on SES indicators.

1.8.1 Specific Objectives

The specific objectives were to:

1. Describe the distribution of child oral health by individual-, school- and area-level socioeconomic characteristics;
2. Explore the associations across individual-, school- and area-level SES indicators to variation in child oral health; and
3. Quantify the effectiveness of targeting of dental services by socioeconomic characteristics.

1.8.2 Hypotheses

1. There is a social gradient in oral health status for 5-12 year old children in NSW measured by individual-, school- and area-characteristics.
2. Individual-, school- and area-characteristics interact in explaining the social gradient of dental caries.
3. SES indicators are an effective approach for targeting dental services.

CHAPTER 2 MATERIALS AND METHODS

This chapter explains the methods used to conduct the research project. It describes the study design, sampling procedures and requirements, data collection methods, including details of a mailed questionnaire, SES indicators and oral examinations. It also outlines the data management process that incorporates data weighting and the analytic plan.

2.1 STUDY DESIGN

The study design was a cross-sectional representative survey of NSW children aged 5 – 12 years. The study was designed to use socioeconomic and oral health data to establish the socioeconomic variation in oral health and explore a targeted approach to health care service provision. The study was undertaken in collaboration with the NSW Centre for Oral Health Strategy as a supplementary study to the NSW Child Dental Health Survey 2007 (NSW CDHS 2007). The questionnaire data were collected was between July 2007 and March 2008.

The NSW CDHS 2007 used a cross-sectional multi-stage, stratified random sample. The sample was stratified according to school and area characteristics. The children and their parents from the selected schools were approached by staff of the NSW Centre for Oral Health Strategy for informed consent (Appendix 1). All children who consented were offered a screening examination. Sampling of the consenting children was undertaken to determine which children would participate in the study. Oral health status was obtained by dental examination. Participating children were examined by trained dental examiners and observations recorded onto a field optical mark reader form (OMR form).

The present study, exploring socioeconomic variation in oral health, utilised hand distributed parental self-complete questionnaires entitled 'The Oral Health Status and Access to Services Project', to collect information on individual socioeconomic characteristics from parents/guardians (Appendix 2). School SES was based on the Index of Community Socio-Educational Advantage (ICSEA) obtained from the '*My Schools'* website in February 2010 to create a school-level of SES ranking. School type data were obtained from the NSW Department of Education and Training, including those identified as disadvantaged. Area SES was based on the Australian Bureau of Statistics (ABS) socioeconomic advantage/disadvantage index (SEIFA IRSAD Census 2006) assigned on the basis of child's residential postcode.

2.1.1 Sampling procedures

2.1.1.1 Sampling: NSW CDHS 2007

The NSW CHDS 2007 sampling approach was a 2-stage stratified clustered random sample. The strata were defined as the eight Area Health Service Regions in New South Wales. The NSW CHDS 2007 selected from public, Catholic, Independent and community schools (excluding special needs schools). Prior to selection, schools were sorted by the IRSAD Socioeconomic Index for areas (SEIFA) to ensure a range of schools from different socioeconomic areas were selected within each Area Health Service Region with a probability proportional to size. The target sample was approximately 8000 children aged between 5 and 12 years that were stratified by 8 Area Health Service regions in New South Wales. Primary schools (n=107) were selected across New South Wales with a fixed number of children per age group per school (n=76 per school). Nineteen schools (18%) selected across Area Health Service regions declined to participate so substitute schools with similar SEIFA index and school type were selected using the same method as the original selection. All children in the selected and consenting schools were given information packs and consent letters for both the NSW CDHS study and the supplementary study.

To select the children in the schools, electronic lists of enrolled children were sorted by birth date and then divided into eight separate lists (one for each age year). Children were then selected from each list by selecting every n^{th} child based on the number of eligible children in a particular age year and the number of children required to be selected based on the age year. The sample size for each year level was determined to provide state estimates for each year of age. Approximately 76 children aged 5 to 12 years were sampled from each selected school with a minimum of 8 children and a maximum of 12 children sampled from each age group per school. Oversampling, a deliberate selection of additional children from the 5-6 year old and 11-12 year old age groups, was carried out so as to provide reasonably precise and reliable regional estimates of dmft and DMFT for 5-6 year olds and 11-12 year olds. Only children with returned consent forms were eligible for selection within a school.

2.1.1.2 Sampling: Supplementary study of the socioeconomic variation

The NSW CHDS 2007 participants served as the population sample for this supplementary study. The aim was to approach all children who completed a dental examination as part of

NSW CHDS 2007. Once the child had a dental examination, the child's parent was sent a package containing an information letter, with a brief description of the study, questionnaire and reply-paid envelope. Completed questionnaires were returned directly to the Australian Research Centre for Population Oral Health (ARCPOH) at The University of Adelaide. A reminder card and up to three follow-up mailings of replacement questionnaires were sent to non-respondents (Appendix 3). If a child's parent/guardian contacted ARCPOH and declined participation, the child was recorded as a refusal. If the follow-up mailing was not delivered to the participating family and was returned to ARCPOH, the child was recorded as 'undelivered'.

2.2 DATA COLLECTION METHODS

Data were collected from three sources, including the CDHS examinations that were conducted over an five month period for each AHS region, the questionnaire distributed upon completion of the examination and, the collection of the school and area socioeconomic scores using the 'MySchools' database and ABS SEIFA IRSAD Index.

2.2.1 Examinations

Staff employed by NSW Health, Centre for Oral Health Strategy and Area Health Service Regions, were responsible for the examination phase. Standardised oral examinations were conducted in schools by teams of trained examiners using standard portable dental equipment (chair, light and compressed air equipment). The examination consisted of a visual assessment using a mirror, a periodontal probe and compressed air based on protocol developed at the ARCPOH (Appendix 4). The protocol measured decayed, including non-cavitated lesions, missing and filled surfaces of all primary and permanent teeth.

Examiners and recorders from NSW Health undertook a two-day training and calibration workshop with staff from ARCPOH; the workshop included a designated NSW Health COHS 'gold standard' examiner. The training and calibration program included didactic information as well as supervised dental examinations for reliability testing. A manual was also provided to examiners and recorders.

Data were recorded on optical mark recognition forms developed by ARCPOH (Appendix 4). The forms were scanned and verified and data were then exported to Microsoft Access for cleaning and checked for missing, erroneous or duplicate data. Erroneous data and children who did not reside within NSW were eliminated from the dataset.

The calibrated staff examined participants using visual criteria to assess tooth status, and coronal caries experience. Tooth status was categorised as one of the following: present, sound, missing for reasons other than caries, missing due to caries. Surfaces were categorised as one of the following: sound, demineralised but not cavitated, cavitated or filled. Brief reports were given to the examined child. Examinations began in August 2007 and were completed in December 2007.

Results from the NSW CDHS 2007 have been separately analysed and reported elsewhere (COHS, 2009).

2.2.2 Questionnaires

The supplementary questionnaire was given to the child to take home on completion of the examination. An identification code was handwritten on the questionnaire to enable matching against the dental examinations data. Children's names and addresses were entered on a Master register which was forwarded to ARCPOH for entering on a separate database. Non-respondents were sent a reminder card two-three weeks later. For those who had not responded, up to three packages containing a further approach letter, questionnaire and reply-paid envelope were sent during the study period. The data collection used the Dillman's Total Design method (TDM) to maximise response rate (Dillman, 1978).

Questionnaires were completed by a family member or guardian. The 12-page questionnaire used close-ended questions to collect information concerning: sociodemographic information, household socioeconomic information, use of services and health behaviours. Sociodemographic information included: age, sex, Indigenous identity, household arrangements, country of birth, language spoken at home and dental insurance. Household socioeconomic information consisted of: household income, source of income, parent occupation, current work status and parent education level. The questionnaire used items from previous mail surveys developed by ARCPOH, including the Study into Child Use of Dental Health Services (SCUDS), Child Fluoride Study Mark One and Mark Two, and the study Dental Decay from Childhood to Adulthood.

2.2.3 School and area SES information

School socioeconomic status was determined using two approaches; school type and school SES score (ICSEA). School type data were obtained from the NSW Department of Education and Training, including those schools identified as disadvantaged schools. School SES scores (ICSEA) were procured in February 2010 from the Australian Government '*My Schools'* database for each selected school.

The postcode of residence was used to determine two area socioeconomic status variables. Each individual's residential postcode was allocated to a Local Health District (LHD). The LHDs were attributed an SES value using two approaches. Firstly a compositional index was used, the Census 2006 Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD), one of four Socioeconomic Indices for Areas (SEIFA) produced by the Australian Bureau of Statistics. The IRSAD was used as it includes variables (education, income, employment, family structure, housing and Internet) that relate to relative advantage and distinguishes between advantaged and disadvantaged areas (ABS, 2006). Secondly, a wealth metric of the area using median house prices for each area as a measure of contextual effect of neighbourhood wealth or deprivation (Moudon et al., 2011). The Wealth Metric SES measure used the residential postcode of the child and attributed an SES value using the median house price for each postcode. Data for the assessed median house price for postcodes was based on house price statistics from Australian Property Monitors (APM, 2013).

2.2.4 Examiner reliability

Inter-examiner reliability tests of dental examinations were undertaken where replicate pairs of examinations were conducted. One hundred and thirty one children were examined by the NSW Health COHS 'gold examiner' and by one of 20 dental examiners. Test-retest examination data were examined for coding of sound, non-cavitated lesions, decayed, missing and filled tooth surfaces. Results of reliability tests have been reported elsewhere (COHS, 2009).

2.3 DATA MANAGEMENT

This section discusses the management of the data and the approach adopted for this research by identifying the oral health and explanatory variables to be used and an outline of the approach to the analyses.

2.3.1 Survey return and data entry

Examination data were recorded on optical mark reader (OMR) forms developed by ARCPOH. OMR forms were returned to the NSW Centre for Oral Health Strategy who scanned the forms and verified the resulting dataset. Data were then exported to Microsoft Access 2007 for cleaning and checked for missing, erroneous or duplicate data. Children who did not reside within NSW were eliminated from the dataset. The dataset was then sent to ARCPOH.

An Excel database was used to document the questionnaire dispatch and return and scheduled follow-up mail-outs. The database included the respondent's unique ID, name, address, date of mail-outs, refusals, return to sender and date received. Returned questionnaires were date-stamped and the return date entered on the database.

An Access database was established for data entry of the returned questionnaires. The database included respondent's unique ID and variables for each of the questionnaire items but did not include any personal information that would identify the individual. All data entry was conducted at ARCPOH by two staff. A document outlining data entry guidelines was developed to clarify requirements for data entry. During data-entry look-up menus were utilised for occupation classifications and location/postcode information, and a height and weight converter was also used. During data cleaning, all written responses for the 'other, please specify' categories were individually assessed and, where possible reassigned. Those that were unable to be assigned codes were marked as 'missing'.

2.3.2 Oral health items

Dental caries data collected from the OMR sheets were managed to calculate three oral health variables for this study: caries prevalence; caries severity; and a Significant Caries Index 10. Each of these was calculated for the both deciduous and permanent dentition. Analysis of deciduous caries experience was limited to children aged 5 – 8 years, while the permanent caries experience included those children aged 6 – 12 years. Caries prevalence was the proportion of children who had experienced at least one decayed missing or filled tooth and was used to measure the disease burden of the NSW children. Caries severity was measured using the mean of the decayed, missing and filled number of teeth (dmft or DMFT) and surfaces (dmfs or DMFS). Caries severity showed the accumulation of dental caries in the past and present and included the treated and untreated decay. The SiC_{10} assessed the caries severity of the top 10 per cent of children in each age group in the caries severity distribution. Caries severity is highly positively skewed. The SiC_{10}

highlighted the minority of children who still have high levels of caries experience that was diluted in the mean caries severity score (Bratthall, 2000, Nishi et al., 2001).

The three caries measures were selected to provide different perspectives on caries experience. The DMF/dmf index is a simple and versatile index that measures the disease in the population and can be used to compare different sub-groups. The decline in prevalence of dental caries means that one measure of dental caries is less informative (Pine and Harris, 2007) and provides an incomplete picture of the disease experience with positively skewed distribution (Antunes et al., 2004, Pitts et al., 2002). Caries prevalence provides a simple measure of those who have experienced caries and those who have not, but does not discriminate between degrees of intensity of disease experience. Mean DMF/dmf is useful to explore the variation in severity of caries between groups to provide comparison and describe the relative status of the SES groups. The SiC_{10} accounts for the skewed distribution of caries experience, measures those that are most affected by caries, as well providing important information about the most vulnerable group (Bratthall, 2000). The three caries measures provide an opportunity to explore the variation across the SES groups and determine differences between groups and between caries measures and pattern of caries distribution in SES groups. The use of a range of caries measures seeks to measure prevalence as well as the polarisation of disease.

2.3.3 Explanatory items

The social gradient in oral health has been established for both children and adults using numerous socioeconomic indicators. Some studies have measured SES at both the individual- and area-level. This study explored three levels of SES: individual-, school- and area-level SES, investigating separate unadjusted associations as well as associations after adjusting for the nested structure in a multi-level model. A range of sociodemographic and socioeconomic items was collected to explore the relationship with oral health outcomes.

2.3.4 Sociodemographic items

A number of items were used to explore individual and family characteristics that may relate to both socioeconomic status and oral health, including age, sex, Indigenous identity, location of birth, household structure, work status and insurance. Age was calculated using the date of birth and the date of examination and then categorised into 2-year age groups.

Sex was marked as male or female. Indigenous identity was collected through five categories, 'Aboriginal', 'Torres Strait Islander', Aboriginal and Torres Strait Islander', 'Not Aboriginal or Torres Strait Islander' and 'Not known'; these were then collapsed to three options, 'Yes', 'No' and 'Not known'. The item related to location of birth generated a new item 'Born in Australia' and was classified as 'Yes' or 'No'. Household structure related to the family composition, whether the child belonged to a two-parent or single-parent family. The household work status item asked about the parent(s) current work status. This was then classified into 'working', 'not working', 'never worked'. The questionnaire also collected household dental insurance status asking parents if they had private dental insurance.

2.3.5 Socioeconomic status items

Two items were used to explore individual SES, income and education. Household income was collected from the questionnaire where parents indicated the household income in one of ten categories ranging from less than $20 000 to more than $180 000. These categories were then collapsed into four categories, 'up to $40 000', '$40 001 to $80 000', '$80 001 to $120 000' and 'over $120 000'. The item related to education of the parents had eight options ranging from primary school through to postgraduate education. These were recoded to four categories for the parents' highest education level: 'some/completed secondary'; 'some/completed trade'; 'some/completed university'; and 'postgraduate education'.

School SES (ICSEA) was determined using the Australian Government 'MySchools' 2010 database utilising the Index of Community Socio-Educational Advantage (ICSEA) score for each selected school. The ICSEA is a special measure created to allow comparison of schools. The ICSEA score comprises socioeconomic characteristics of the small areas in which students live, rural/remote location and the proportion of Indigenous students enrolled at the school. The average ICSEA score is 1000 with most schools ranging from 900 to 1100. This has been described in more detail elsewhere (ACARA). Each school was allocated an ICSEA score and then these scores were categorised into the following quartiles 'Lowest' (≤ 977), 'Mid-low' (978-1008), 'mid-high' (1009-1061), 'and highest' (≥ 1062).

School type data were obtained from NSW Department of Education that provided a list of all schools that were Independent, Catholic, public school and special school. Special

schools were excluded from the sample frame. A list of disadvantaged public schools (2007) was also obtained from the NSW Department of Education that identified disadvantaged public schools as those that were eligible for Priority Action Schools (PAS) or Public School Funding Program (PSP). School type was then categorised into 'Independent', 'Catholic', 'Public' and 'Disadvantaged public'.

Two area-based indicators were used for each Local Health District (LHD), a Census based SES score and a wealth metric based on median house price. The area-based level of socioeconomic status used the residential postcode of the child and attributed an SES value using the ABS SEIFA Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD) 2006. The SEIFA IRSAD was a composite value based on the characteristics of people and households within a small area collection district and represents the collective socioeconomic status of the people from that area. SEIFA aims to capture relative socioeconomic disadvantage in relation to material and social resources. The average IRSAD score is 1000 with approximately two-thirds of the areas ranging from 900 to 1100.The areas were ranked in order of their score where a low IRSAD score indicates that an area has a larger proportion of disadvantaged households. Once the IRSAD scores were attributed to the residential postcodes of children in the study, the variable was then re-categorised into five Local Health District categories 'Lowest', 'Mid-low', 'Mid', 'Mid-high', 'Highest '. The Wealth Metric SES measure used the median house price for each postcode as a variable that reflects the SES of an area rather than a collective, aggregated measure. House prices capture the contextual effect (Moudon et al., 2011) and may be associated with health due to the value placed on particular areas and the services that are available (Ratcliffe, 2012). Contextual factors such as services, amenities, and employment rates may change at the same time as house prices (Ratcliffe, 2012). The LHD areas were ranked in order of their score where a low wealth metric score indicates that an area has a lower median house price. Once the wealth metric scores were attributed to the residential postcodes of children in the study, the variable was then re-categorised into five Local Health District categories 'Lowest', 'Mid-low', 'Mid', 'Mid-high', 'Highest '.

2.3.6 Survey Weighting

In order to provide population estimates for caries prevalence and experience, the data were weighted by a child's probability of selection in the Survey. This was determined by a range of factors, including: for each Area Health Service region; each schools' enrolment

size as designated in the sampling frame; and, the number of children of a particular age enrolled in the school. Weighting incorporated two stages, the first and initial weight calculated for each child to reflect their probability of selection in the NSW CDHS 2007, and second, an adjustment to ensure that estimates derived from the study were consistent with the Australian Bureau of Statistics Estimated Residential Population (ERP) counts for each NSW AHS region. The ERP counts were single year of age by sex population counts as at 30th June 2007.

2.3.7 Analysis plan

Questionnaires, dental examination data and school and area socioeconomic indices were linked into a single dataset and analysed. Statistical analyses were conducted using SPSS® version 17.0 (IBM SPSS Inc), SAS ®version 9.2 (SAS Institute Inc) and SUDAAN® (Research Triangle Institute) to account for the complex sampling design.

Descriptive analysis was employed to describe the prevalence, severity and Significant Caries Index, together with their 95% confidence interval (CI), among the study sample were reported. If the 95% confidence intervals were non-overlapping then the difference between the estimates was determined as statistically significant. Bivariate analyses were used to report and compare oral health by sociodemographic, individual-, school- and area-level socioeconomic characteristics.

Sequential and regression models were generated for each of the individual-, school- and area-level socioeconomic variables. Initially, the standard control variables age and sex were included together with sociodemographic factors (Indigenous identity, location of birth and household structure) based on the conceptual model. Each of these variables were assessed against the criteria for a confounder (Rothman et al., 2008) and included in the initial full multivariable models (Appendix 5 Diagrammatic Acyclical Graphs for each level). A backward deletion method (Rothman et al., 2008) was used to obtain the final model. The estimates for the SES-dental caries relationship were obtained, while controlling for all other covariates (variables that remain in the model as potential confounders) for the full model and for the reduced model. An impact measure of confounding [$\ln(\text{Estimate}_{crude}/\text{Estimate}_{adjusted})$] with a cut point of 0.10 was used to assess the difference between the estimates obtained from each model. If the difference was greater than 10% then the reduced model does not control for confounding and the variable being assessed would be left in the model. If the estimate from the reduced model were not

substantially different from the full model (<10%) then the variable would be dropped permanently. The precision was also considered to have an estimate as precise as possible. If the variable that was dropped severely impacts the precision, the decision to remove the variable from the model was reconsidered. Ideally, the final model would be the one that gives essentially the same point estimate as the full model (the model controlling for the most variables) and gives the most meaningful gain in precision. The estimate variation tables are included in Appendix 6.

Adjusted prevalence ratios (PR) and rate ratios (RR) between the SES groups were calculated using Poisson regression models (SUDAAN PROC LOGLINK, SAS PROC GENMOD) (Barros and Hirakata, 2003, Greenland, 2004), with the highest SES group allocated as the reference group. Each SES level (individual-, school- and area-) were analysed separately. The explanatory variables, related to the specific SES level, were added into a series of three sequential models reporting a prevalence ratio or rate ratio for each SES category in relation to the reference category. The pair of SES indicators for each level of SES were introduced individually and then in combination to determine which would better explain the disease experience. The extent to which these socioeconomic factors accounted for variation in oral health was evaluated by comparing the prevalence ratios or rate ratios and their 95% confidence intervals among these sequential models. In addition, the final model was examined to investigate the change in point estimates between the models. A direct method for comparison of SES indicators and confounder assessment was to 'compare the estimates of effect obtained with and without controlling for each potential confounder' (Rothman et al., 2008). The magnitude of confounding or association effect was determined by examining the point estimates obtained without adjusting for the alternate SES indicator (and potential confounder) compared to the point estimates obtained when adjusting for the alternate SES indicator. The change in estimate between the models was used to determine which SES indicator provided the most stable association. A common difficulty in multivariable regression is multicollinearity where there is the potential for high levels of common variance across a set of explanatory variables. Each model was tested for multicollinearity amongst the explanatory variables using the Variance Inflation Factor (VIF) with results reported in Appendix 7. A general rule is that that VIF values higher than 2.50, 4.00 and 10.00 are problematic (Tuohy and McVey, 2008) while others state that VIF values not 'unusually' larger than one are not a problem (Mansfield and Helms, 1982). None of the explanatory variables exceeded the value of 2.00.

Multi-level analyses were conducted to account for the nested structure of individuals within schools and schools within areas. Given the structure of the survey and the aim to examine the effects of individual and contextual school and area-level variables, a multi-level analytic approach was necessary to examine the role of context in explaining social gradient in oral health (Diez-Roux, 2000, Greenland, 2000). One measure was selected from each of the three levels, individual, school and area. The SES indicators that recorded stronger and more stable associations across bivariate and sequential analyses were used. SES variables were checked for concordance. Initially each socioeconomic indicator were tested alone and then in a full model to determine if schools and areas make a difference to socioeconomic differences in oral health (Diez-Roux et al., 2001). Odds ratios (OR) and rate ratios (RR) between the SES groups were calculated using multi-level regression models (SAS PROC GLIMMIX) to test oral health variation among the explanatory variables. The GLIMMIX procedure models data that are not normally distributed for both binary and continuous distributions, using Loglink function and Residual PL estimation technique (Schabenberger, 2005). The school- and area-levels were set as random effects while the explanatory factors were included as fixed effects. Pseudo AIC was used to assess model fit and 95% CI for odds ratios and rate ratios to determine significance of the estimates. Model 1 is a Null model with school and area as random effects. Model 2 includes the Level 1 individual income as a fixed effect with ORs for SES categories. Model 3 shows Level 2 school type as a fixed effect. LHD wealth is explored as a fixed effect in Model 4. Model 5 is the full model with all three explanatory levels included as fixed effects. The estimates between the models were also compared.

In this study a population perspective on oral health SES differences is explored. This reflects a need to highlight the total SES variation in the population burden in dental caries in children by considering the number of cases of caries prevalence and high caries severity (SiC_{10}) that was attributed to the association with individual, school or area SES. The total numbers of cases attributed indicated the quantum of disease that could be reduced by the targeting of a highly successful dental program on the basis of each level of SES characteristic or their combination. This approach provided data to assist oral health policy decision making to reduce SES differences (Harper and Lynch, 2005, Harper and Lynch, 2007). The contributions of the individual-, school- and area-level socioeconomic characteristics are quantified using the summary measure Population Attributable Fraction (PAF%), to estimate the population health impact of these SES differences (Rothman et al.,

2008). PAF was used to compare the associations of SES indicators with child oral health and the population impact of those factors. The SES indicator for each level was included in separate models. The models were generated by Poisson distribution (SUDAAN PROC LOGLINK, SAS PROC GENMOD). Prevalence ratios (PR) and Rate ratios (RR) were estimated for each of the included indicators. The adjusted Population Attributable Fraction (PAF) of each SES indicator was estimated as a percentage for each SES indicator as a weighted average [*Overall PA*F= PAF=[1-∑(population/PR)]/population] (Bruzzi et al., 1985, Rowe et al., 2004). Category specific attributable fraction was calculated [PAF each category= (proportion exposed cases)* (RR-1)/RR] to compare the population impact of each level of SES (Boyko, 2000, Rockhill et al., 1998). PAF estimates indicate the proportion of the disease in the population attributable to that particular factor or sub-group.

2.4 ETHICAL IMPLICATIONS AND APPROVALS

The research study abided by the principles of ethical conduct (integrity, respect for persons, beneficence and justice) towards participants. The University of Adelaide Human Research and Ethics Committee, the New South Wales Population and Health Services Research Committee, the State Education Research Process of New South Wales Department of Education and Training and the Catholic Education Commission and Association of Independent Schools granted ethics approval for the NSW CDHS 2007. An information summary sheet on the survey and supplementary study was given to all schools, and a consent form was completed and signed by each parent/guardian before the examination and collection of questionnaire information.

Written informed consent sought from participants covered two stages of this project. Firstly, all children who received an examination as part of the NSW CDHS 2007 were asked to sign a consent form that covered release of their examination data to ARCPOH, School of Dentistry, and The University of Adelaide. NSW Centre for Oral Health Strategy handled this consent. Copies of their information sheet and consent forms are attached (Appendix 1). Secondly, all children who attended for the NSW CDHS 2007 examination received a questionnaire that included an information summary sheet. This involved the exercising of voluntary choice to participate in the supplementary study. Individuals were able to refuse to participate without giving reasons or justification for that decision. They were assured that dental advice and treatment would be unaffected should they choose not to participate or withdraw consent at any stage.

Confidentiality was maintained in the field, and all paper and electronic documents stored securely. Datasets had personal information removed and children were identified using only a 9-digit identification number. Confidentiality of information supplied on children was maintained by the use of this identification number on all computer files. The personal details collected as part of the dental examination by NSW Child Dental Health Survey 2007 have been stored securely by NSW Centre for Oral Health Strategy and only de-identified examination data were made available for analysis. The information provided by children was only used for the purpose of the research for which it was collected. This information was treated as confidential and individual identity further protected through the reporting of results in aggregate form.

CHAPTER 3 RESULTS

The results consist of eight major sections, which are further divided into sub-sections. Each section may contain descriptive, bivariate and multivariable statistics for that section. The major sections consist of:

1. Response rates of the NSW Child Dental Health Study and this supplementary study – subsection 3.1
2. Descriptive findings of the explanatory variables including sociodemographic, and socioeconomic (individual-, school- and area-level) – subsection 3.2
3. Correlation statistics for explanatory variables – subsection 3.3
4. Descriptive, bivariate and sequential model analysis of caries prevalence – subsection 3.4
5. Descriptive, bivariate and sequential model analysis of caries severity – subsection 3.5
6. Descriptive, bivariate and sequential model analysis of SiC_{10} – subsection 3.6
7. Multi-level analysis to evaluate SES variation – subsection 3.7
8. Population measures of association and impact – subsection 3.8

The data presented in the following results relate to information collected from the dental examinations, questionnaire and socioeconomic indicators. Where indicated, the per cent or mean values shown in the tables are weighted data, whereas the numbers of individuals are unweighted.

3.1 PARTICIPATION

3.1.1 Participation results of NSW examination phase

Table 2 presents the enrolment rate, number of schools and respondents for the NSW Child Dental Health Survey and the response rate of the supplementary study questionnaire. The Table describes the consenting schools and children and participation elements for both the CDHS 2007 and the supplementary study.

A total of 126 schools were selected to achieve the required 107 schools. A total of 8,002 children were selected from the pool of children who had consented to participate in the NSW CDHS and were present of the day of the examination, with 7,975 children with complete dental examinations for an overall response rate of 64.8% for the NSW CDHS 2007. All children who were examined for the NSW CDHS 2007 received a supplementary questionnaire on the day of the examination of which 5,264 responded. The completed questionnaires were then matched with the examination data and resulted in an adjusted total of 5,243 linked respondents at a response rate of 66% for the supplementary study and an overall response rate of 43% of the children approached.

Table 2: Enrolment rate for the CDHS and supplementary study

Element	Numbers	Percent
NSW CDHS 2007		
Schools approached	126	
Schools participated	107	85%
Children approached	40,833	
Children consented	26,150	65%
Children selected for examination for study	8002	
Children examined for the study	7975	99.7%
Children not participating in the study but offered screening examination	18,148	
Supplementary Study		
Children given questionnaires	7975	
Completed questionnaires returned	5264	66%
Matched exams and questionnaires	5243	66%

3.1.2 Participation results of supplementary questionnaire phase

The following tables (Table 3 and 4) report the participation in the questionnaire stage of the study where questionnaires were distributed to those children attending for the examinations. A response rate of 66% was achieved after a reminder card and up to three follow-up letters.

Table 3: Returns for supplementary questionnaire

Response	
Exams/questionnaires distributed	7975
Returned to sender	143
Refusals	41
Returned completed questionnaires	5264
Matched exams and questionnaires	**5243**

Table 4 describes the response rate for each of the Area Health Service (AHS) regions. The response rate was higher among the metropolitan AHS regions (67.5%) compared with the rural AHS regions (63.4%). North Sydney Central Coast AHS exhibited the highest response rate (71%) in contrast to Greater Southern and Greater Western AHS (60%), a difference of nearly 20%.

Table 4: Participation results across Area Health Service Regions

Area Health Service		**Surveys sent**	**Surveys returned and matched**	**Response rate**
Greater Southern	Rural	901	543	60%
Greater Western	Rural	726	436	60%
Hunter New England	Rural	985	660	67%
North Coast	Rural	820	537	66%
Nth Sydney Central Coast	Metro	1162	828	71%
S-Eastern Sydney Illawarra	Metro	987	674	68%
Sydney South West	Metro	1180	803	68%
Sydney West	Metro	1214	762	63%
TOTAL		7975	5243	66%

3.2 DESCRIPTIVE FINDINGS – EXPLANATORY VARIABLES

3.2.1 Sociodemographic data from the sample

Table 5 presents the sample characteristics by age, age-group and sex. Proportions for unweighted including those with missing data, unweighted excluding those with missing data and weighted data are presented. There were slightly more children of 11-years (17.6%) with fewer from the 7-9 year olds. This was to ensure adequate numbers in the 5-6 and 11-12 age groups to allow for deciduous and permanent caries experience comparisons across Area Health Service regions. There were slightly more boys than girls. The majority of participants were born in Australia with only 7.5% born overseas. Nearly 80% children lived in a household with two parents. The greatest proportion of children was in a household where two parents were working. Families who had private dental insurance comprised 44.5% of the sample. There were some missing data for household structure (7.3%), work status (1.6%) and dental insurance (1.7%).

Table 5: Sociodemographic characteristics of participants

Variable	Category	Frequency	Unweighted Missing incl. %	Unweighted Missing excl. %	Weighted %
All		5243			
Age	5 yrs	644	12.3	12.3	12.3
	6 yrs	742	14.2	14.2	12.5
	7 yrs	604	11.5	11.5	12.3
	8 yrs	569	10.9	10.9	12.3
	9 yrs	546	10.4	10.4	12.5
	10 yrs	587	11.2	11.2	12.5
	11 yrs	920	17.6	17.6	12.8
	12 yrs	631	12.0	12.0	12.8
Age gps	5-6 yrs	1386	26.4	26.4	24.7
	7-8 yrs	1173	22.4	22.4	24.6
	9-10 yrs	1133	21.6	21.6	25.0
	11-12 yrs	1551	29.6	29.6	25.6
Sex	Male	2637	50.3	50.3	51.2
	Female	2606	49.7	49.7	48.8
Indigenous identity	Yes	213	4.1	4.1	3.6
	No	4465	85.2	85.2	85.4
	Not known	565	10.8	10.8	11.0
Child born Australia	Yes	4853	92.6	92.8	92.5
	No	378	7.2	7.2	7.5
	Missing	12	0.2		
Household structure	Two parent family	4100	78.2	84.3	84.5
	Single parent family	762	14.5	15.7	15.5
	Missing	381	7.3		
Household work status	Two parents working	2919	55.7	56.6	55.6
	One parent working	1736	33.1	33.7	34.3
	No parent working	503	9.6	9.8	10.1
	Missing	85	1.6		
Dental Insurance	Insured	2300	43.9	44.6	44.5
	Uninsured	2855	54.5	55.4	55.5
	Missing	88	1.7		

3.2.1.1 Population benchmarking

This section compared proportions derived from the NSW Child Oral Health supplementary study with the known distribution of selected demographic characteristics within the NSW child population based on NSW population census data. Table 6 compares the distributions for the NSW supplementary study against the ABS Census 2006 for the following variables: sex, Indigenous identity, location of birth, household structure, household income and area SES. The demographic characteristics were population benchmarks reported in the 2006 Australian Census of Population and Housing for NSW. Area SES was re-categorised to match the cut-points used for ABS Census 2006. The benchmarking demonstrated whether there were demographic groups who were less likely to participate in the NSW CDHS and the supplementary study. If the census statistic fell within the 95% CI for the variable then it was determined that there was not a statistically significant difference.

There were no differences for sex. The proportion of children who were identified as Indigenous was similar to census data. However, those who did not identify as Indigenous or marked 'not known' did differ. Those that were not born in Australia, were children in single parent families, had higher household income and lived in a lower SES area were less likely to participate in the NSW CDHS and supplementary study.

Table 6: Comparison of characteristics of participants of supplementary study and the NSW ABS Census 2006

Variable		Supplementary study %	NSW Census 2006
Sex	Male	**51.2** *49.3-53.0*	**51.3**
	Female	**48.8** *47.0-50.7*	**48.7**
Indigenous	Yes	**3.6** *2.7-4.4*	**4.1**
	No	**85.4** *83.9-86.9*	**90.2**
	Not known	**11.0** *9.8-12.3*	**5.7**
Australian born[(a)]	Yes	**92.5** *90.9-94.1*	**87.1**
	No	**7.5** *5.9-9.1*	**12.9**
Household structure[(a)]	Two parent	**84.5** *82.6-86.3*	**78.3**
	One parent	**15.5** *13.7-17.4*	**21.7**
Household income[(a)]	Up to $40,000	**26.5** *22.9-30.2*	**26.1**
	$40,001-$80,000	**31.7** *29.5-33.9*	**31.4**
	$80,001-$120,000	**24.1** *21.8-26.4*	**15.0**
	$120,000 +	**17.6** *14.4-20.8*	**27.5**
Area SEIFA[(a)] (using ABS cut-off scores)	High	**26.8** *20.2-34.8*	**25**
	Mod-high	**32.5** *25.1-40.9*	**25**
	Mod –low	**26.9** *21.0-33.7*	**25**
	Low	**13.8** *8.9-20.6*	**25**

Notes:
(a) Excludes missing data: Child born in Australia (12); Household structure (381); Household income (333); Area SEIFA (4)

3.2.1.2 Child Dental Health Survey comparison

This section compared proportions derived from the NSW Child Oral Health supplementary study with the proportions from the parent study, the NSW Child Dental Health Survey (Table 7). The demographic characteristics age, sex, and Indigenous identity were compared. This will demonstrate if there are demographic groups who were less likely to participate in the questionnaire phase of the study. There were no differences for age and sex. The proportion of children for each category of Indigenous identity was similar with slightly higher proportions of those who did not identify as Indigenous participating in the supplementary study.

Table 7: Comparison of sociodemographic characteristics of NSW CDHS 2007 and supplementary study

Variable	Category	NSW CDHS n=7975	Supplementary study n=5243
All			
Age	5 yrs	12.3	12.3
	6 yrs	14.0	14.2
	7 yrs	10.8	11.5
	8 yrs	11.0	10.9
	9 yrs	10.8	10.4
	10 yrs	10.8	11.2
	11 yrs	17.7	17.6
	12 yrs	12.6	12.0
Sex	Male	49.2	50.3
	Female	50.8	49.7
Indigenous	No	82.7	85.7
	Yes	5.8	3.5
	Unknown	11.6	10.8

3.2.2 Individual socioeconomic indicators

Table 8 presents the socioeconomic characteristics of the sample respondents. There was a spread of respondents across the household income groups though the lowest proportion was the group earning over $120,000. Just over a quarter of the participants had highest parent qualification that was primary or secondary school-level only.

Table 8: Sample socioeconomic characteristics

Variable	Category	Frequency	%
Household Income[(a)]	Over $120,000	846	17.6
	$80,001 to $120,000	1198	24.1
	$40,001 to $80,000	1570	31.7
	Up to $40,000	1296	26.6
Highest parent education[(a)]	Postgraduate	947	18.4
	Some or completed university	1891	38.0
	Completed trade	887	17.1
	Primary or secondary	1308	26.5

Notes:
(a) Excludes missing data: household income (333); highest parent education (210)

3.2.3 School socioeconomic indicators

The socioeconomic status of the children, using school indicators, is presented in Table 9. The distribution across the school SES (ICSEA) ranking are categorised into quartiles. The highest proportion of children for school type are those who attended public schools that were not considered disadvantaged with similar proportions for the Catholic and disadvantaged schools with the smallest proportion of children attending Independent schools.

Table 9: School socioeconomic characteristics

Variable	Category	Frequency	%
School type	Independent	623	12.3
	Catholic	1165	20.8
	Public other	2392	47.1
	Public PAS/PSP	1063	19.7
School SES (ICSEA)	Highest SES quartile	1302	25.9
	Mid-high quartile	1297	25.0
	Mid-low quartile	1332	26.3
	Lowest SES quartile	1312	22.8

Notes:
No missing data for school variables

3.2.4 Area socioeconomic indicators

The socioeconomic status of the study sample, using two area indicators, is presented in Table 10. The highest proportion of children was from LHDs with a mid-range SEIFA score. When comparing LHD by the wealth metric, the highest proportion of children was in the mid-range category with the lowest proportion in the highest wealth metric category.

Table 10: Area socioeconomic characteristics

Variable	Category	Frequency	%
LHD SEIFA SES [(a)]	Highest SES category	975	18.6
	Mid-high category	1043	19.9
	Mid category	1285	24.5
	Mid-low category	964	18.4
	Lowest SES category	972	18.6
LHD Wealth SES [(a)]	Highest SES category	806	15.4
	Mid-high category	938	17.9
	Mid category	1308	25.0
	Mid-low category	1173	22.4
	Lowest SES category	1014	19.4

Notes:
(a) Excludes missing data: LHD SEIFA (4); LHD wealth (4)

3.3 CORRELATION AND CONCORDANCE STATISTICS FOR EXPLANATORY VARIABLES

Spearman's Rho correlation and concordance analysis was undertaken to determine whether and how strongly the pairs of sociodemographic and socioeconomic variables were related and if multicollinearity was an issue (Table 11-12). Collinearity may be an issue if sociodemographic and socioeconomic factors at an individual or environmental or contextual level are highly correlated with each other where it can be difficult to separate the effects at the statistical level where estimates may have large variances (Rothman et al., 2008). The large sample size should reduce the impact on the estimates and confidence intervals. Collinearity needs to be considered when including variables in the regression models and when considering the contribution of explanatory variables on the oral health outcomes. Multicollinearity was assessed for each model using the Variation Inflation Factor (VIF). There were no statistically significant results; all variables recorded VIF less than two (Appendix 7).

3.3.1 Correlation statistics

The majority of the sociodemographic and individual SES paired variables recorded only a weak correlation while none showed a strong correlation. Four paired variables reported a moderate correlation; income and household structure (0.435), parent education and income (0.475) and parent work status, household structure (0.519) and parent work status and income (0.515). Income showed a moderate correlation with all except 'Born in Australia'.

Table 11: Correlation statistics for individual demographic and socioeconomic characteristics

		Child born in Australia[(a)]	Household structure	Income	Parent work status	Parent education
Household structure[(a)]	*Spearman Rho coefficient*	-0.037				
	n	4852				
Income[(a)]	*Spearman Rho coefficient*	0.013	-0.435			
	n	4900	4580			
Parent work status[(a)]	*Spearman Rho coefficient*	-0.062	0.519	0.515		
	n	5148	4820	4863		
Parent education[(a)]	*Spearman Rho coefficient*	0.138	-0.242	0.475	0.294	
	n	5023	4713	4741	4997	
Dental Insurance[(a)]	*Spearman Rho coefficient*	0.025	0.202	-0.472	-0.296	-0.331
	n	5145	4800	4869	5088	4966

Notes: (a) Excludes missing data

Table 12 reports the correlation statistics for the individual-, school- and area-level SES variables. Income and education showed only a weak-moderate correlation with the school and area SES indicators. School type SES showed only a weak correlation with the two LHD area SES variables, while the school ICSEA SES variable and the two LHD area SES variables showed a moderate-strong correlation. The two school SES variables recorded a moderate correlation (0.435). However, there was a stronger correlation between the two area SES variables (0.690).

Table 12: Correlation statistics for the individual-, school- and area-level socioeconomic characteristics

		Income[(a)]	Parent education	School SES (ICSEA)	School type	LHD SEIFA
Parent education[(a)]	*Spearman Rho coefficient*	0.475				
	n	4741				
School SES (ICSEA)	*Spearman Rho coefficient*	0.383	0.380			
	n	4910	5033			
School type	*Spearman Rho coefficient*	0.314	0.302	0.435		
	n	4910	5033	5243		
LHD SEIFA[(a)]	*Spearman Rho coefficient*	0.227	0.206	0.561	0.057	
	n	4909	5029	5239	5239	
LHD Wealth[(a)]	*Spearman Rho coefficient*	0.237	0.245	0.622	0.194	0.690
	n	4909	5029	5239	5239	5239

Notes: (a) Excludes missing data

3.3.2 Concordance analysis

Concordance analysis (Tables 13-18) was undertaken to provide a descriptive measure of concordance between individual-, school- and area-level SES indicators to: complement the correlation analysis; to evaluate and understand the strength of the relationship; to ensure that the different levels of SES indicators were not measuring the same SES relationship; and, to ensure that there were adequate numbers in cells (Thomson and Mackay, 2004). Each cell contains the number and proportion of the total number of children. The cross tabulation distribution of children across the categories using different SES indicators was reviewed to evaluate similarities and differences between the distributions. The concordance assessed whether the categories coincided (both variables recorded the same category) or differed (higher by one variable but lower by another).

The different concordance analyses for the variables are outlined in the summary below.

Table 13 Individual SES (income; education) and School SES (ICSEA)
Table 14 Individual SES (income; education) and School SES (type)
Table 15 Individual SES (income; education) and Area SES (LHD SEIFA)
Table 16 Individual SES (income; education) and Area SES (LHD wealth)
Table 17 School SES (type; ICSEA) and Area SES (LHD SEIFA)
Table 18 School SES (type; ICSEA) and Area SES (LHD wealth)

Table 13 demonstrates the concordance distribution of the individual and school ICSEA SES indicators. There was variation in the distribution across the categories when comparing income and parent education with school ICSEA ranking. The comparison showed lack of concordance between the SES indicators where income and school ICSEA coincided for 2185 children (42%) where both variables recorded the same category (shown in the diagonal shaded sections). There were 1806 children (34%) below the diagonal where they recorded lower on income than on the school ICSEA; and 1279 children (24%) that were above the diagonal where they reported higher on income than on the school ICSEA.

Highest parent education and school ICSEA SES coincided for 1769 children (35%). A third of the children (1610) were below the diagonal where they recorded lower on parent education than on the school ICSEA; and 1554 children (31%) that were above the diagonal where they reported higher on parent education than on the school ICSEA.

Table 13: Concordance statistics for individual and school ICEA SES characteristics

Individual	**School ICSEA**							
	Highest quartile		Mid-high quartile		Mid-low quartile		Lowest quartile	
	n	*%*	n	*%*	n	*%*	n	*%*
Household Income								
Over $120,000	846	*9.9*	191	*3.9*	108	*2.2*	61	*1.2*
$80,001 to $120,000	347	*7.1*	348	*7.1*	279	*5.7*	224	*4.6*
$40,001 to $80,000	258	*5.3*	428	*8.7*	468	*9.5*	416	*8.5*
Up to $40,000	131	*2.7*	261	*5.3*	381	*7.8*	523	*10.7*
Highest parent education								
Postgraduate	430	*8.5*	249	*4.9*	160	*3.2*	108	*2.1*
Some/completed uni	610	*12.1*	508	*10.1*	446	*8.9*	327	*6.5*
Some/completed trade	119	*2.4*	235	*4.7*	269	*5.3*	264	*5.2*
Primary/secondary	103	*2.0*	238	*4.7*	405	*8.0*	562	*11.2*

Notes:
Excludes missing data

Table 14 shows the concordance distribution of the individual SES indicators and school type. Income and school type coincided for 1818 children (37%) where both variables recorded the same category (shown in the diagonal shaded sections). There were 1440 children (29%) below the diagonal where they recorded lower on income than on the school type, and a third of the children (1652) that were above the diagonal where they reported higher on income than on the school type.

The highest parent education and school type variables coincided for 1576 that related to 31% of the children. There were 1344 children (27%) below the diagonal where they recorded lower on parent education than on the school type, and 2113 children (42%) that were above the diagonal where they reported higher on parent education than on the school type.

Table 14: Concordance statistics for individual and school type characteristics

Individual	**School type**							
	Independent		Catholic		Public		Public disadvantaged	
	n	*%*	n	*%*	n	*%*	n	*%*
Household Income								
Over $120,000	211	*4.3*	198	*4.0*	391	*8.0*	46	*0.9*
$80,001 to $120,000	146	*3.0*	347	*7.1*	588	*12.0*	117	*2.4*
$40,001 to $80,000	142	*2.9*	368	*7.5*	748	*15.2*	312	*6.4*
Up to $40,000	84	*1.7*	165	*3.4*	535	*10.9*	512	*10.4*
Highest parent education								
Postgraduate	207	*4.1*	225	*4.5*	450	*8.9*	65	*1.3*
Some/completed uni	262	*5.2*	450	*8.9*	937	*18.6*	242	*4.8*
Some/completed trade	52	*1.0*	239	*4.7*	402	*8.0*	194	*3.9*
Primary/secondary	43	*0.9*	206	*4.1*	542	*10.8*	517	*10.3*

Notes:
Excludes missing data

Tables 15-18 show the concordance distribution between individual and school SES indicators, and the area SES indicators. The individual and school SES indicators were categorised into four categories while the area indicators were categorised into five categories. As a result, the concordance distribution is mapped differently. A broader diagonal approach for concordance has been adopted. The mid-high and mid-low categories for the area SES indicators were matched to the mid-high and mid-low categories for the individual and school SES indicators. In addition, the middle category of the area indicator was also matched to the two mid-categories of the individual and school variables.

Table 15 shows the concordance distribution between individual SES indicators and area SES (LHD SEIFA). The comparison showed concordance for 1945 children (49%) across the diagonal (shown in the shaded sections). There were 1747 children (35%) below the diagonal where they recorded lower on income than on the LHD SEIFA; and 1214 children (25%) that were above the diagonal where they reported higher on income than on the LHD SEIFA.

Highest parent education and LHD SEIFA SES coincided across the diagonal for 1843 children (37%). There were a third of the children (1723) who were below the diagonal where they recorded lower on parent education than on the LHD SEIFA; and 1463 children (29%) that were above the diagonal where they reported higher on parent education than on the LHD SEIFA.

Table 15: Concordance statistics for individual and area SES (LHD SEIFA)

Individual	**Area SES** (LHD SEIFA) Highest category		Mid-high category		Mid category		Mid-low quartile		Lowest category	
	N	%	N	%	N	%	N	%	N	%
Household Income										
Over $120,000	392	*8.0*	130	*2.7*	130	2.7	107	*2.2*	87	*1.8*
$80,001 to $120,000	256	*5.2*	205	*4.2*	307	6.3	233	*4.8*	197	*4.0*
$40,001 to $80,000	170	*3.5*	330	*6.7*	396	8.1	341	*7.0*	333	*6.8*
Up to $40,000	95	*1.9*	311	*6.3*	356	7.3	229	*4.7*	304	*6.2*
Highest parent education										
Postgraduate	322	*6.4*	155	*3.1*	197	3.9	140	*2.8*	132	*2.6*
Some/completed uni	462	*9.2*	393	*7.8*	397	7.9	342	*6.8*	296	*5.9*
Some/completed trade	94	*1.9*	157	*3.1*	231	4.6	203	*4.0*	201	*4.0*
Primary/secondary	70	*1.4*	294	*5.9*	408	8.1	238	*4.7*	297	*5.9*

Notes:
Excludes missing data

Table 16 shows the concordance distribution of the individual SES indicators and area SES (LHD wealth). The comparison showed 1973 children (40%) across the diagonal (shown in the shaded sections). There were 1557 children (32%) below the diagonal where they recorded lower on income than on the LHD wealth; and 1379 children (28%) that were above the diagonal where they reported higher on income than on the LHD wealth.

Highest parent education and area SES (LHD wealth) coincided for 1897 children (38%). There were 1529 children (30%) below the diagonal where they recorded lower on parent education than on the LHD wealth; and a third of the children (1603) that were above the diagonal where they reported higher on parent education than on the LHD wealth.

Table 16: Concordance statistics for individual and area SES (LHD wealth)

Individual	Area SES (LHD wealth)									
	Highest category		Mid-high category		Mid category		Mid-low category		Lowest category	
	n	%	n	%	n	%	n	%	n	%
Household Income										
Over $120,000	331	*6.7*	176	*3.6*	146	*3.0*	125	*2.6*	68	*1.4*
$80,001 to $120,000	183	*3.7*	228	*4.6*	289	*5.9*	292	*6.0*	206	*4.2*
$40,001 to $80,000	160	*3.3*	234	*4.8*	416	*8.5*	394	*8.0*	366	*7.5*
Up to $40,000	80	*1.6*	240	*4.9*	378	*7.7*	282	*5.7*	315	*6.4*
Highest parent education										
Postgraduate	266	*5.3*	178	*3.5*	208	*4.1*	175	*3.5*	119	*2.4*
Some/completed uni	390	*7.8*	404	*8.0*	409	*8.1*	426	*8.5*	261	*5.2*
Some/completed trade	68	*1.4*	115	*2.3*	235	*4.7*	232	*4.6*	236	*4.7*
Primary/secondary	53	*1.1*	216	*4.3*	392	*7.8*	295	*5.9*	351	*7.0*

Notes:
Excludes missing data

The concordance analysis for school type and ICSEA measured against area SES (LHD SEIFA) is reported in Table 17. The comparison showed 1960 children (37%) across the diagonal (shown in the shaded sections). There were 1996 children (38%) below the diagonal where they recorded lower on school type than on the LHD SEIFA, and a quarter of the children (1283) that were above the diagonal where they reported higher on school type than on the LHD SEIFA.

School ICSEA and area SES (LHD SEIFA) coincided for showed half the children (2559) coincided across the diagonal. There were 1312 children (25%) below the diagonal where they recorded lower on school type than on the LHD SEIFA, and 1358 children (26%) that were above the diagonal where they reported higher on school type than on the LHD SEIFA.

Table 17: Concordance statistics for school SES and area SES (LHD SEIFA)

School	**Area SES** (LHD SEIFA) Highest category		Mid-high category		Mid category		Mid-low category		Lowest category	
	n	*%*	n	*%*	n	*%*	n	*%*	n	*%*
School type										
Independent	125	*2.4*	186	*3.6*	88	*1.7*	123	*2.4*	101	*1.9*
Catholic	168	*3.2*	110	*2.1*	323	*6.2*	295	*5.6*	267	*5.1*
Public	682	*13.0*	465	*8.9*	594	*11.4*	427	*8.2*	223	*4.3*
Public - disadvantaged	0	*0.0*	282	*5.4*	280	*5.3*	119	*2.3*	381	*7.3*
School ICSEA SES										
Highest SES quartile	797	*15.2*	273	*5.2*	230	*4.4*	1	*0.0*	0	*0.0*
Mid-high quartile	178	*3.4*	273	*5.2*	280	*5.3*	355	*6.8*	209	*4.0*
Mid-low quartile	0	*0.0*	296	*5.7*	363	*6.9*	383	*7.3*	290	*5.5*
Lowest SES quartile	0	*0.0*	201	*3.8*	412	*7.9*	225	*4.3*	473	*9.0*

Notes:
Excludes missing data

The concordance analysis for school type and ICSEA measured against area SES (LHD wealth) is reported in Table 18. The comparison showed 1941 children (37%) coincided across the diagonal (shown in the shaded sections). There were 1876 children (36%) below the diagonal where they recorded lower on school type than on the LHD wealth, and 1422 children (27%) that were above the diagonal where they reported higher on school type than on the LHD wealth.

School ICSEA and area SES (LHD wealth) showed the highest concordance with 3053 children (58%) coinciding across the diagonal. There were 979 children (19%) below the diagonal where they recorded lower on school ICSEA than on the LHD wealth, and a quarter of the children (1207) that were above the diagonal where they reported higher on school ICSEA than on the LHD wealth.

Table 18: Concordance statistics for school SES and area SES (LHD wealth)

School	**Area SES** (LHD Wealth) Highest category		Mid-high category		Mid category		Mid-low category		Lowest category	
	N	*%*	N	*%*	N	*%*	N	*%*	N	*%*
School type										
Independent	98	*1.9*	213	*4.1*	184	*3.5*	64	*1.2*	64	*1.2*
Catholic	211	*4.0*	67	*1.3*	337	*6.4*	374	*7.1*	174	*3.3*
Public	496	*9.5*	534	*10.2*	444	*8.5*	568	*10.8*	349	*6.7*
Public - disadvantaged	1	*0.0*	124	*2.4*	343	*6.6*	167	*3.2*	427	*8.2*
School ICSEA SES										
Highest SES quartile	731	*14.0*	303	*5.8*	134	*2.6*	97	*1.9*	36	*0.7*
Mid-high quartile	71	*1.4*	380	*7.3*	381	*7.3*	277	*5.3*	186	*3.6*
Mid-low quartile	4	*0.1*	211	*4.0*	499	*9.5*	444	*8.5*	174	*3.3*
Lowest SES quartile	0	*0.0*	44	*0.8*	294	*5.6*	355	*6.8*	618	*11.8*

Notes:
Excludes missing data

3.4 CARIES PREVALENCE

This subsection outlining results for caries experience will present descriptive, bivariate and multivariable statistics that will consist of:

1. Caries prevalence in deciduous dentition - by sociodemographic and socioeconomic (individual-, school- and area-level) [3.4.1]
2. Caries prevalence in permanent dentition - by sociodemographic and socioeconomic (individual-, school- and area-level) [3.4.2]

3.4.1 Caries prevalence in deciduous dentition

The prevalence of caries of the children in the supplementary study is reported in Tables 19 – 22. Almost 40% of the participants had evidence of some caries experience with variation evident across the age groups. Overall there was a general trend for the deciduous caries prevalence to increase across the older age groups though the differences were only significant between those aged six and those aged eight years. There was virtually no difference between girls and boys. There were significant differences in deciduous caries prevalence for those children that identified as Indigenous (1.8 times), were born outside Australia (1.5 times), had no parent working and were uninsured (1.4 times) between the highest and lowest estimates. Differences were apparent between the one and two parent families. However, these were not significant.

Table 19: Caries prevalence in deciduous dentition by sociodemographic characteristics

	% Caries prevalence	
Age at time of survey	**n=2559**	*95% CI[(a)]*
Age 5-8 yrs	**39.1**	*36.3-42.0*
Age[(b)]		
5 yrs	**37.5**	*33.2-41.8*
6 yrs	**33.6**	*29.5-37.7*
7 yrs	**41.7**	*36.6-46.8*
8 yrs	**43.8**	*39.3-48.4*
Sex(5-8 yrs)		
Male	**39.1**	*36.5-42.7*
Female	**39.2**	*35.9-42.4*
Indigenous identity		
Yes	**68.9**	*57.6-80.2*
No	**38.2**	*35.4-40.9*
Not known	**38.4**	*30.3-46.5*
Child born Australia		
Yes	**37.8**	*35.0-40.5*
No	**56.1**	*47.8-64.4*
Household structure		
Two parent family	**37.4**	*34.4-40.4*
One parent family	**45.4**	*39.6-51.3*
Household work status		
Both parents working	**35.4**	*32.5-38.3*
One parent working	**40.4**	*36.2-44.6*
No parent working	**51.7**	*45.1-58.2*
Dental Insurance		
Insured	**31.1**	*27.8-34.5*
Uninsured	**45.2**	*41.9-48.5*

Notes:
(a) 95%CI = 95% confidence interval for estimated prevalence
(b) Rows are arranged by age at time of survey.

To determine whether caries prevalence was associated with study participants' socioeconomic characteristics, bivariate analysis was conducted. If the 95% confidence intervals were non-overlapping then the difference between the estimates was determined as statistically significant. Significant associations were noted between the individual socioeconomic variables and deciduous caries prevalence (Table 20). Deciduous caries prevalence was significantly associated with both level of household income and parent education. A social gradient was evident across all of the socioeconomic variables with the higher socioeconomic groups experiencing significantly lower prevalence of caries. Income exhibited differences between those in the highest and those in the lowest SES group with nearly twice as high caries prevalence in the lowest income groups. The parents' highest education was significantly associated with caries prevalence where more children whose parents had only primary or secondary education were likely to have experienced caries. When comparing the change in estimate across the SES categories, income recorded a greater variation (1.9 times) in caries prevalence across the SES categories compared to highest parent education (1.5 times).

Table 20: Caries prevalence in deciduous dentition by individual socioeconomic characteristics

All 5-8 yrs(n=2559)	**%**	*95% CI*
	39.1	*36.3-42. 0*
Household Income		
Over $120,000	**27.9**	*23.3-32.4*
$80,001 to $120,000	**30.7**	*26.4-35.0*
$40,001 to $80,000	**41.5**	*37.5-45.5*
Up to $40,000	**51.6**	*47.0-56.2*
Highest parent education		
Postgraduate	**34.1**	*29.4-38.8*
Some/completed uni	**34.9**	*31.1-38.8*
Some/completed trade	**39.5**	*34.1-44.9*
Completed secondary	**48.8**	*43.8-53.9*

Table 21 presents deciduous caries prevalence for school socioeconomic characteristics. There was variation in deciduous caries prevalence between the children who attended different types of schools. However, only those children who attended a disadvantaged public school recorded statistically significant differences to all other school types. When categorising participants by school SES (ICSEA) there were significant differences between SES groups and a social gradient; with the highest SES group reporting significantly lower deciduous caries prevalence than both the lower quartile groups. When comparing the change in estimate across the highest and the lowest SES categories, school type recorded a greater variation (1.8 times) in caries prevalence across the SES categories compared to school ICSEA (1.6 times).

Table 21: Caries prevalence in deciduous dentition – school socioeconomic characteristics

All 5-8 yrs(n=2559)	**%**	*95% CI*
	39.1	*36.3-42.0*
School (school type)		
Independent	**29.3**	*21.0-37.6*
Catholic	**34.2**	*28.3-40.0*
Public other	**38.3**	*34.2-42.4*
Public PAS/PSP	**51.8**	*47.6-56.0*
School SES (ICSEA)		
Highest SES quartile	**29.5**	*24.3-34.7*
Mid-high quartile	**38.2**	*32.9-43.5*
Mid-low quartile	**41.5**	*35.7-47.3*
Lowest SES quartile	**48.2**	*42.7-53.7*

Significant associations were apparent for the area socioeconomic variables (Table 22). The lowest area SES group using the LHD SEIFA score showed significantly higher caries prevalence compared with the other SES categories. There was lower deciduous caries prevalence in the highest area SES category when using the LHD wealth factor. There was no clear gradient across the middle SES categories for both area SES variables.

Table 22: Caries prevalence in deciduous dentition – area socioeconomic characteristics

All 5-8 yrs (n=2559)	**%** **39.1**	*95% CI* *36.3-42.0*
LHD SEIFA SES		
Highest SES category	**30.1**	*23.6-37.6*
Mid-high category	**42.7**	*36.3-49.3*
Mid category	**36.8**	*31.8-42.2*
Mid-low category	**40.3**	*34.0-47.0*
Lowest SES category	**52.6**	*47.3-57.7*
LHD Wealth SES		
Highest SES category	**29.3**	*23.7-35.6*
Mid-high category	**40.7**	*33.3-43.1*
Mid category	**40.8**	*35.1-46.7*
Mid-low category	**38.1**	*33.3-48.5*
Lowest SES category	**47.7**	*40.1-54.8*

Sequential and regression modelling was used to assess the impact of each of the pairs of SES indicators at the individual-, school- and area-level factors on caries prevalence for the deciduous dentition (Tables 23 – 25). This analysis assisted in understanding the independent association of each SES indicator with caries prevalence. Table 23 presents sequential models for deciduous caries prevalence for household income (Model 1) and highest parent education (Model 2), and a regression model with both indicators in Model 3. The strength of the association was determined by examining the point estimates obtained without adjusting for the alternate SES indicator compared to the point estimates obtained when adjusting for the alternate SES indicator. The change in estimate between the models was used to determine which SES indicator provided the most stable or stronger association. Similar sequential and regression modelling was explored in Table 24 for the two school SES variables, and Table 25 with area SES.

Table 23 demonstrated that household income and education were both significant factors in Model 1 and 2 when introduced separately. An increasing prevalence ratio was evident for both income and education with the lower two categories statistically significant compared to the highest SES category. In Model 1 it was evident that children from a household with a lower income had a significantly higher likelihood of having deciduous caries compared to the highest household income group with the lowest group having a prevalence ratio of nearly two. Model 2 substituted highest parent education and demonstrated a statistically significant increase in the likelihood of caries for the two lowest education categories compared to those children whose parents had the highest education level. Children whose parents reported a highest education level of primary or secondary school had a 40% higher prevalence ratio for deciduous caries than those children whose parents had a postgraduate education. The final model included both income and education. Only income showed a social gradient with prevalence ratios that remained statistically significant for the two lowest income groups compared to the highest income group. The reduction in the prevalence ratio estimates for the lowest category for household income was 0.1 while for the lowest parent education it was 0.3. While the prevalence ratio for the lowest household remained significant, the prevalence ratio for the lowest parent education was no longer significant compared to the respective reference group.

Table 23: Sequential and regression models for deciduous caries prevalence for individual-level SES

	Model 1 ***n =2277***		**Model 2** ***n =2329***		**Model 3** ***n =2230***	
	Prevalence Ratio	*95% CI*	*Prevalence Ratio*	*95% CI*	*Prevalence Ratio*	*95% CI*
Household Income						
Over $120,000	**Ref**				**Ref**	
$80,001 to $120,000	**1.1**	*0.8-1.4*			**1.1**	*0.9-1.4*
$40,001 to $80,000	***1.5**	*1.2-1.8*			***1.5**	*1.2-1.8*
Up to $40,000	***1.9**	*1.5-2.2*			***1.8**	*1.4-2.2*
Highest parent education						
Postgraduate			**Ref**		**Ref**	
Some/completed uni			**1.0**	*0.9-1.2*	**0.9**	*0.8-1.1*
Some/completed trade			**1.2**	*1.0-1.4*	**1.0**	*0.8-1.2*
Primary/secondary			***1.4**	*1.2-1.7*	**1.1**	*0.9-1.3*

Notes:
95%CI = 95% confidence interval for estimated prevalence
*: p<0.1; **: p<0.05; ***: p<0.001

Table 24 reports on the association of school ICSEA SES and school type with deciduous caries prevalence. Model 1 demonstrated a social gradient by school type although only the children who attended a disadvantaged public school had statistically significant prevalence ratio for deciduous caries compared to the children who attended an Independent school (PR 1.8, p<0.001). In Model 2, children who attended a school of lower ICSEA score were associated with a significantly higher prevalence of deciduous caries, 60% higher, compared to those children who attended the highest ICSEA ranked school. Model 3 included both school SES variables in a regression model. School type showed a social gradient with a prevalence ratio that remained statistically significant for those children who attended disadvantaged schools recording a higher prevalence of caries (PR 1.6, p<0.05) compared to those children who attended Independent schools. In Model 3 the prevalence ratios were reduced compared to those in Model 1 and 2. The change in prevalence ratio estimates between the models was smaller for school type compared to school ICSEA, where the disadvantaged schools group demonstrated a 0.2 reduction while for the lowest SES school ICSEA it was 0.3. Both remained significant compared to the respective reference group.

Table 24: Sequential and regression models for deciduous caries prevalence for school-level SES

	Model 1 ***n =2559***		**Model 2** ***n = 2559***		**Model 3** ***n = 2559***	
	Prevalence Ratio	*95% CI*	*Prevalence Ratio*	*95% CI*	*Prevalence Ratio*	*95% CI*
School (school type)						
Independent	**Ref**				**Ref**	
Catholic	**1.2**	*0.8-1.6*			**1.1**	*0.8-1.5*
Public other	**1.3**	*0.9-1.8*			**1.3**	*0.9-1.7*
Public PAS/PSP	***1.8**	*1.3-2.4*			**1.6**	*1.2-2.2*
School SES (ICSEA)						
Highest SES quartile			**Ref**		**Ref**	
Mid-high quartile			**1.3**	*1.0-1.6*	**1.3**	*1.1-1.6*
Mid-low quartile			**1.4**	*1.1-1.8*	**1.4**	*1.1-1.7*
Lowest SES quartile			***1.6**	*1.3-2.0*	**1.3**	*1.0-1.7*

Notes:
95%CI = 95% confidence interval for estimated prevalence
*: p<0.1; **: p<0.05; ***: p<0.001

Table 25 reports on the association of area SES with deciduous caries prevalence. In Model 1 it was evident that children who lived in the LHD with the lowest SEIFA score had a significantly higher likelihood of having deciduous caries compared to the highest LHD SEIFA area. Model 2 substituted the LHD Wealth metric and demonstrated a statistically significant prevalence ratio for the all categories against the reference group, children who lived in the highest wealth metric area. The final model included both LHD area SES variables. The reduction in the prevalence ratio estimates for the lowest category for LHD SEIFA was 0.2 while for the lowest LHD Wealth it was 0.4. While the prevalence ratio for the lowest LHD SEIFA remained significant, the prevalence ratio for the lowest LHD Wealth was no longer significant compared to the respective reference group.

Table 25: Sequential and regression models for deciduous caries prevalence for area-level SES

	Model 1 ***n = 4369***		**Model 2** ***n = 4369***		**Model 3** ***n = 4369***	
	Prev Ratio	*95% CI*	*Prev Ratio*	*95% CI*	*Prev Ratio*	*95% CI*
LHD SEIFA SES						
Highest SES category	**Ref**				**Ref**	
Mid-high category	****1.4**	*1.1-1.9*			**1.3**	*0.9-1.8*
Mid category	**1.2**	*0.9-1.6*			**1.2**	*0.7-2.0*
Mid-low category	****1.3**	*1.0-1.8*			**1.3**	*0.8-2.1*
Lowest SES category	*****1.8**	*1.4-2.3*			****1.6**	*1.0-2.6*
LHD Wealth SES						
Highest SES category			**Ref**		**Ref**	
Mid-high category			****1.4**	*1.1-1.8*	**1.3**	*0.9-1.7*
Mid category			*****1.4**	*1.1-1.8*	**1.2**	*0.7-1.8*
Mid-low category			****1.3**	*1.0-1.7*	**1.1**	*0.7-1.9*
Lowest SES category			*****1.6**	*1.3-2.1*	**1.2**	*0.8-1.9*

Notes:
95%CI = 95% confidence interval for estimated prevalence
*: p<0.1; **: p<0.05; ***: p<0.001

3.4.2 Caries prevalence in permanent dentition

The prevalence of permanent caries of the children in the supplementary study is reported in Tables 26 – 29. Over 20% of the participants had experienced permanent caries (Table 26). Overall there was an increase in the caries prevalence across older age groups with some significant differences. There was a minor difference between girls and boys that was not significant. There were significant differences between those children who identified as Indigenous compared to those who did not, with those who did not know the Indigenous identity showing a slightly higher caries prevalence than those who did not identify as Indigenous, although this was not significant. Those children who were not born in Australia, were in a single parent family, or were uninsured, reported significantly higher prevalence of permanent caries. Children who had one or two parents working had a lower caries prevalence compared to those who had no parents working.

Table 26: Caries prevalence in permanent dentition – sociodemographic characteristics

Age at time of survey	% Caries prevalence n= 4461	95% CI[(a)]
Age 6-12 yrs	**21.6**	*20.1-23.2*
Age[(b)]		
6 yrs	**5.2**	*3.5-6.7*
7 yrs	**14.1**	*10.8-17.4*
8 yrs	**14.1**	*11.0-17.3*
9 yrs	**20.3**	*16.6-24.1*
10 yrs	**29.3**	*25.4-32.3*
11 yrs	**32.3**	*29.1-35.5*
12 yrs	**32.0**	*27.3-36.6*
Sex(6-12 yrs)		
Male	**20.3**	*18.3-22.4*
Female	**22.9**	*20.9-25.0*
Indigenous identity		
Yes	**30.6**	*25.1-36.8*
No	**20.9**	*19.4-22.5*
Not known	**23.6**	*19.4-28.5*
Child born Australia		
Yes	**20.8**	*19.3-22.3*
No	**30.9**	*24.7-37.0*
Household structure		
Two parent family	**20.6**	*19.0-22.2*
One parent family	**26.7**	*22.7-30.6*
Household work status		
Both parents working	**19.1**	*17.3-20.9*
One parent working	**22.3**	*19.7-24.9*
No parent working	**31.6**	*25.5-37.7*
Dental Insurance		
Insured	**17.6**	*15.8-19.4*
Uninsured	**24.7**	*22.6-26.8*

Notes:
(a) 95%CI = 95% confidence interval for estimated prevalence
(b) Rows are arranged by age at time of survey.

Significant associations were noted between both individual socioeconomic variables and permanent caries prevalence (Table 27). Variation was evident across all of the socioeconomic variables where children from the higher socioeconomic groups experienced a significantly lower prevalence of permanent caries. The income SES indicator did not demonstrate a clear gradient. Those children whose parents had only primary or secondary education had the highest permanent caries prevalence. Similarly to income there appeared to be almost a threshold effect for the lowest category of primary or secondary education only. When comparing the caries prevalence estimate across the SES categories, income recorded a greater variation (1.7 times) in caries prevalence across the SES categories compared to highest parent education (1.4 times).

Table 27: Caries prevalence in permanent dentition – socioeconomic characteristics

All 6-12 yrs(n=4461)	**%**	*95%CI*
	22.1	*20.6-23.7*
Household Income		
Over $120,000	**17.3**	*13.9-20.6*
$80,001 to $120,000	**15.9**	*13.6-18.3*
$40,001 to $80,000	**21.7**	*19.3-24.1*
Up to $40,000	**28.6**	*24.9-32.3*
Highest parent education		
Postgraduate	**18.5**	*15.6-21.4*
Some/completed uni	**18.4**	*16.3-20.6*
Some/completed trade	**21.3**	*18.0-24.6*
Primary/secondary	**27.4**	*23.7-31.1*

Table 28 presents permanent caries prevalence by school socioeconomic characteristics. When utilising the school type categorisation, those children who attended a disadvantaged public school had a significantly higher caries prevalence than those who attended each of the other school types. A social gradient was evident across the school SES (ICSEA) groups with significant differences between the lowest ICSEA group and the highest ICSEA groups. When comparing the change in permanent caries prevalence estimate across the SES categories, school type recorded a greater variation in caries prevalence across the SES categories (1.7 times) compared to school ICSEA (1.5 times).

Table 28: Caries prevalence in permanent dentition – school socioeconomic characteristics

	%	*95% CI*
All 6-12 yrs(n=4461)	**22.1**	*20.6-23.7*
School (type)		
Independent	**17.5**	*14.2-20.8*
Catholic	**19.5**	*16.4-22.5*
Public other	**20.6**	*18.5-22.7*
Public PAS/PSP	**28.8**	*24.2-33.4*
School SES (ICSEA)		
Highest SES quartile	**18.3**	*16.1-20.6*
Mid-high quartile	**19.7**	*16.9-22.6*
Mid-low quartile	**22.1**	*19.0-25.1*
Lowest SES quartile	**26.9**	*22.5-31.2*

Table 29 presents permanent caries prevalence by area socioeconomic characteristics. When utilising the LHD SEIFA variable some differences were noted between the highest and lowest SES categories. When examining the permanent caries prevalence using the LHD Wealth metric there was also a significant difference between the highest and lowest SES categories. Those children who lived in a LHD that had a lower wealth score had 1.6 times the caries prevalence of those lived in a LHD with the highest wealth score. The variation in the middle three categories of both area SES indicators was inconsistent.

Table 29: Caries prevalence in permanent dentition –area socioeconomic characteristics

	%	*95% CI*
All 6-12 yrs (n=4461)	**22.1**	*20.6-23.7*
LHD SEIFA SES		
Highest category	**18.7**	*15.8-22.0*
Mid-high category	**23.4**	*19.2-28.2*
Mid category	**22.7**	*19.8-26.0*
Mid-low category	**16.2**	*13.4-19.4*
Lowest category	**28.0**	*24.6-31.5*
LHD Wealth SES		
Highest category	**16.6**	*13.4-20.5*
Mid-high category	**23.1**	*19.2-27.5*
Mid category	**22.9**	*19.9-26.2*
Mid-low category	**19.0**	*16.0-22.5*
Lowest category	**26.8**	*23.8-29.9*

Table 30 presents the sequential and regression models for the prevalence of caries in the permanent dentition by the two individual socioeconomic indicators. Model 1 demonstrated the income effect on caries prevalence with statistically significant increased prevalence ratios for the children from the two lowest income groups compared to the reference highest income group. The lowest income group reported a 66% higher prevalence than those in the highest income group. Model 2 highlights the impact of parent education where children from a household with parents that had highest education at primary or secondary level had a significantly higher likelihood of permanent caries prevalence compared to children whose parents had a postgraduate education (PR 1.5, p<0.001). Model 3 included both income and highest parent education. Parent education showed a higher reduction in prevalence ratio estimate where the lowest education group recorded 0.4 change compared to the lowest household income that recorded 0.2 change. While the prevalence ratio for the lowest household income remained significant, the prevalence ratio for the lowest parent education was no longer significant compared to the respective reference group.

Table 30: Sequential and regression models for permanent caries prevalence for individual-level SES

	Model 1 ***n = 4105***		**Model 2** ***n = 4231***		**Model 3** ***n = 3984***	
	Prevalence Ratio	*95% CI[(a)]*	*Prevalence Ratio*	*95% CI*	*Prevalence Ratio*	*95% CI*
Household Income						
Over $120,000	**Ref**				**Ref**	
$80,001 to $120,000	**0.9**	*0.7-1.2*			**0.9**	*0.7-1.2*
$40,001 to $80,000	***1.3**	*1.0-1.6*			**1.2**	*0.9-1.5*
Up to $40,000	***1.7**	*1.2-2.1*			***1.5**	*1.2-2.0*
Highest parent education						
Postgraduate			**Ref**		**Ref**	
Some/completed uni			**1.0**	*0.8-1.2*	**0.9**	*0.8-1.1*
Some/completed trade			**1.2**	*0.9-1.5*	**1.0**	*0.8-1.3*
Primary/secondary			***1.5**	*1.2-1.8*	**1.1**	*0.9-1.5*

Notes:
95%CI = 95% confidence interval for estimated prevalence
*: p<0.1; **: p<0.05; ***: p<0.001

Table 31 presents the sequential and regression modelling using both school type and school ICSEA SES indicators. Table 31 demonstrates that children who attended a disadvantaged public school had a significantly higher prevalence ratio (PR1.6 p<0.001) and children who attended Catholic and the remaining public schools showing a non-significant slightly higher prevalence rate than children who attended Independent schools. Children who attended schools with lower ICSEA SES ranking had a higher prevalence ratio of permanent caries compared to those children who attended a school with the highest ICSEA rankings (Model 2). Model 3 included both school type and school ICSEA SES in the model where only the school type remained significant for the children who attended a disadvantaged public school (PR1.5 p<0.05) with a significantly higher prevalence than those children attending Independent schools. In the final model there were only small changes in the prevalence ratio estimate for the middle categories of both school variables. The reduction in the prevalence ratio estimates for the children from the disadvantaged schools was 0.1 while for the lowest school ICSEA SES it was 0.3. While the prevalence ratio for the disadvantaged schools remained significant, the prevalence ratio for the lowest SES ICSEA schools was no longer significant compared to the respective reference group.

Table 31: Sequential and regression models for permanent caries prevalence for school-level SES

	Model 1 ***n = 4369***		**Model 2** ***n = 4369***		**Model 3** ***n = 4369***	
	Prevalence Ratio	*95% CI*	*Prevalence Ratio*	*95% CI*	*Prevalence Ratio*	*95% CI*
School (school type)						
Independent	**Ref**				**Ref**	
Catholic	**1.1**	*0.9-1.4*			**1.1**	*0.8-1.4*
Public other	**1.2**	*0.9-1.5*			**1.2**	*0.9-1.4*
Public PAS/PSP	***1.6**	*1.3-2.1*			**1.5**	*1.1-2.0*
School SES (ICSEA)						
Highest SES quartile			**Ref**		**Ref**	
Mid-high quartile			**1.1**	*0.9-1.3*	**1.1**	*0.9-1.3*
Mid-low quartile			**1.2**	*1.0-1.5*	**1.2**	*0.9-1.4*
Lowest SES quartile			***1.5**	*1.2-1.8*	**1.2**	*0.9-1.5*

Notes:
95%CI = 95% confidence interval for estimated prevalence
*: p<0.1; **: p<0.05; ***: p<0.001

Sequential and regression modelling was undertaken to analyse the effect of the two area SES variables for the prevalence of permanent caries (Table 32). Model 1 demonstrated the LHD SEIFA effect on caries prevalence with a statistically significant higher prevalence ratio for the children from the lowest SEIFA LHD compared to those in the highest SEIFA LHD. Model 2 highlights the impact of the LHD Wealth metric where children from a LHD with the lowest wealth score had a significantly higher likelihood of having permanent caries compared to the LHD with the highest wealth score group (PR 1.6, $p<0.001$). Model 3 included both LHD SEIFA and LHD Wealth. There was no significant difference for the LHD SEIFA, but two LHD Wealth categories, including the lowest SES category had a significantly higher prevalence than the reference category, the highest LHD Wealth category. The reduction in the prevalence ratio estimates for the lowest SES category for LHD SEIFA was 0.2 while for the lowest SES category for LHD Wealth there was no change. While the prevalence ratio for the lowest LHD Wealth remained significant, the prevalence ratio for the lowest LHD SEIFA was no longer significant compared to the respective reference group.

Table 32: Sequential and regression models for permanent caries prevalence for area-level SES

	Model 1 ***n = 4369***		**Model 2** ***n = 4369***		**Model 3** ***n = 4369***	
	Prev Ratio	*95% CI*	*Prev Ratio*	*95% CI*	*Prev Ratio*	*95% CI*
LHD SEIFA SES						
Highest SES category	**Ref**				**Ref**	
Mid-high category	**1.3**	*1.0-1.6*			**1.1**	*0.8-1.5*
Mid category	**1.2**	*1.0-1.5*			**1.2**	*0.8-1.9*
Mid-low category	**0.9**	*0.7-1.1*			**0.8**	*0.5-1.2*
Lowest SES category	***1.5**	*1.2-1.8*			**1.3**	*0.9-2.0*
LHD Wealth SES						
Highest SES category			**Ref**		**Ref**	
Mid-high category			****1.4**	*1.1-1.8*	****1.4**	*1.0-1.8*
Mid category			****1.4**	*1.1-1.8*	**1.2**	*0.7-1.8*
Mid-low category			**1.2**	*0.9-1.5*	**1.2**	*0.8-1.9*
Lowest SES category			***1.6**	*1.3-2.1*	****1.6**	*1.1-2.3*

Notes:
95%CI = 95% confidence interval for estimated prevalence
*: p<0.1; **: p<0.05; ***: p<0.001

Table 33 presents the summary of findings for the prevalence of caries in both the deciduous and permanent dentition exploring the variation by individual-, school- and area-level socioeconomic factors. Prevalence of caries was 39.1% in the deciduous dentition for 5-8 year olds and 21.6 % in the permanent dentition for 6-12 year olds. A consistent association and variation in caries prevalence for each of the socioeconomic indicators was evident where the lowest SES category had significantly higher caries prevalence compared to the highest SES category for all SES indicators in both the deciduous and permanent dentition. Using results from the multivariable model (Model 3) including both indicators in the pair at each level (individual, school and area), there was a reasonably consistent finding that the lowest SES category for one or other indicator would be significant. This indicates that the pair of indicators have a level of correlation. The pattern of significant findings was similar for the deciduous and permanent caries prevalence.

Table 33: Summary of findings related to caries prevalence

		Caries prevalence	
		Deciduous	**Permanent**
Household Income	Ref=Over $120,000		
	$80,001 to $120,000	~	~
	$40,001 to $80,000	↑↑	~
	Up to $40,000	↑↑	↑↑
Highest parent education	Ref=Postgraduate		
	Some/completed uni	~	~
	Some/completed trade	~	~
	Completed secondary	~	~
School (school type)	Ref=Independent		
	Catholic	~	~
	Public other	~	~
	Public PAS/PSP	↑↑	↑↑
School SES (ICSEA)	Ref=Highest SES quartile		
	Mid-high quartile	↑	~
	Mid-low quartile	↑	~
	Lowest SES quartile	↑↑	~
LHD SEIFA SES	Ref=Highest SES category		
	Mid-high category	~	~
	Mid category	~	~
	Mid-low category	~	~
	Lowest SES category	↑↑	~
LHD Wealth SES	Ref=Highest SES category		
	Mid-high category	~	↑↑
	Mid category	~	~
	Mid-low category	~	~
	Lowest SES category	~	↑↑

Notes:
Ref: reference group; ↓↓: markedly lower; ↓: lower; ~: not sig. different; ↑: higher; ↑↑: markedly higher

3.5 CARIES SEVERITY

This subsection outlining results for caries experience will present descriptive, bivariate and multivariable statistics that will consist of:

1. Caries severity in deciduous dentition - by sociodemographic and socioeconomic (individual-, school- and area-level) [3.5.1]
2. Caries severity in permanent dentition - by sociodemographic and socioeconomic (individual-, school- and area-level) [3.5.2]

3.5.1 Caries severity in deciduous dentition

The caries severity in NSW is reported in Tables 34 – 37. Overall the mean dmfs for children aged 5-8 years was 3.18 (CI 2.76-3.60). Six year olds had a lower caries rate than all other ages although there was a general trend for increased caries across the older age categories, this was not significant. Girls had higher dmfs than boys but this was not significant. Children that identified as Indigenous, not born in Australia, had no parent working or were uninsured had significantly higher mean caries experience. Those children who identified as Indigenous had twice the caries experience of those that did not. Children not born in Australia had over twice the caries of those that were born in Australia. Children of single parent families had higher mean caries although this was not significant. A social gradient in caries experience was observed for the household work status. Household dental insurance was associated with lower mean caries experience.

Table 34: Caries severity in deciduous dentition – sociodemographic characteristics

Age at time of survey	Caries severity mean dmfs	*95% CI[(b)]*
Age 5-8 yrs[(a)]	**3.18**	*2.76-3.60*
Age		
5 yrs	**3.22**	*2.46-3.99*
6 yrs	**2.70**	*2.15-3.24*
7 yrs	**3.32**	*2.64-4.01*
8 yrs	**3.47**	*2.93-4.01*
Sex(5-8 yrs)		
Male	**3.06**	*2.59-3.53*
Female	**3.30**	*2.77-3.83*
Indigenous identity		
Yes	**6.40**	*4.81-8.00*
No	**2.97**	*2.57-3.38*
Not known	**3.89**	*2.55-5.22*
Child born Australia		
Yes	**2.92**	*2.53-3.32*
No	**6.29**	*4.62-7.97*
Household structure		
Two parent family	**3.01**	*2.57-3.44*
One parent family	**3.59**	*2.81-4.37*
Household work status		
Both parents working	**2.76**	*2.35-3.17*
One parent working	**3.17**	*2.54-3.80*
No parent working	**4.99**	*4.03-5.95*
Dental Insurance		
Insured	**2.19**	*1.77-2.62*
Uninsured	**3.96**	*3.41-4.50*

Notes:
(a) Columns are arranged by age at time of survey.
(b) 95%CI = 95% confidence interval for estimated mean dmfs

Bivariate analysis was conducted to determine whether caries severity was associated with study participants' individual socioeconomic characteristics. Caries severity was significantly associated with household income and highest parent education (Table 35). A social gradient was evident for both socioeconomic variables with the higher socioeconomic groups experiencing significantly lower caries experience. Income exhibited statistically significant variation across the SES categories with a steep gradient where children from the lowest income group experienced over three times the caries than those children from the highest income group. Parent education was significantly associated with caries experience where children whose parents had only primary or secondary education exhibited higher levels of caries. When comparing the change in estimate across the SES categories, income recorded a greater variation (3.4 times) in caries experience across the SES categories compared to highest parent education (1.8 times).

Table 35: Caries severity in deciduous dentition – individual socioeconomic characteristics

All 5-8 yrs(n=2559)	**mean**	*95% CI*
	3.18	*2.75-3.60*
Household Income		
Over $120,000	**1.51**	*1.13-1.89*
$80,001 to $120,000	**2.43**	*1.81-3.04*
$40,001 to $80,000	**3.19**	*2.63-3.76*
Up to $40,000	**5.00**	*4.16-5.83*
Highest parent education		
Postgraduate	**2.54**	*1.86-3.22*
Some/completed uni	**2.57**	*2.13-3.02*
Some/completed trade	**3.16**	*2.33-3.99*
Primary/secondary	**4.46**	*3.70-5.23*

Notes:
95%CI = 95% confidence interval for estimated mean

Table 36 presents mean dmfs for school socioeconomic characteristics. School type was associated with caries severity with a social gradient across the SES categories. Those children who attended a disadvantaged public school had significantly higher mean caries than the other school groups, with over twice the caries rate of those children who attended an Independent school. When participants were categorised by school SES (ICSEA) a social gradient was observed with significant differences between the lower two SES groups compared to the highest SES group. When comparing the change in estimate across the SES categories for each variable, all three variables recorded a similar variation in caries severity across the SES categories (school type 2.6 times, school ICSEA 2.6 times).

Table 36: Caries severity in deciduous dentition – school socioeconomic characteristics

All 5-8 yrs(n=2559)	**mean**	*95% CI*
	3.18	*2.75-3.60*
School (school type)		
Independent	**2.10**	*1.21-2.98*
Catholic	**2.25**	*1.64-2.86*
Public other	**2.87**	*2.24-3.50*
Public PAS/PSP	**5.47**	*4.58-6.35*
School SES (ICSEA)		
Highest SES quartile	**1.84**	*1.25-2.44*
Mid-high quartile	**2.58**	*1.89-3.26*
Mid-low quartile	**3.56**	*2.58-4.54*
Lowest SES quartile	**4.87**	*3.98-5.75*

Notes:
95%CI = 95% confidence interval for estimated mean

Table 37 presents mean dmfs for area socioeconomic characteristics. Significant associations were also apparent for the area socioeconomic variables. The children who resided in the highest SES LHDs showed significantly lower mean caries compared to the children who resided in the lowest SES areas for both the composite (LHD SEIFA) and contextual (LHD Wealth) area variables. There was no clear gradient across the middle SES categories. When comparing the change in estimate across the SES categories for each variable, the two variables recorded a similar variation in caries severity across the SES categories (LHD SEIFA 2.9 times, LHD Wealth 2.7 times).

Table 37: Caries severity in deciduous dentition – area socioeconomic characteristics

	All 5-8 yrs (n=2559)	**mean** **3.18**	*95% CI* *2.75-3.60*
LHD SEIFA SES			
Highest SES category		**1.72**	*1.01-2.42*
Mid-high category		**3.86**	*2.58-5.13*
Mid category		**3.19**	*2.47-3.91*
Mid-low category		**2.81**	*1.95-3.66*
Lowest SES category		**4.95**	*3.78-6.12*
LHD Wealth SES			
Highest SES category		**1.77**	*1.26-2.28*
Mid-high category		**3.40**	*2.09-4.71*
Mid category		**3.52**	*2.66-4.37*
Mid-low category		**2.73**	*2.13-3.32*
Lowest SES category		**4.73**	*3.35-6.12*

Notes:
95%CI = 95% confidence interval for estimated mean

Sequential and regression modelling was used to assess the impact of each of the pairs of SES indicators at the individual-, school- and area-level on caries severity for the deciduous dentition (Tables 38 – 40). Table 38 presents mean deciduous caries for household income and highest parent education, individually and in combination. Similar analysis for school SES is shown in Table 39 adding the two school SES variables, ICSEA SES and school type. Table 40 presents analysis of caries severity for area SES.

Individual-level variables were added into a series of three sequential models reporting a rate ratio for each category in relation to the reference category. In Model 1 household income was entered and recorded significant variation in rate ratios across the three income categories when compared to the highest income group. Children from the lowest income families had a higher mean deciduous dmfs score that was more than 3 times that of the children from the highest income families. Model 2 reported the effect of highest parent education and demonstrated a statistically significant increase in the likelihood of more severe caries for the two lowest education groups compared to those children whose parent/s had postgraduate education. In Model 3, both household income and highest parent education variables were included. Only household income showed a social gradient and remained statistically significant. Parent education showed a higher reduction in rate ratio estimate (lowest category 0.8) compared to income (lowest category 0.1) when both individual SES factors were included in the final model. While the rate ratio for the lowest household remained significant, the rate ratio for the lowest parent education was no longer significant compared to the respective reference group.

Table 38: Sequential and regression models for deciduous caries severity caries for individual-level SES

	Model 1 ***n = 2275***		**Model 2** ***n = 2327***		**Model 3** ***n = 2228***	
	Rate Ratio	*95% CI*	*Rate Ratio*	*95% CI*	*Rate Ratio*	*95% CI*
Household Income						
Over $120,000	**Ref**				**Ref**	
$80,001 to $120,000	***1.6**	*1.2-2.1*			***1.6**	*1.2-2.1*
$40,001 to $80,000	***2.1**	*1.6-2.7*			***2.1**	*1.6-2.7*
Up to $40,000	***3.3**	*2.6-4.2*			***3.2**	*2.5-4.2*
Highest parent education						
Postgraduate			**Ref**		**Ref**	
Some/completed uni			**1.0**	*0.8-1.2*	**0.8**	*0.7-1.0*
Some/completed trade			***1.2**	*1.0-1.6*	**0.9**	*0.7-1.2*
Primary/secondary			***1.8**	*1.4-2.1*	**1.0**	*0.8-1.3*

Notes:
95%CI = 95% confidence interval for estimated rate ratio
*: p<0.1; **: p<0.05; ***: p<0.001

Sequential and regression models were generated for deciduous dmfs scores for the school SES variables (Table 39). School type was included in Model 1 where a social gradient was evident with increasing rate ratios as SES decreased. This was significant for the two lowest SES groups: both disadvantaged public and remaining public schools. Children who attended a disadvantaged public school were associated with a significantly higher likelihood of having higher mean deciduous caries compared to the children who attended an Independent school (RR = 2.6, p<0.001). Model 2 examined the effect of school ICSEA SES. A statistically significant gradient was apparent with those children who attended schools with lower ICSEA SES scores recording a higher rate of caries compared with those who attended schools with higher ICSEA SES ranking. In the final model both school variables were included. The disadvantaged public school category remained significant compared to children who attend Independent schools with nearly twice the caries severity. School ICSEA remained significant and showed a social gradient. However, for the lowest category the rate ratio estimate for school type demonstrated smaller reduction (0.7) compared to school ICSEA (0.8).

Table 39: Sequential and regression models for deciduous caries severity caries for school-level SES

	Model 1 ***n = 2380***		**Model 2** ***n = 2380***		**Model 3** ***n = 2380***	
	Rate Ratio	*95% CI*	*Rate Ratio*	*95% CI*	*Rate Ratio*	*95% CI*
School (school type)						
Independent	**Ref**				**Ref**	
Catholic	**1.1**	*0.8-1.4*			**0.9**	*0.7-1.2*
Public other	****1.4**	*1.1-1.8*			**1.3**	*1.0-1.6*
Public PAS/PSP	*****2.6**	*2.0-3.4*			*****1.9**	*1.4-2.6*
School SES (ICSEA)						
Highest SES quartile			**Ref**		**Ref**	
Mid-high quartile			****1.4**	*1.1-1.7*	****1.4**	*1.1-1.8*
Mid-low quartile			*****1.9**	*1.6-2.4*	*****1.8**	*1.5-2.2*
Lowest SES quartile			*****2.6**	*2.2-3.2*	*****1.8**	*1.4-2.4*

Notes:
95%CI = 95% confidence interval for estimated rate ratio
*: p<0.1; **: p<0.05; ***: p<0.001

Table 40 presents the sequential and regression models for deciduous dmfs score for area SES. Model 1 and 2 shows the rate ratios for the area SES indicators separately. For both LHD SES indicators, children who lived in lower SES areas were significantly associated with having a higher mean dmfs score compared to those children who lived in the highest SES areas. However when both LHD indicators were included in the model then only the LHD categorised by SEIFA remained significant across all of the categories compared to the respective reference group. The lowest LHD Wealth category showed a reduction in the rate ratio estimate (1.3) while the lowest LHD SEIFA showed an increase in rate ratio estimate (0.2).

Table 40: Sequential and regression models for deciduous caries severity caries for area-level SES

	Model 1 ***n = 4369***		**Model 2** ***n = 4369***		**Model 3** ***n = 4369***	
	Rate Ratio	*95% CI*	*Rate Ratio*	*95% CI*	*Rate Ratio*	*95% CI*
LHD SEIFA SES						
Highest SES category	**Ref**				**Ref**	
Mid-high category	***2.2	*1.8-2.8*			***2.0	*1.5-2.5*
Mid category	***1.9	*1.5-2.3*			***2.5	*1.6-3.9*
Mid-low category	***1.6	*1.3-2.1*			***2.0	*1.3-3.1*
Lowest SES category	***2.9	*2.3-3.7*			***3.1	*2.0-4.8*
LHD Wealth SES						
Highest SES category			**Ref**		**Ref**	
Mid-high category			***1.9	*1.5-2.5*	***1.5	*1.2-2.0*
Mid category			***2.0	*1.6-2.5*	**1.0**	*0.6-1.5*
Mid-low category			***1.5	*1.2-2.0*	**0.9**	*0.6-1.4*
Lowest SES category			***2.7	*2.1-3.5*	**1.4**	*1.0-2.1*

Notes:
95%CI = 95% confidence interval for estimated rate ratio
*: p<0.1; **: p<0.05; ***: p<0.001

3.5.2 Caries severity in permanent dentition

The permanent caries severity experience of the children in the supplementary study is reported in Tables 41 – 44. The mean DMFS for children aged 6-12 years was 0.61. Caries severity increased across the age groups with some significant differences between the younger children and the older children. Girls had higher DMFS than boys but this was not significant. Those children who were identified as Indigenous had over twice the mean permanent caries of those who did not. Children born overseas had significantly higher mean DMFS when compared to those children who were Australian born. Non-significant differences were noted for household structure where those children from a single parent family recorded higher mean DMFS. Significant differences and a social gradient were observed for household work status. Children with no parents working showed twice the mean caries compared to children with two parents working. There was a significant association between dental insurance and caries severity where children from families who had dental insurance reported lower caries experience.

Table 41: Caries severity in permanent dentition – sociodemographic characteristics

Age at time of survey	**DMFS N=4461**	*95% CI[(b)]*
Age 6-12 yrs[(a)]	**0.61**	*0.55-067*
Age		
6 yrs	**0.11**	*0.06-0.15*
7 yrs	**0.32**	*0.23-0.41*
8 yrs	**0.38**	*0.26-0.50*
9 yrs	**0.50**	*0.38-0.62*
10 yrs	**0.87**	*0.70-1.04*
11 yrs	**0.99**	*0.85-1.13*
12 yrs	**0.99**	*0.78-1.19*
Sex(6-12 yrs)		
Male	**0.59**	*0.52-0.66*
Female	**0.63**	*0.55-0.71*
Indigenous identity		
Yes	**1.15**	*0.77-1.53*
No	**0.55**	*0.50-0.61*
Not known	**0.86**	*0.61-1.11*
Child born Australia		
Yes	**0.58**	*0.52-0.63*
No	**1.02**	*0.72-1.32*
Household structure		
Two parent family	**0.58**	*0.52-0.65*
One parent family	**0.73**	*0.59-0.88*
Household work status		
Both parents working	**0.50**	*0.44-0.57*
One parent working	**0.62**	*0.51-0.72*
No parent working	**1.10**	*0.82-1.39*
Dental Insurance		
Insured	**0.45**	*0.39-0.51*
Uninsured	**0.74**	*0.65-0.82*

Notes:
(a) Columns are arranged by age at time of survey.
(b) 95%CI = 95% confidence interval for estimated prevalence

Analysis was undertaken to establish whether permanent caries severity was associated with individual socioeconomic characteristics (Table 42). A social gradient was evident across all of the socioeconomic variables with the children from higher socioeconomic groups recording a significantly lower caries experience. The income category rankings reported significant differences where those children from the lowest SES income group varied significantly from all other income groups with twice the mean DMFS than children from the highest income group. Highest parent education showed variation in caries experience across the education categories. Children whose parents had only primary or secondary education had significantly higher experience of caries compared to children whose parents had postgraduate education. When comparing the change in estimate across the SES categories for each SES indicator, highest parent education recorded a slightly larger variation in caries experience (2.3 times) across the SES categories compared to income (2.2 times).

Table 42: Caries severity in permanent dentition – individual socioeconomic characteristics

All 6-12 yrs(n=4461)	**mean**	*95% CI*
	0.61	*0.55-0.67*
Household Income		
Over $120,000	**0.44**	*0.33-0.54*
$80,001 to $120,000	**0.43**	*0.34-0.52*
$40,001 to $80,000	**0.59**	*0.50-0.67*
Up to $40,000	**0.89**	*0.75-1.03*
Highest parent education		
Postgraduate	**0.38**	*0.30-0.47*
Some/completed uni	**0.50**	*0.43-0.58*
Some/completed trade	**0.60**	*0.48-0.72*
Primary/secondary	**0.87**	*0.73-1.01*

Notes:
95%CI = 95% confidence interval for estimated mean

Table 43 presents permanent caries severity by school socioeconomic characteristics. When participants were categorised by school type, the children from the disadvantaged public schools had a significantly higher experience of caries than those children who attended each of the other school types. The children who attended a disadvantaged public school (DMFS 0.92) recorded twice the mean caries than Independent school children (DMFS 0.43). A social gradient was evident across the school SES (ICSEA) group, though this was significant only for the children from the lowest ICSEA ranked schools. When comparing the change in estimate across the SES categories, school type recorded a greater variation (2.3 times) in caries severity across the SES categories compared to school ICSEA (1.9 times).

Table 43: Caries severity in permanent dentition – school socioeconomic characteristics

	mean	*95% CI*
All **6-12**yrs (n=4461)	**0.61**	*0.55-0.67*
School (school type)		
Independent	**0.43**	*0.30-0.57*
Catholic	**0.51**	*0.43-0.60*
Public other	**0.57**	*0.50-0.64*
Public PAS/PSP	**0.92**	*0.75-1.10*
School SES (ICSEA)		
Highest SES quartile	**0.46**	*0.38-0.54*
Mid-high quartile	**0.52**	*0.43-0.60*
Mid-low quartile	**0.64**	*0.52-0.76*
Lowest SES quartile	**0.84**	*0.68-1.01*

Notes:
95%CI = 95% confidence interval for estimated mean

Table 44 presents permanent caries severity by area socioeconomic characteristics. Significant associations were apparent for the area socioeconomic variables, where the children who reside in the lowest SES LHD categorised by the SEIFA composite score recorded twice the mean caries compared to those children who resided in the highest SES LHD by SEIFA. When the contextual wealth metric for LHD was used there was nearly half the caries for those children in the wealthiest LHD compared to those children in the poorest LHD. The variation in the middle three categories of both area SES indicators was inconsistent.

Table 44: Caries severity in permanent dentition – area socioeconomic characteristics

	mean	*95% CI*
All 6-12 yrs (n=4461)	**0.61**	*0.55-0.67*
LHD SEIFA SES		
Highest SES category	**0.46**	*0.37-0.54*
Mid-high category	**0.69**	*0.51-0.88*
Mid category	**0.64**	*0.54-0.74*
Mid-low category	**0.46**	*0.34-0.57*
Lowest SES category	**0.85**	*0.69-1.01*
LHD Wealth SES		
Highest SES category	**0.40**	*0.29-0.50*
Mid-high category	**0.67**	*0.51-0.83*
Mid category	**0.64**	*0.54-0.74*
Mid-low category	**0.56**	*0.45-0.68*
Lowest SES category	**0.77**	*0.60-0.95*

Notes:
95%CI = 95% confidence interval for estimated mean

Sequential and regression modelling was undertaken to explore the individual-, school- and area-level SES variation in mean caries for the permanent dentition (Tables 45 – 47). Table 45 presents the rate ratio for mean permanent caries investigating household income and highest parent education. School SES is explored in Table 46 including school type and school ICSEA variables. Table 47 presents analysis of caries severity with area SES as a factor.

Individual SES explanatory variables were added into a series of three sequential and regression models reporting the individual effect of income and education. Model 1, demonstrated the household income effect on caries experience with statistically significant higher rate of caries experience for the children from the two lowest income groups. The children from the lowest income group recorded twice the rate of caries experience compared to the children from the highest income group. Model 2 explored the rate ratio for highest parent education. A statistically significant social gradient was found. In Model 3, both household income and highest parent education variables were included. Both individual SES indicators remained significant although the rate ratios for each were lower than in the individual models. The reduction in rate ratios was less for income (lowest category 0.5) compared to highest parent education (lowest category 0.6).

Table 45: Sequential and regression models for permanent caries severity caries for individual-level SES

	Model 1 ***n = 4104***		**Model 2** ***n = 4230***		**Model 3** ***n = 3983***	
	Rate Ratio	*95% CI*	*Rate Ratio*	*95% CI*	*Rate Ratio*	*95% CI*
Household Income						
Over $120,000	**Ref**				**Ref**	
$80,001 to $120,000	**1.0**	*0.8-1.2*			**0.9**	*0.7-1.1*
$40,001 to $80,000	***1.3**	*1.1-1.6*			**1.1**	*0.9-1.4*
Up to $40,000	***2.1**	*1.7-2.5*			***1.6**	*1.3-1.9*
Highest parent education						
Postgraduate			**Ref**		**Ref**	
Some/completed uni			***1.3**	*1.1-1.6*	**1.2**	*1.0-1.5*
Some/completed trade			***1.6**	*1.3-2.0*	***1.4**	*1.1-1.8*
Primary/secondary			***2.3**	*1.9-2.8*	***1.7**	*1.4-2.1*

Notes:
95%CI = 95% confidence interval for estimated rate ratio
*: p<0.1; **: p<0.05; ***: p<0.001

Table 46 presents the sequential and regression models generated for permanent DMFS scores and school SES variables. Model 1 shows children who attended a disadvantaged public school were associated with a significantly higher rate of permanent caries compared to the children who attended an Independent school (RR = 2.2, p<0.001). Model 2 investigated school ICSEA SES with increasing rate ratio of permanent caries across the ICSEA SES ranked schools. The final model investigated the effect of both school SES indicators and resulted in a similar change in estimates for both indicators. However, both remained significant for the lowest two SES categories. A gradient was also evident for both school type and school ICSEA SES indicators where children from the lowest SES category recorded a higher rate of caries compared with those children who attended a higher SES ranked schools. The change in rate ratios was the same for each of the lowest SES categories for school type (lowest category 0.5) and school ICSEA (lowest category 0.5).

Table 46: Sequential and regression models for permanent caries severity caries for school-level SES

	Model 1 ***n = 4369***		**Model 2** ***n = 4369***		**Model 3** ***n = 4369***	
	Rate Ratio	*95% CI*	*Rate Ratio*	*95% CI*	*Rate Ratio*	*95% CI*
School (school type)						
Independent	**Ref**				**Ref**	
Catholic	**1.2**	*1.0-1.5*			**1.1**	*0.9-1.4*
Public other	****1.3**	*1.1-1.6*			****1.2**	*1.0-1.5*
Public PAS/PSP	*****2.2**	*1.7-2.7*			*****1.7**	*1.3-2.2*
School SES (ICSEA)						
Highest SES quartile			**Ref**		**Ref**	
Mid-high quartile			**1.1**	*0.9-1.3*	**1.1**	*0.9-1.3*
Mid-low quartile			*****1.4**	*1.2-1.7*	*****1.3**	*1.1-1.6*
Lowest SES quartile			*****1.9**	*1.6-2.2*	****1.4**	*1.1-1.7*

Notes:
95%CI = 95% confidence interval for estimated rate ratio
*: p<0.1; **: p<0.05; ***: p<0.001

Table 47 presents the sequential and regression models for permanent DMFS by area SES. The model demonstrated that area SES was significantly associated with the variation in permanent mean caries rates with significant differences in caries severity for most of the categories when compared to the highest SES LHD when using either area SES measure. Children who lived in lower SES areas were associated with a significantly higher mean DMFS score compared to the children who lived in the highest SES areas. The variation in the middle categories of both area SES indicators was inconsistent. In Model 3 the reduction in the rate ratio estimates for the lowest category for LHD SEIFA was 0.2 while for the lowest LHD Wealth it was 0.3. Both rate ratio for the lowest SES category for each of the SES indicators remained significant compared to the respective reference group.

Table 47: Sequential and regression models for permanent caries severity for area-level SES

	Model 1 ***n = 4369***		**Model 2** ***n = 4369***		**Model 3** ***n = 4369***	
	Rate Ratio	*95% CI*	*Rate Ratio*	*95% CI*	*Rate Ratio*	*95% CI*
LHD SEIFA SES						
Highest category	**Ref**				**Ref**	
Mid-high category	***1.5	*1.2-1.8*			**1.3	*1.0-1.5*
Mid category	***1.4	*1.2-1.7*			**1.4**	*0.9-2.0*
Mid-low category	**1.0**	*0.8-1.3*			**0.9**	*0.6-1.3*
Lowest SES category	***1.9	*1.5-2.3*			***1.7	*1.2-2.5*
LHD Wealth SES						
Highest category			**Ref**		**Ref**	
Mid-high category			***1.7	*1.4-2.1*	***1.6	*1.2-1.9*
Mid category			***1.6	*1.3-2.0*	**1.2**	*0.8-1.8*
Mid-low category			***1.5	*1.2-1.8*	**1.4**	*0.9-2.1*
Lowest SES category			***1.9	*1.6-2.4*	***1.6	*1.1-2.2*

Notes:
95%CI = 95% confidence interval for estimated rate ratio
*: p<0.1; **: p<0.05; ***: p<0.001

Table 48 presents the summary of findings for caries severity in both the deciduous and permanent dentition exploring the variation by individual-, school- and area-level socioeconomic factors. The mean dmfs was 3.18 for 5-8 year olds while in the permanent dentition the mean DMFS was 0.61 for 6-12 year olds. A social gradient was apparent for each of the SES indicators for both deciduous and permanent dentition.

Using results from the regression model (Model 3) including both indicators in the pair at each level individual, school and area, there was a reasonably consistent finding that the lowest SES category for one or other indicator would be significant. This indicates that the pair of indicators have a level of correlation. The pattern of significant findings was somewhat similar for the deciduous and permanent caries prevalence.

Table 48: Summary of findings related to caries severity

		Caries severity	
		Deciduous	**Permanent**
Household income	Ref=Over $120,000		
	$80,001 to $120,000	↑↑	~
	$40,001 to $80,000	↑↑	~
	Up to $40,000	↑↑	↑↑
Highest parent education	Ref=Postgraduate		
	Some/completed uni	~	↑
	Some/completed trade	~	↑↑
	Completed secondary	~	↑↑
School (school type)	Ref=Independent		
	Catholic	~	~
	Public other	~	↑
	Public PAS/PSP	↑↑	↑↑
School SES (ICSEA)	Ref=Highest SES quartile		
	Mid-high quartile	↑	~
	Mid-low quartile	↑↑	↑
	Lowest SES quartile	↑↑	↑↑
LHD SEIFA SES	Ref=Highest SES category		
	Mid-high category	↑↑	↑
	Mid category	↑↑	~
	Mid-low category	↑↑	~
	Lowest SES category	↑↑	↑↑
LHD Wealth SES	Ref=Highest SES category		
	Mid-high category	↑	↑↑
	Mid category	~	~
	Mid-low category	~	~
	Lowest SES category	~	↑↑

Notes: Ref: reference group; ↓↓: markedly lower; ↓: lower; ~: not sig. different; ↑: higher; ↑↑: markedly higher

3.6 SIGNIFICANT CARIES GROUP

This subsection outlining results for SiC_{10} experience will present descriptive, bivariate and multivariable statistics that will consist of:

1. SiC_{10} in deciduous dentition - by sociodemographic and socioeconomic (individual-, school- and area-level) [3.6.1]
2. SiC_{10} in permanent dentition - by sociodemographic and socioeconomic (individual-, school- and area-level) [3.6.2]

3.6.1 Significant caries in deciduous dentition

The prevalence of SiC_{10} in the deciduous dentition is measured by the distribution of children (weighted) in the SiC_{10} category. Table 49 reports the mean dmfs score for the SiC_{10} group compared to the remaining participants as well as the overall sample (state mean). The mean dmfs for children in the SiC_{10} group was 20.39 compared to 1.35 for the rest of the participants, and 3.18 for the whole supplementary study sample; resulting in the SiC_{10} group of children reporting 15 times the mean caries compared to the non-SiC_{10} group of children. Overall there were minor variations in the mean dmfs for the SiC_{10} group by age. There was some differences found between girls and boys but this was not significant.

Table 49: SiC_{10} mean dmfs in deciduous dentition – sociodemographic characteristics

Age at time of survey			**n**
Deciduous SiC_{10} (5-8 yrs)	mean	**20.39**	**250**
	95% CI[(a)]	*18.97-21.81*	
Rest of sample	mean	**1.35**	**2309**
	95% CI	*1.22-1.49*	
State mean	mean	**3.18**	**2559**
	95% CI	*2..76-3.60*	
Age			
5 yrs	mean	**20.87**	73
	95% CI	*17.43-24.32*	
6 yrs	mean	**20.46**	65
	95% CI	*17.66-23.27*	
7 yrs	mean	**21.25**	54
	95% CI	*19.14-23.35*	
8 yrs	mean	**18.97**	58
	95% CI	*16.93-21.02*	
Sex(5-8 yrs)			
Male	mean	**19.35**	117
	95% CI	*17.52-21.18*	
Female	mean	**21.47**	133
	95% CI	*19.69-23.26*	

Notes:
(a) 95%CI = 95% confidence interval for estimated mean dmfs

Table 50 presents sociodemographic characteristics of the children from the SiC_{10} group. The distribution of the children from the study within each variable category was determined followed by the proportion of children from each variable category within the SiC_{10} group and finally the distribution of children from the SiC_{10} group across the variable categories. There were a higher proportion of the overseas born children (21.5%) in the SiC_{10} group though this comprised only 16.2% of the SiC_{10} group. Those children who were identified as Indigenous were more likely to be in the SiC_{10} caries group (23.3%). Similar proportions of children from two parent or single parent families were in the SiC_{10} group but 84.1% of the children in the SiC_{10} group had two parents due to the larger proportion in the sample. Children from households where no parent worked had a higher proportion in the SiC_{10} group though overall this comprised less than 20%. Those who did not have dental insurance had a higher proportion in the SiC_{10} group than those who did not which meant that nearly three quarters of the children in the SiC_{10} group were not covered by dental insurance.

Table 50: Prevalence of SiC_{10} in deciduous dentition – sociodemographic characteristics

Deciduous SiC_{10} (n=250)				SiC_{10} **proportion**	
Variable (Var)	**Sample N**	**Sample %**	SiC_{10} **n**	**% of Var.** *95% CI*	SiC_{10} **distribution** *95% CI*
Child born Australia					
Yes	2374	92.7%	213	**8.6** *7.0-10.2*	**83.8** *77.8-89.8*
No	*177*	*7.2%*	36	**21.5** *14.6-28.8*	**16.2** *10.2-22.2*
Indigenous identity					
Yes	88	3.5	19	**23.3** *12.9-33.7*	**7.7** *4.0-11.4*
No	2217	85.7	200	**8.6** *7.1-10.1*	**77.4** *71.1-83.8*
Not known	254	10.8	31	**13.6** *8.1-19.0*	**14.9** *8.9-20.9*
Household structure					
Two parent family	2036	84.9%	187	**9.1** *7.4-10.9*	**84.1** *79.1-89.0*
One parent family	352	15.1%	39	**9.7** *6.6-12.9*	**15.9** *11.0-20.9*
Household work status					
Both parents working	1378	53.3%	126	**8.5** *6.7-10.2*	**47.7** *38.6-56.8*
One parent working	890	36.0%	76	**8.9** *6.1-11.8*	**34.0** *26.2-41.8*
No parent working	254	10.7%	43	**16.2** *12.0-20.4*	**18.3** *12.5-24.1*
Dental Insurance					
Insured	*1121*	44.1%	69	**5.9** *4.2-7.5*	**27.0** *19.6-34.4*
Uninsured	1401	55.9%	178	**12.5** *10.1-14.9*	**73.0** *65.6-80.4*

Notes:
95%CI = 95% confidence interval for estimated proportion

Table 51 presents the individual socioeconomic characteristics reporting the distribution from each variable category followed by the distribution related to the SiC_{10} group. Individual SES categories were significantly associated with deciduous SiC_{10} with a social gradient evident for both income and parent education SES indicators. Seventeen percent of the children from the lowest income category were in the deciduous SiC_{10} group which then comprised nearly half of the children in the SiC_{10} group. Those children whose parents' highest education was primary/secondary had a higher proportion of children in the deciduous SiC_{10} group which then comprised 40% of the SiC_{10} group.

Table 51: Prevalence of SiC_{10} in deciduous dentition – individual socioeconomic characteristics

Deciduous SiC_{10} (n=250)				SiC_{10} **proportion**	
Variable (Var)	**Sample N**	**Sample %**	SiC_{10} **n**	**% of Var.** *95% CI*	SiC_{10} **distribution** *95% CI*
Household Income					
Over $120,000	452	18.1%	16	**3.1** *1.3-5.0*	**6.0** *2.1-9.9*
$80,001 to $120,000	575	23.5%	45	**7.2** *4.6-9.8*	**17.7** *11.7-23.7*
$40,001 to $80,000	782	32.1%	72	**9.1** *6.8-11.4*	**30.5** *23.1-38.0*
Up to $40,000	625	26.3%	103	**16.6** *12.7-20.4*	**45.8** *36.0-55.6*
Highest parent education					
Postgraduate	511	19.5%	38	**6.9** *4.5-8.3*	**14.1** *9.3-19.1*
Some/completed uni	959	38.9%	68	**7.2** *5.4-9.0*	**29.8** *23.0-36.7*
Some/completed trade	399	16.1%	44	**9.8** *6.0-13.5*	**16.7** *10.5-22.9*
Primary/secondary	609	25.5%	89	**14.5** *11.1-18.0*	**39.3** *30.3-48.3*

Notes:
95%CI = 95% confidence interval for estimated proportion

Table 52 presents the deciduous SiC_{10} distribution by school socioeconomic characteristics. School SES categories showed statistically significant variation in membership of the deciduous SiC_{10} group. Varying proportions were noted across the social strata for each school SES variable. When utilising the school type SES indicator a higher proportion of those children from disadvantaged public schools were found in the SiC_{10} group. The public and disadvantaged public schools then comprised three quarters of the SiC_{10} group. The school ICSEA SES indicator showed a gradient in the proportion of children in the SiC_{10} group and a corresponding gradient for those within the SiC_{10} group.

Table 52: Prevalence of SiC_{10} in deciduous dentition – school socioeconomic characteristics

Deciduous SiC_{10} (n=250)				SiC_{10} **proportion**	
	Sample	**Sample**	SiC_{10}	**% of Var.**	SiC_{10} **distribution**
Variable (Var)	*N*	*%*	*n*	*95% CI*	*95% CI*
School (school type)					
Independent	307	11.5%	19	**6.3**	**7.5**
				3.2-9.3	*1.6-13.4*
Catholic	566	21.0%	46	**7.1**	**15.6**
				4.4-9.8	*7.5-23.7*
Public other	1176	47.2%	93	**7.7**	**37.7**
				5.5-9.8	*25.2-50.3*
Public PAS/PSP	510	20.3%	92	**18.5**	**39.2**
				14.0-23.1	*25.2-53.1*
School SES (ICSEA)					
Highest SES quartile	666	25.8%	34	**5.1**	**13.8**
				2.7-7.6	*5.5-22.0*
Mid-high quartile	624	24.8%	45	**6.8**	**17.6**
				4.4-9.3	*9.0-26.3*
Mid-low quartile	641	26.1%	68	**11.2**	**30.4**
				7.0-15.3	*17.1-43.7*
Lowest SES quartile	628	23.3%	103	**15.6**	**38.2**
				12.2-19.1	*25.4-50.9*

Notes:
95%CI = 95% confidence interval for estimated proportion

The prevalence of SiC_{10} by area socioeconomic characteristics is reported in Table 53. Both LHD SES indicators showed significantly lower proportion of children from the highest SES LHD were in the SiC_{10} group. There was three times the proportion of children in the SiC_{10} group from the lowest LHD areas, by both area SES indicators, compared to the highest LHD areas.

Table 53: Prevalence of SiC_{10} in deciduous dentition – area socioeconomic characteristics

Deciduous SiC_{10} (n=385)				SiC_{10} **proportion**	
	Sample	**Sample**	SiC_{10}	**% of Var**	SiC_{10} **distribution**
SES Variable (Var)	*N*	*%*	*n*	*95% CI*	*95% CI*
LHD SEIFA SES					
Highest category	514	19.9%	22	**4.2** *1.9-6.4*	**8.7** *3.6-13.8*
Mid-high category	493	21.0%	60	**12.9** *7.6-18.2*	**28.2** *15.2-41.2*
Mid category	621	30.4%	59	**10.0** *7.1-12.9*	**31.8** *19.9-43.7*
Mid-low category	467	16.9%	35	**7.3** *4.0-10.5*	**12.8** *7.1-18.5*
Lowest category	463	11.8%	74	**15.1** *10.3-19.8*	**18.6** *13.0-24.1*
LHD Wealth SES					
Highest category	412	12.8%	20	**4.6** *2.8-6.5*	**7.6** *3.2-12.1*
Mid-high category	471	24.3%	47	**11.2** *6.0-16.5*	**25.0** *12.1-38.0*
Mid category	622	25.7%	69	**10.8** *7.5-14.2*	**29.1** *18.9-39.3*
Mid-low category	565	21.4%	36	**7.1** *4.6-9.7*	**18.1** *9.8-26.4*
Lowest category	488	15.8%	78	**15.1** *10.0-20.3*	**20.2** *14.1-26.2*

Notes:
95%CI = 95% confidence interval for estimated proportion

Sequential and regression analysis was used to assess the impact of each of the pairs of SES indicators at the individual-, school- and area-level socioeconomic indicators on determining which children were significantly associated with SiC_{10} for the deciduous dentition (Tables 54 – 56). Table 54 presents deciduous SiC_{10} prevalence ratios for household income and highest parent education. Similar analysis was explored in Table 55 for school SES and Table 56 presents analysis of SiC_{10} prevalence ratios for area SES.

Table 54 demonstrated that household income was a significantly associated with SiC_{10} in Model 1 where the three income categories had a significantly higher likelihood of membership of the SiC_{10} group. In particular, those children from the lowest income group were five times more likely to be in the SiC_{10} group (PR 5.3, $p<0.001$) when compared to the children from the highest income group. In Model 2 it is evident that children from a household with lower parent education were associated with deciduous SiC_{10} compared to the children from the highest household parent education group. Children from the lowest parent education group reported twice the likelihood of membership of the SiC_{10} group compared to the children whose parents had the highest education level (PR 2.1, $p<0.001$). Model 3 included both household income and highest parent education in the model where only household income remained significant and shows a social gradient. The children from the lowest income group recorded nearly five times the likelihood of membership of the SiC_{10} group compared to the children from the highest income group. The reduction in the prevalence ratio estimates for the lowest category for household income was 0.1 while for the lowest parent education it was 1.0. While the prevalence ratio for the lowest household remained significant, the prevalence ratio for the lowest parent education was no longer significant compared to the respective reference group.

Table 54: Sequential and regression models for deciduous SiC_{10} caries for individual-level SES

	Model 1 ***n =2277***		**Model 2** ***n =2329***		**Model 3** ***n =2230***	
	Prevalence Ratio	*95% CI*	*Prevalence Ratio*	*95% CI*	*Prevalence Ratio*	*95% CI*
Household Income						
Over $120,000	**Ref**				**Ref**	
$80,001 to $120,000	****2.3**	*1.1-4.6*			****2.2**	*1.1-4.6*
$40,001 to $80,000	****2.9**	*1.5-5.6*			****2.7**	*1.4-5.4*
Up to $40,000	*****5.3**	*2.8-10.1*			*****5.0**	*2.5-9.8*
Highest parent education						
Postgraduate			**Ref**		**Ref**	
Some/completed uni			**1.1**	*0.7-1.6*	**0.8**	*0.5-1.2*
Some/completed trade			**1.4**	*0.9-2.4*	**1.0**	*0.6-1.7*
Primary/secondary			*****2.1**	*1.4-3.3*	**1.1**	*0.7-1.7*

Notes:
95%CI = 95% confidence interval for estimated prevalence ratio
*: p<0.1; **: p<0.05; ***: p<0.001

To ascertain the prevalence ratios for SiC_{10} by school SES group, sequential and regression modelling was conducted using both school ICSEA SES and school type variables (Table 55). Model 1 reported increasing likelihood of membership of the SiC_{10} group across the school type SES categories. Only the children from the disadvantaged public schools was significantly associated with deciduous SiC_{10}, with over three times the proportion of children in the SiC_{10} group compared to those children who attended Independent schools. In Model 2, children who attended the two lowest categories of SES ICSEA ranked schools were significantly associated with deciduous SiC_{10} compared to the highest SES school. The children attending the lowest ICSEA ranked SES schools reported three times the likelihood of membership of the SiC_{10} group compared to the reference category, the highest ranked ICSEA school. A social gradient was evident for both Model 1 and 2. Model 3 included both school type and school ICSEA SES in the model and showed that children who attended a disadvantaged public school were twice as likely to be part of the SiC_{10} group. The reduction in prevalence ratio estimates was less for school type (lowest category 0.8) compared to school ICSEA SES (lowest category 1.3). While the prevalence ratio for the disadvantaged schools group remained significant, the prevalence ratio for the school ICSEA group was no longer significant when compared to the respective reference group.

Table 55: Sequential and regression models for deciduous SiC_{10} caries for school-level SES

	Model 1 ***n =2380***		**Model 2** ***n =2380***		**Model 3** ***n =2380***	
	Prevalence Ratio	*95% CI*	*Prevalence Ratio*	*95% CI*	*Prevalence Ratio*	*95% CI*
School (school type)						
Independent	**Ref**				**Ref**	
Catholic	**1.1**	*0.6-2.1*			**1.0**	*0.5-1.9*
Public other	**1.2**	*0.7-2.2*			**1.1**	*0.6-2.0*
Public PAS/PSP	***3.0**	*1.7-5.1*			**2.2**	*1.0-4.7*
School SES (ICSEA)						
Highest SES quartile			**Ref**		**Ref**	
Mid-high quartile			**1.3**	*0.7-2.4*	**1.3**	*0.7-2.3*
Mid-low quartile			***2.2**	*1.2-4.0*	**2.0**	*1.1-3.5*
Lowest SES quartile			***3.1**	*1.8-5.2*	**1.8**	*0.9-3.6*

Notes:
95%CI = 95% confidence interval for estimated prevalence ratio
*: p<0.1; **: p<0.05; ***: p<0.001

Sequential and regression analysis was undertaken to assess the effect of area SES on the prevalence ratio for the SiC_{10} group (Table 56). Model 1 examined the effect of area SES when categorising by the composite LHD SEIFA score. Results demonstrated that area SES was a significantly associated with deciduous SiC_{10} where children who lived in the lowest LHD SEIFA area were associated with the highest proportion of deciduous caries when compared to those in the highest SEIFA ranked LHD. The children from the lowest SEIFA LHD reported over three times the likelihood of membership of the deciduous SiC_{10} group (PR 3.6, $p<0.001$) compared to the children who lived in the highest SEIFA LHD. When the wealth metric was included in Model 2 there were similar estimates for membership of the SiC_{10} group. In the final Model, with both area SES factors included, only the LHD SEIFA remained significant where the lowest LHD by SEIFA recorded a prevalence ratio of 5.2 ($p<0.001$). The lowest category for LHD Wealth showed a reduction in prevalence ratio of 2.0 while the lowest category for LHD SEIFA showed in increase in prevalence ratio of 1.6.

Table 56: Sequential and regression models for deciduous SiC_{10} caries for area-level SES

	Model 1 ***n = 4369***		**Model 2** ***n = 4369***		**Model 3** ***n = 4369***	
	Prev Ratio	*95% CI*	*Prev Ratio*	*95% CI*	*Prev Ratio*	*95% CI*
LHD SEIFA SES						
Highest category	**Ref**				**Ref**	
Mid-high category	***3.1	*1.6-6.1*			***2.7	*1.4-5.4*
Mid category	***2.4	*1.3-4.5*			**5.0	*1.4-18.6*
Mid-low category	**1.7**	*0.9-3.5*			**3.1**	*0.8-11.6*
Lowest category	***3.6	*1.9-6.7*			***5.2	*1.5-17.5*
LHD Wealth SES						
Highest category			**Ref**		**Ref**	
Mid-high category			***2.4	*1.3-4.5*	**1.8**	*1.0-3.0*
Mid category			***2.3	*1.4-3.9*	**0.7**	*0.2-2.2*
Mid-low category			**1.5**	*0.9-2.6*	**0.6**	*0.2-1.9*
Lowest category			***3.3	*2.0-5.5*	**1.3**	*0.5-3.5*

Notes:
95%CI = 95% confidence interval for estimated prevalence ratio
*: p<0.1; **: p<0.05; ***: p<0.001

3.6.2 Significant caries in permanent dentition

Table 57 reports the mean DMFS score for the SiC_{10} group compared to the remainder of the study participants, as well as the overall sample (state mean). The mean DMFS for children in the SiC_{10} group was 5.01 compared with 0.21 for the children who were not in the SiC_{10} group and 0.61 for the whole sample. Overall there were significant differences in the mean DMFS for the SiC_{10} group by age. There was some variation found between girls and boys but the variation was not significant.

Table 57: SiC_{10} mean DMFS in permanent dentition – sociodemographic characteristics

Age at time of survey			**n**
Permanent SiC_{10} (6-12yrs)	mean	**5.01**	**385**
	95% CI[(a)]	*4.70-5.32*	
Rest – non SiC_{10}	mean	**0.21**	**4076**
	95% CI	*0.19-0.23*	
State mean	mean	**0.61**	**4461**
	95% CI	*0.55-067*	
Age			
6yrs	mean	**2.09**	35
	95% CI	*1.51-2.67*	
7 yrs	mean	**3.50**	43
	95% CI	*2.80-4.20*	
8 yrs	mean	**3.94**	49
	95% CI	*3.11-4.76*	
9 yrs	mean	**4.66**	37
	95% CI	*4.04-5.29*	
10 yrs	mean	**5.59**	66
	95% CI	*4.79-6.38*	
11 yrs	mean	**6.18**	89
	95% CI	*5.57-6.80*	
12 yrs	mean	**6.59**	66
	95% CI	*5.67-7.50*	
Sex(6-12 yrs)			
Male	mean	**5.20**	182
	95% CI	*4.76-5.63*	
Female	mean	**4.84**	203
	95% CI	*4.39-5.29*	

Notes:
95%CI = 95% confidence interval for estimated mean DMFS

Analysis was conducted on the SiC_{10} group for the permanent dentition. Table 58 presents sociodemographic characteristics of the children from the permanent SiC_{10} group. The distribution of the children from the supplementary study within each variable category was determined followed by the distribution and proportion of children from each variable category within the SiC_{10} group and finally the distribution of children from the SiC_{10} group across the variable categories. There was a higher proportion of the overseas born children (12%) and Indigenous (17%) that were in the SiC_{10} group. There was a higher proportion of children from single parent families in the SiC_{10} group but the difference was not significant. There was a higher proportion of children from a household where no parent worked that recorded a DMFS in the top 10% of permanent caries experience though overall this comprised only 18% of the SiC_{10} group. Those who did not have dental insurance had a higher proportion of children in the SiC_{10} group that resulted in 69% of the permanent SiC_{10} group that reported no household dental insurance.

Table 58: Prevalence of SiC_{10} in permanent dentition – sociodemographic characteristics

Permanent SiC_{10} (n=385)				SiC_{10} **proportion**	
Variable (Var)	**Sample** *N*	**Sample** *%*	SiC_{10} *n*	**% of Var.** *95% CI* **%**	SiC_{10} **distribution** *95% CI*
Child born Australia					
Yes	4254	92.3%	342	**8.0** *7.0-8.9*	**88.3** *83.7-93.0*
No	337	7.7%	43	**12.3** *8.4-16.3*	**11.7** *7.0-16.3*
Indigenous identity					
Yes	*189*	*3.7*	30	**17.0** *11.3-22.8*	**7.7** *4.2-11.2*
No	*3786*	*85.2*	309	**7.8** *6.8-8.7*	**79.7** *74.6-84.8*
Not known	*486*	*11.1*	*46*	**9.4** *6.3-12.5*	**12.6** *8.6-16.6*
Household structure					
Two parent family	3590	84.2%	284	**7.9** *6.8-8.9*	**80.5** *82.4-86.3*
One parent family	674	15.8%	69	**10.0** *7.5-12.5*	**19.5** *13.7-17.6*
Household work status					
Both parents working	2586	56.1%	186	**7.0** *5.9-8.0*	**48.0** *41.4-54.7*
One parent working	1516	34.3%	120	**8.0** *6.5-9.5*	**33.8** *28.1-39.3*
No parent working	422	9.6%	66	**15.2** *11.0-19.4*	**18.2** *11.8-24.6*
Dental Insurance					
Insured	2037	44.9%	121	**5.8** *4.7-7.0*	**31.5** *25.2-37.8*
Uninsured	2486	55.1%	257	**10.2** *9.0-11.5*	**68.5** *62.2-74.8*

Notes:
95%CI = 95% confidence interval for estimated proportion

Analysis was conducted on the SiC_{10} group for the permanent dentition and the individual socioeconomic characteristics. Table 59 presents the distribution of individual SES indicators for the permanent SiC_{10} group. Household income recorded 11% of the children from the lowest income group in the SiC_{10} group and subsequently had the highest proportion within the SiC_{10} group (37%). Nearly 70% of the permanent SiC_{10} group comprised children from the two lowest income groups. Those children whose parents' highest education was primary/secondary had a higher proportion in the SiC_{10} group that resulted in nearly 40% of children within the SiC_{10} group.

Table 59: Prevalence of SiC_{10} in permanent dentition – individual socioeconomic characteristics

Permanent SiC_{10} (n=385)				SiC_{10} **proportion**	
	Sample	**Sample**	SiC_{10}	**% of Var.**	SiC_{10} **distribution**
Variable (Var)	*N*	*%*	*n*	*95% CI*	*95% CI*
Household Income					
Over $120,000	742	17.6%	45	**6.3**	**13.5**
				4.4-8.3	*9.0-17.9*
$80,001 to $120,000	1063	24.3%	65	**6.0**	**17.8**
				4.5-7.6	*12.6-22.9*
$40,001 to $80,000	1373	31.8%	116	**8.4**	**32.3**
				6.7-10.1	*26.7-37.9*
Up to $40,000	1120	26.3%	133	**11.4**	**36.5**
				9.5-13.4	*29.3-43.7*
Highest parent education					
Postgraduate	805	18.0%	44	**5.6**	**12.2**
				3.7-7.4	*8.1-16.3*
Some/completed uni	1653	38.0%	116	**6.9**	**32.0**
				5.5-8.3	*26.0-38.0*
Some/completed trade	795	17.4%	64	**7.5**	**16.0**
				5.6-9.5	*11.6-20.4*
Primary/secondary	1154	26.7%	139	**12.1**	**39.8**
				10.0-14.1	*32.9-46.7*

Notes:
95%CI = 95% confidence interval for estimated proportion

Table 60 presents the distribution for permanent SiC_{10} by school socioeconomic characteristics. When analysed by the school type, a higher proportion of children from disadvantaged schools were in the SiC_{10} group (12.7%). The public and disadvantaged public schools then comprised nearly three-quarters of the SiC_{10} group. When children were categorised by school SES (ICSEA) there was an increasing likelihood of being in the permanent SiC_{10} group as the school SES decreased. This resulted in a social gradient within the SiC_{10} group.

Table 60: Prevalence of SiC_{10} in permanent dentition – school socioeconomic characteristics

Permanent SiC_{10} (n=385)				SiC_{10} **proportion**	
	Sample	**Sample**	SiC_{10}	**% of Var**	SiC_{10} **distribution**
Variable (Var)	*N*	*%*	*n*	*95% CI*	*95% CI*
School (school type)					
Independent	545	12.5%	31	**6.0**	**9.1**
				3.4-8.6	*2.8-15.5*
Catholic	1026	20.6%	73	**7.0**	**17.4**
				5.3-8.7	*9.5-23.4*
Public other	2093	47.2%	161	**7.6**	**43.4**
				6.4-8.9	*32.4-54.4*
Public PAS/PSP	935	19.7%	120	**12.7**	**30.1**
				10.5-14.9	*19.5-40.6*
School SES (ICSEA)					
Highest SES quartile	1136	26.0%	67	**6.2**	**19.4**
				4.7-7.7	*11.6-27.1*
Mid-high quartile	1139	24.9%	82	**7.1**	**21.3**
				5.5-8.6	*12.3-30.2*
Mid-low quartile	1172	26.3%	102	**8.6**	**27.3**
				6.6-10.5	*17.0-37.5*
Lowest SES quartile	1152	22.7%	134	**11.7**	**32.1**
				9.5-13.8	*21.6-42.6*

Notes:
95%CI = 95% confidence interval for estimated proportion

Table 61 reports the distribution of children in the SiC_{10} group for permanent caries experience across the area socioeconomic characteristics. For both LHD SES indicators there were higher proportions of children from the lowest SES category that were in the SiC_{10} but when considering the distribution within the SiC_{10} group there were higher proportions from the three middle categories due to the sample distribution.

Table 61: Prevalence of SiC_{10} in permanent dentition – area socioeconomic characteristics

Permanent SiC_{10} (n=385)				SiC_{10} **proportion**	
	Sample	**Sample**	SiC_{10}	**% of Var**	SiC_{10} **distribution**
Variable (Var)	*N*	*%*	*n*	*95% CI*	*95% CI*
LHD SEIFA SES					
Highest category	870	20.6	56	**6.1**	**15.2**
				4.3-7.8	*9.5-20.9*
Mid-high category	833	20.3	77	**9.0**	**22.2**
				6.4-11.6	*13.4-30.9*
Mid category	1099	29.7	99	**8.9**	**32.2**
				7.4-10.4	*22.3-42.0*
Mid-low category	825	17.2	53	**6.2**	**13.0**
				4.2-8.3	*8.2-17.8*
Lowest category	831	12.3	99	**11.6**	**17.4**
				8.8-14.5	*13.5-21.4*
LHD Wealth SES					
Highest category	676	15.7	37	**5.3**	**10.1**
				3.3-7.3	*5.6-14.6*
Mid-high category	789	21.2	76	**9.0**	**23.1**
				6.6-11.3	*14.2-32.0*
Mid category	1117	25.9	109	**9.3**	**29.2**
				7.6-11.0	*21.5-36.8*
Mid-low category	1004	23.9	70	**7.2**	**20.8**
				5.3-9.0	*12.9-28.6*
Lowest category	872	13.3	92	**10.4**	**16.9**
				8.1-12.7	*12.9-20.9*

Notes:
95%CI = 95% confidence interval for estimated proportion

Table 62 presents the sequential and regression modelling for SiC_{10} caries in the permanent dentition. Model 1 demonstrated an income variation although only the lowest income group was significant when compared to the highest income group (PR 1.8, p<0.001). Model 2 highlighted the impact of highest parent education with increasing prevalence ratios across the parent education groups but only those children with parents having primary or secondary education were statistically significant with twice the likelihood of membership of the SiC_{10} group. The final model included both income and education where the inclusion of these two variables in the model altered the income effect to a non-significant factor while education remained significant. The reduction in the prevalence ratio estimates for the lowest category for household income was 0.4 while for the lowest parent education it was 0.5.

Table 62: Sequential and regression models for the prevalence of permanent SiC_{10} caries for individual-level SES

	Model 1 ***n =4104***		**Model 2** ***n = 4230***		**Model 3** ***n = 3983***	
	Prevalence Ratio	*95% CI*	*Prevalence Ratio*	*95% CI*	*Prevalence Ratio*	*95% CI*
Household Income						
Over $120,000	**Ref**				**Ref**	
$80,001 to $120,000	**1.0**	*0.7-1.4*			**0.9**	*0.6-1.3*
$40,001 to $80,000	**1.3**	*0.9-1.9*			**1.1**	*0.8-1.6*
Up to $40,000	***1.8**	*1.3-2.5*			**1.4**	*1.0-2.0*
Highest parent education						
Postgraduate			**Ref**		**Ref**	
Some/completed uni			**1.2**	*0.9-1.8*	**1.1**	*0.8-1.7*
Some/completed trade			**1.4**	*0.9-2.2*	**1.3**	*0.8-2.0*
Primary/secondary			***2.2**	*1.5-3.2*	***1.7**	*1.1-2.6*

Notes:
95%CI = 95% confidence interval for estimated prevalence ratio
Ref: reference group ; *: p<0.1; **: p<0.05; ***: p<0.001

Sequential and regression modelling was conducted using both school ICSEA SES and school type variables (Table 63) where a social gradient was evident. Model 1 reports the prevalence ratios for school type where the children from disadvantaged public schools showed significantly higher prevalence ratio compared to those children who attended Independent schools. In Model 2, the schools with the lowest SES ICSEA score were associated with having the highest proportion of children in the permanent SiC_{10} group compared to the reference group, Independent schools.

Model 3 included both school SES indicators in the model. Although both SES indicators were not statistically significant, a gradient was still apparent. By including the two school indicators the prevalence ratios were influenced where the change in prevalence ratios was less for school type (lowest category 0.4) compared to school ICSEA (lowest category 0.5).

Table 63: Sequential and regression models for the prevalence of permanent SiC_{10} caries for school-level SES

	Model 1 ***n =4369***		**Model 2** ***n =4369***		**Model 3** ***n =4369***	
	Prevalence Ratio	*95% CI*	*Prevalence Ratio*	*95% CI*	*Prevalence Ratio*	*95% CI*
School (school type)						
Independent	**Ref**				**Ref**	
Catholic	**1.2**	*0.7-1.9*			**1.1**	*0.6-1.8*
Public other	**1.3**	*0.8-2.0*			**1.2**	*0.8-1.9*
Public PAS/PSP	****2.1**	*1.3-3.4*			**1.7**	*0.9-3.1*
School SES (ICSEA)						
Highest SES quartile			**Ref**		**Ref**	
Mid-high quartile			**1.1**	*0.8-1.6*	**1.1**	*0.8-1.6*
Mid-low quartile			**1.4**	*1.0-1.9*	**1.3**	*0.9-1.8*
Lowest SES quartile			***1.9**	*1.4-2.6*	**1.4**	*0.9-2.2*

Notes:
95%CI = 95% confidence interval for estimated prevalence ratio
Ref: reference group ; *: p<0.1; **: p<0.05; ***: p<0.001

Table 64 demonstrated that area SES contributed to variation in the SiC_{10} group. Model 1 included LHD by SEIFA and showed that children who lived in the lowest LHD were significantly associated with permanent SiC_{10} compared to the children from the highest LHD area with a prevalence ratio of 1.9 ($p< 0.001$). Model 2 included the contextual variable LHD wealth metric and reported significant differences where children who resided in the LHD with the lowest wealth score reported a prevalence ratio of 2.0 ($p<0.001$). Model 3 included both LHD SES indicators and showed the lowest SES LHD by SEIFA remained significant with twice the likelihood of children being in the SiC_{10} group. The lowest category for LHD Wealth showed a reduction in prevalence ratio of 0.6 while the lowest category for LHD SEIFA showed in increase in prevalence ratio of 0.2.

Table 64: Sequential and regression models for the prevalence of permanent SiC_{10} caries for area-level SES

	Model 1 ***n = 4369***		**Model 2** ***n = 4369***		**Model 3** ***n = 4369***	
	Prev Ratio	*95% CI*	*Prev Ratio*	*95% CI*	*Prev Ratio*	*95% CI*
LHD SEIFA SES						
Highest category	**Ref**				**Ref**	
Mid-high category	**1.5**	*1.0-2.2*			**1.3**	*0.9-1.9*
Mid category	****1.5**	*1.1-2.1*			**1.9**	*0.9-3.9*
Mid-low category	**1.0**	*0.7-1.6*			**1.2**	*0.6-2.4*
Lowest category	*****1.9**	*1.3-2.8*			****2.1**	*1.1-4.0*
LHD Wealth SES						
Highest category			**Ref**		**Ref**	
Mid-high category			****1.7**	*1.1-2.6*	****1.5**	*1.0-2.3*
Mid category			*****1.8**	*1.2-2.6*	**1.0**	*0.5-2.0*
Mid-low category			**1.4**	*0.9-2.1*	**1.0**	*0.5-2.0*
Lowest category			*****2.0**	*1.3-3.0*	**1.4**	*0.8-2.4*

Notes:
95%CI = 95% confidence interval for estimated prevalence ratio
Ref: reference group ; *: p<0.1; **: p<0.05; ***: p<0.001

In summary, the children in the SiC_{10} group had significantly higher mean caries compared to the children who were not in the SiC_{10} group and the sample mean, for both the deciduous (dmfs 20.39, 1.35, 3.18 respectively) and permanent dentition (DMFS 5.01, 0.21, 0.61 respectively). The difference in caries experience between the groups is considerable with the children in the SiC_{10} group reporting over 15 times the deciduous caries experience, and over 20 times the permanent caries experience, compared to the non-SiC_{10} children. In the bivariate analysis, there were significantly higher proportions of the SiC_{10} group in the lowest SES category across all SES indicators in both the deciduous and permanent dentitions, although the deciduous dentition showed greater differences across the SES categories. Using results from the regression model (Model 3) including both indicators in the pair at each level individual, school and area, there was a reasonably consistent finding that the lowest SES category for one or other indicator would be significant. This indicates that the pair of indicators have a level of correlation.

Table 65: Summary of findings related to SiC_{10}

		SiC_{10} distribution	
		Deciduous	**Permanent**
Household Income	Ref=Over $120,000		
	$80,001 to $120,000	↑↑	~
	$40,001 to $80,000	↑↑	~
	Up to $40,000	↑↑	~
Highest parent education	Ref=Postgraduate		
	Some/completed uni	~	~
	Some/completed trade	~	~
	Completed secondary	~	↑↑
School (school type)	Ref=Independent		
	Catholic	~	~
	Public other	~	~
	Public PAS/PSP	↑↑	~
School SES (ICSEA)	Ref=Highest SES quartile		
	Mid-high quartile	~	~
	Mid-low quartile	↑↑	~
	Lowest SES quartile	~	~
LHD SEIFA SES	Ref=Highest SES category		
	Mid-high category	↑↑	~
	Mid category	↑↑	~
	Mid-low category	~	~
	Lowest category	↑↑	↑↑
LHD Wealth SES	Ref=Highest SES category		
	Mid-high category	~	↑↑
	Mid category	~	~
	Mid-low category	~	~
	Lowest category	~	~

Notes: Ref: reference group; ↓↓: markedly lower; ↓: lower; ~: not sig. different; ↑: higher; ↑↑: markedly higher

3.7 MULTI-LEVEL ANALYSIS TO EVALUATE SES VARIATION

So far this thesis has analysed individual-, school- and area-level SES for three caries measures across both dentitions. A pair of SES indicators was explored at each level, separately and in combination, to identify each member of the pairs independent association with caries measures.

However, the separate models within each level of SES do not account for the fact that there may be nested effects of individuals within schools and schools within areas. Multi-level analysis was used to determine the association of individual-, school- and area-level SES indicators with child caries independently and in combination after adjusting for the nested multi-level structure.

The multi-level modelling included individual-, school- and area-level SES factors for each of the three caries outcomes: caries prevalence; caries experience; and, significant caries experience for both the deciduous and permanent dentition. One measure was selected from each of the three levels, based on strength of association, stability across the oral health outcome measures and ability to provide contextual perspective: household income for individual-level; school type for school SES; and, LHD wealth metric for area SES. Initially each socioeconomic indicator were tested alone and then in a full model to determine if schools and areas make a difference to socioeconomic differences in oral health (Diez-Roux et al., 2001).

All the models presented account for the nesting of individuals within schools and schools within areas. Five different models were fitted for multi-level analysis. The first model was included as a null model including random effects for school and area (to account for the nesting of individuals with schools and schools within areas); the second model included household income; the third model included school type; the fourth included the wealth metric of the Local Health District; and, the fifth included all three explanatory SES variables.

Model 1: Multi-level random effect [school (area)]

Model 2: Multi-level random effect [school (area)] + fixed effects individual SES

Model 3: Multi-level random effect [school (area)] + fixed effects school SES

Model 4: Multi-level random effect [school (area)] + fixed effects area SES

Model 5: Multi-level random effect [school (area)] + fixed effects individual-, school- and area-level SES

Odds ratios (OR) and rate ratios (RR) were calculated as exponential of beta estimates of the models using multi-level regression models (SAS PROC GLIMMIX) to test oral health variation between the SES groups. The school- and area-levels were set as random effects while the explanatory SES variable, individual-level SES, was included as fixed effects. The ORs and RRs measured the association between the SES indicator and likelihood of caries or more severe caries compared to the reference category, the highest SES category. Significance and precision of the estimate was determined using 95% CI. The estimates between the models were also compared. Pseudo AIC was used to assess which model was the best fit among those considered and a measure of the strength of association for each model. The smaller the Pseudo AIC, the better the model fit.

This subsection outlining results of the multi-level analysis will present the five models for each caries measure and dentition that will consist of:

1. Multi-level modelling for deciduous caries prevalence [3.7.1]
2. Multi-level modelling for permanent caries prevalence [3.7.2]
3. Multi-level modelling for deciduous caries experience [3.7.3]
4. Multi-level modelling for permanent caries experience [3.7.4]
5. Multi-level modelling for deciduous SiC_{10} [3.7.5]
6. Multi-level modelling for permanent SiC_{10} [3.7.6]

3.7.1 Multi-level modelling for deciduous caries prevalence

The multi-level analysis for deciduous caries prevalence is reported in Table 66. Multi-level modelling was conducted including all three SES levels to explore the variation in deciduous caries across a range of models.

Model 1 was the null model and established the model accounting for the nesting of individuals within schools and schools within areas.

Model 2 included the explanatory variable income as an individual SES factor. A social gradient was observed although only the lowest category of income had an OR for prevalence that was significantly higher than the reference category. Those children who were from the lowest household income group reported nearly twice the odds for prevalence of deciduous caries (OR 1.86, 95% CI 1.23-2.82) compared to those children from the highest household income group.

In Model 3, school SES was explored as an explanatory variable using school type. School type categories were not significant for deciduous caries prevalence in the multi-level approach. The children who attended a disadvantaged public school had higher odds of caries compared to those who attended an Independent school. There was also a gradient across the SES categories. However, these were not significant.

Model 4 included Local Health District wealth metric as a contextual area SES explanatory variable and demonstrated increasing odds ratios across the SES categories compared to the reference category, the wealthiest LHD category. The poorest Local Health District was statistically significant with higher likelihood of deciduous caries (OR 2.48, 95% CI 1.10-5.59) compared to the wealthiest Local Health District.

Model 5 incorporated all three SES explanatory variables. A social gradient was observed across all of the three SES factors with significant association with deciduous caries prevalence for those children who reside in the LHD with the lowest wealth metric (OR 2.27, 95% CI 1.04-4.96) compared to the wealthiest Local Health District and for those children who have the lowest household income (OR 1.76, 95% CI 1.14-2.71) compared to those children from the highest household income group.

To evaluate the improvement of fit between the models the AIC indices were compared. The smaller the AIC, the better the model. Model 3 (AIC 4729) and Model 4 (AIC 4732) showed little variation from the Null model (AIC 4722) while Model 2 and 5 recorded a reduction in the AIC and therefore a better explanatory model. Although the multi-level Model 2 (AIC 4484) had the lowest AIC and therefore demonstrated the best model incorporating only individual SES as an explanatory factor, Model 5 was not significantly different from Model 2 and as AIC penalises models with more factors, the best model could be considered either Model 2 or 5.

Table 66: Association between individual-, school- and area-level factors for deciduous caries prevalence in children aged 8-9 years

	Model 1 Null model		Model 2 Level 1 SES		Model 3 Level 2 SES		Model 4 Level 3 SES		Model 5 L 1, 2, 3 SES	
N=1105			OR	*95%CI*	OR	*95%CI*	OR	*95%CI*	OR	*95%CI*
Fixed effects intercept			-0.41*	*0.19*	-0.36	*0.22*	-0.48	*0.29*	-0.74	*0.34*
Level 1										
Income										
High (ref)										
Mod-High			1.05	*0.70-1.60*					1.02	*0.69-1.55*
Low-mod			1.36	*0.91-2.02*					1.29	*0.86-1.93*
Low			1.86*	*1.23-2.82*					1.76*	*1.14-2.71*
Level 2										
School type										
Independent (ref)										
Catholic					1.05	*0.65-1.71*			1.02	*0.62-0.67*
Public					1.28	*0.83-1.98*			1.13	*0.73-1.77*
Public disadvantaged					1.55	*0.96-2.52*			1.16	*0.69-1.95*
Level 3										
LHD Wealth SES										
High (ref)										
Mod-High							1.05	*0.44-2.51*	0.98	*0.43-2.22*
Mod							1.19	*0.55-2.61*	1.09	*0.52-2.29*
Low-mod							1.54	*0.68-3.49*	1.42	*0.65-3.06*
Low							2.48*	*1.10-5.59*	2.27*	*1.04-4.96*
Model statistics		*se*		*se*		*se*		*se*		*se*
Intercept school(area)	0.007	*0.06*	0.00	*0.00*	0.006	*0.06*	0.01	*0.08*	0.00	*0.00*
Intercept LHD	0.17	*0.09*	0.15	*0.08*	0.14	*0.08*	0.10	*0.08*	0.08	*0.07*
Model fit (AIC)	4722		4486		4729		4732		4503	
-2Log Likelihood	4718		4484		4725		4728		4501	

Notes:
OR, Odds Ratio; ref, Reference group; *: p<0.05; *ns*, not significant; *se*, Standard error of estimates; AIC, Akaike Information Criterion (smaller is better)

3.7.2 Multi-level modelling for permanent caries prevalence

The multi-level analysis for permanent caries prevalence is reported in Table 67. Multi-level modelling was conducted including all three SES levels to explore the variation in permanent caries across a range of models.

Model 1 was the null model and established the model accounting for the nesting of individuals within schools and schools within areas.

Model 2 included income as an explanatory factor at the individual-level. The two lowest categories of income reported statistically significant higher likelihood of caries compared to those children from the highest household income group. The children from the low-moderate income group had twice the odds of caries (OR 2.03, 95% CI 1.04-3.97) and the lowest income group four times the odds (OR 4.33, 95% CI 2.22-8.46).

In Model 3, school type was included as an explanatory variable. School type categories were significantly associated with higher odds of permanent caries in the multi-level approach where those children who attended public schools or disadvantaged public schools had significantly higher likelihood of caries compared to those children who attended an Independent school. A gradient across the SES categories was also noted.

Model 4 explored Local Health District wealth metric as an area SES explanatory variable. Although each of the four categories for LHD wealth reported higher odds ratios compared to the wealthiest LHD, none of these were significant and no clear pattern was observed. While not significant, the children from the poorest LHD had higher odds for permanent caries (OR 2.30) compared to the children from the wealthiest Local Health District.

Model 5 incorporated all three SES explanatory variables. The children in the lowest SES categories for all explanatory variables had higher odds ratio for permanent caries prevalence compared to the reference category. The association between the lowest income group and deciduous caries prevalence was attenuated but remained significant as an explanatory variable where children from the lowest income group recorded significantly higher odds ratio (OR 3.75, 95% CI 1.85-7.60) compared to those children from the highest household income group. The association between school type and deciduous caries was no longer significant.

The AIC was used to assess the best model fit. Model 3 (AIC 2767) and Model 4 (AIC 2770) showed little variation in the AIC from the Null model (AIC 2756) while Model 2

(AIC 2578) and Model 5 (2599) recorded a reduction in the AIC and therefore a better explanatory models.

Table 67: Association between school and area-level factors of permanent caries prevalence in children aged 12 years

	Model 1 Null model		Model 2 Level 1 SES		Model 3 Level 2 SES		Model 4 Level 3 SES		Model 5 L 1, 2, 3 SES	
N=1105			OR	*95%CI*	OR	*95%CI*	OR	*95%CI*	OR	*95%CI*
Fixed effects intercept			-1.49*	*0.30*	-1.31*	*0.33*	-1.20*	*0.48*	-2.31*	*0.62*
Level 1										
Income										
High (ref)										
Mod-High			1.88	*0.96-3.71*					1.65	*0.82-3.33*
Low-mod			2.03*	*1.04-3.97*					1.74	*0.87-3.50*
Low			4.33*	*2.22-8.46*					3.75*	*1.85-7.60*
Level 2										
School type										
Independent (ref)										
Catholic					1.70	*0.79-3.64*			1.67	*0.71-3.96*
Public					2.12*	*1.06-4.25*			2.12	*0.97-4.65*
Public disadvantaged					2.33*	*1.09-4.97*			1.78	*1.75-4.24*
Level 3										
LHD Wealth SES										
High (ref)										
Mod-High							1.94	*0.46-8.19*	1.59	*0.37-6.90*
Mod							1.81	*0.50-6.54*	1.59	*0.42-5.96*
Low-mod							1.49	*0.39-5.71*	1.09	*0.28-4.33*
Low							2.30	*0.62-8.58*	1.83	*0.46-7.20*
Model statistics		*se*		*se*		*se*		*se*		*se*
Intercept school(area)	0.12	*0.12*	0.13	*0.13*	0.12	*0.12*	0.07	*0.11*	0.14	*0.14*
Intercept LHD	0.16	*0.13*	0.14	*0.18*	0.15	*0.12*	0.26	*0.20*	0.25	*0.20*
Model fit (AIC)	2760		2582		2771		2774		2603	
-2Log Likelihood	2756		2578		2767		2770		2599	

Notes:
OR, Odds Ratio; ref, Reference group; *: p<0.05; *ns*, not significant; *se*, Standard error of estimates; AIC, Akaike Information Criterion (smaller is better)

3.7.3 Multi-level modelling for deciduous caries severity

The multi-level analysis for deciduous caries severity is reported in Table 68. Multi-level modelling was conducted (SAS PROC GLIMMIX Loglink) including all three SES levels to explore the variation in deciduous caries across a range of models.

Model 1 was the null model and established the model accounting for the nesting of individuals within schools and schools within areas.

Model 2 included the explanatory variable income as an individual SES factor. The two lowest income categories were significantly associated with caries severity where both groups showed higher rate of caries experience (1.5 times) compared to the reference category, the highest income group.

In Model 3, school type was added as an explanatory SES variable. The different school types were not significant for deciduous caries severity in the multi-level approach although those children who attended a disadvantaged public school had higher risk ratio for caries compared to those who attended an Independent school.

Model 4 included Local Health District wealth metric as a contextual area variable and demonstrated higher risk ratios for the 3 lowest LHD wealth categories although these were not significant. The poorest Local Health District showed twice the risk ratio for deciduous caries (RR 2.34, ns) compared to the wealthiest Local Health District.

Model 5 incorporated all three SES explanatory variables. Only individual income categories were significant as an explanatory factor. However, each of the lowest SES categories across all of the three SES factors reported higher risk ratio for deciduous caries when compared to the reference category, the highest SES category. The two lowest income groups remained significant in the final model with little change in the estimates.

The AIC was used to assess the best model fit. Model 3 and 4 showed little variation from the Null model (AIC 8773) while Model 2 (AIC 8187) and Model 5 (AIC 8184) recorded a reduction in the AIC and therefore better explanatory models in explaining the variation in deciduous caries severity in children.

Table 68: Association between school and area-level factors of deciduous caries severity in children aged 8-9 years

	Model 1 Null model		Model 2 Level 1 SES		Model 3 Level 2 SES		Model 4 Level 3 SES		Model 5 L 1, 2, 3 SES	
N=1105			RR	*95%CI*	RR	*95%CI*	RR	*95%CI*	RR	*95%CI*
Fixed effects intercept			0.71*	*0.16*	0.87*	*0.23*	0.64	*0.37*	0.34	*0.38*
Level 1										
Income										
High (ref)										
Mod-High			1.07	*0.93-1.24*					1.07	*0.92-1.23*
Low-mod			1.49*	*1.30-1.71*					1.48*	*1.29-1.69*
Low			1.46*	*1.26-1.67*					1.43*	*1.25-1.65*
Level 2										
School type										
Independent (ref)										
Catholic					1.05	*0.66-1.67*			0.97	*0.61-1.54*
Public					1.05	*0.69-1.59*			0.96	*0.63-1.46*
Public disadvantaged					1.43	*0.92-2.24*			1.22	*0.78-1.92*
Level 3										
LHD Wealth SES										
High (ref)										
Mod-High							0.78	*0.28-2.17*	0.81	*0.32-2.04*
Mod							1.54	*0.63-3.78*	1.58	*0.70-3.58*
Low-mod							1.39	*0.93-5.88*	1.43	*0.61-3.38*
Low							2.34	*0.91-3.93*	2.18	*0.93-5.13*
Model statistics		*se*		*se*		*se*		*se*		*se*
Intercept school(area)	0.45	*0.07*	0.43	*0.07*	0.45	*0.08*	0.45	*0.07*	0.44	*0.08*
Intercept LHD	0.27	*0.13*	0.24	*0.12*	0.23	*0.12*	0.21	*0.13*	0.16	*0.10*
Model fit (AIC)	8773		8191		8764		8773		8188	
-2Log Likelihood	8769		8187		8760		8769		8184	

Notes:
RR, Rate Ratio; ref, Reference group; *: p<0.05; *ns*, not significant; *se*, Standard error of estimates; AIC, Akaike Information Criterion (smaller is better)

3.7.4 Multi-level modelling for permanent caries severity

The multi-level analysis for permanent caries severity is reported in Table 69. Multi-level modelling was conducted including all three SES levels to explore the variation in permanent caries across a range of models.

Model 1 was the null model and established the model accounting for the nesting of individuals within schools and schools within areas.

Model 2 included income as an explanatory factor at the individual-level. All three income categories reported higher risk ratios for caries severity compared to those children from the highest household income group. The lowest income group reported over four times the rate of deciduous caries (RR 4.76, 95% CI 3.06-7.36) compared to the reference category, the highest income category. A statistically significant social gradient was also observed.

In Model 3, school type was added as an explanatory variable. School type was significantly associated with permanent caries severity in the multi-level model where those children who attended a public school or disadvantaged public school had significantly higher rate ratio compared to those children who attended an Independent school. A gradient across the SES categories was also observed.

Model 4 added Local Health District wealth metric as an area SES explanatory variable. Although each of the four wealth categories reported higher rate ratios compared to the wealthiest LHD, none of these were significant and no clear pattern was observed. While not significant, the poorest Local Health District had twice the rate of permanent caries (RR 2.08) compared to the wealthiest Local Health District.

Model 5 incorporated all three SES explanatory variables. The area SES factor using LHD wealth metric demonstrated some small variation. However, no clear pattern was noted. Both school type and income retained a social gradient in the final model. The children who attended disadvantaged public schools demonstrated a statistically significant higher rate of permanent caries (RR 2.75, 95% CI 1.36-5.55) compared to children who attended Independent schools. Income remained significant as an explanatory variable and children from all three groups recorded a significantly higher risk ratio with the children from the lowest income category reporting over four times the rate of permanent caries compared to the children from the highest income category. There was slight attenuation of the estimates in the final model when including explanatory factors for all three levels.

The AIC was used to assess the best model fit. Model 2 - 5 showed higher AIC compared to the Null model.

Table 69: Association between school and area-level factors of permanent caries severity in children aged 12 years

	Model 1 Null model		Model 2 Level 1 SES		Model 3 Level 2 SES		Model 4 Level 3 SES		Model 5 L 1, 2, 3 SES	
N=1105			RR	*95%CI*	RR	*95%CI*	RR	*95%CI*	RR	*95%CI*
Fixed effects intercept			-1.31*	*0.22*	-0.89*	*0.30*	-0.67	*0.37*	-1.92*	*0.45*
Level 1										
Income										
High (ref)										
Mod-High			2.48*	*1.59-3.87*					2.36*	*1.51-3.71*
Low-mod			2.83*	*1.82-4.40*					2.66*	*1.70-4.15*
Low			4.76*	*3.06-7.36*					4.26*	*2.75-6.70*
Level 2										
School type										
Independent (ref)										
Catholic					1.68	*0.84-3.36*			1.60	*0.78-3.31*
Public					1.99*	*1.06-3.75*			1.77	*0.92-3.40*
Public disadvantaged					2.97*	*1.54-5.81*			2.75*	*1.36-5.55*
Level 3										
LHD Wealth SES										
High (ref)										
Mod-High							1.68	*0.65-4.34*	1.22	*0.56-2.68*
Mod							1.68	*0.70-3.99*	1.15	*0.55-2.39*
Low-mod							1.35	*0.55-3.32*	0.85	*0.40-1.81*
Low							2.08	*0.85-5.03*	1.15	*0.53-2.46*
Model statistics		*se*		*se*		*se*		*se*		*se*
Intercept school(area)	0.30	*0.11*	0.57	*0.13*	0.63	*0.14*	0.68	*0.15*	0.58	*0.13*
Intercept LHD	0.04	*0.06*	0.02	*0.05*	0.03	*0.06*	0.10	*0.11*	0.03	*0.08*
Model fit (AIC)	2603		2872		3195		3196		2879	
-2Log Likelihood	2597		2868		3191		3192		2875	

Notes:
RR, Rate Ratio; ref, Reference group; *: p<0.05; *ns*, not significant; *se*, Standard error of estimates; AIC, Akaike Information Criterion (smaller is better)

3.7.5 Multi-level modelling for membership of the deciduous significant caries group

The multi-level analysis for deciduous SiC_{10} is reported in Table 70. Model 1 was the null model and established the model accounting for the nesting of individuals within schools and schools within areas.

Model 2 included the explanatory variable income as an individual SES factor. A social gradient was observed although only the two lowest categories of income had an odds ratio for significant caries that was significantly higher than the reference category. Those children who were from the lowest household income group reported over three times the likelihood for membership of the deciduous SiC_{10} group (OR 3.63, 95% CI 1.42-9.28) compared to those children from the highest household income group.

In Model 3, school SES was explored as an explanatory variable using school type. School type was significant for deciduous SiC_{10} in the multi-level approach where those children who attended a disadvantaged public school had over twice the odds ratio for significant caries compared to those who attended an Independent school.

Model 4 included Local Health District wealth metric as an area SES explanatory variable and demonstrated higher odds ratios for the different wealth categories compared to the wealthiest Local Health district. The poorest Local Health District was the only significant category with over five times the odds for deciduous significant caries (OR 5.40, 95% CI 1.11-26.15) compared to the wealthiest Local Health District.

Model 5 incorporated all three SES explanatory variables. Children who resided in the LHD with the three lowest wealth metric scores or who attended disadvantaged public schools had higher odds ratio for significant caries although these were not significant. Household income remained a significant factor in the full model where children from low-moderate income (OR 3.72, 95% CI 1.47-9.42) and those children who have the lowest household income (OR 3.16, 95% CI 1.21-8.25) reported significant association with membership of the deciduous SiC_{10} group compared to the reference category, children from the highest income category.

When comparing the AIC to assess the best model fit, it was found that Model 3 and 4 were slightly higher than the Null model while Model 2 and 5 recorded a reduction in the AIC and therefore a better explanatory model. The multi-level model 2 had the lowest

AIC (5569) and therefore demonstrated the best model incorporating only individual SES as an explanatory factor.

Table 70: Association between school and area-level factors of deciduous SiC_{10} caries in children aged 8-9 years

	Model 1 Null model		Model 2 Level 1 SES		Model 3 Level 2 SES		Model 4 Level 3 SES		Model 5 L 1, 2, 3 SES	
N=1105			OR	*95%CI*	OR	*95%CI*	OR	*95%CI*	OR	*95%CI*
Fixed effects intercept			-3.22*	*0.46*	-2.47*	*0.40*	-3.11*	*0.60*	-3.86*	*0.72*
Level 1										
Income										
High (ref)			ref						ref	
Mod-High			1.94	*0.72-5.20*					1.86	*0.69-5.03*
Low-mod			4.04*	*1.62-10.09*					3.72*	*1.47-9.42*
Low			3.63*	*1.42-9.28*					3.16*	*1.21-8.25*
Level 2										
School type										
Independent (ref)					ref				ref	
Catholic					1.26	*0.51-3.12*			1.14	*0.44-2.96*
Public					1.10	*0.49-2.51*			0.96	*0.40-2.30*
Public disadvantaged					2.13*	*0.92-4.91*			1.45	*0.58-3.60*
Level 3										
LHD Wealth SES										
High (ref)							ref		ref	
Mod-High							1.22	*0.20-7.38*	0.96	*0.20-4.77*
Mod							3.35	*0.71-15.87*	2.36	*0.60-9.34*
Low-mod							1.90	*0.37-9.92*	1.39	*0.33-5.94*
Low							5.40*	*1.11-26.15*	3.41	*0.84-13.91*
Model statistics		*se*		*se*		*se*		*se*		*se*
Intercept school(area)	0.17	*0.15*	0.13	*0.15*	0.15	*0.15*	0.19	*0.15*	0.16	*0.16*
Intercept LHD	0.58	*0.32*	0.41	*0.25*	0.41	*0.26*	0.35	*0.28*	0.20	*0.21*
Model fit (AIC)	5750		5569		5774		5802		5623	
-2Log Likelihood	5746		5565		5770		5798		5619	

Notes:
OR, Odds Ratio; ref, Reference group; *: p<0.05; *ns*, not significant; *se*, Standard error of estimates; AIC, Akaike Information Criterion (smaller is better)

3.7.6 Multi-level modelling for membership of the permanent significant caries group

The multi-level analysis for permanent significant caries is reported in Table 71. Multi-level modelling was conducted including all three SES levels to explore the variation in permanent significant caries across a range of models. Model 1 was the null model and established the model accounting for the nesting of individuals within schools and schools within areas.

Model 2 included income as an explanatory factor at the individual-level. All three household income categories reported higher odds ratios for significant caries compared to the highest household income group. The children from the lowest income group recorded statistically significant higher odds (OR 22.47, 95% CI 2.82-179.37) for membership of the SiC_{10} group compared to children from the reference category, the highest income category, when accounting for the nested structure.

In Model 3, school type used as an explanatory variable. School type was significantly associated with permanent SiC_{10} in the multi-level approach where those children who attended a disadvantaged public school had significantly higher odds ratio for membership of the SiC_{10} group (OR 7.44, 95% CI 1.54-35.86) compared to those who attended an Independent school. A gradient across the SES categories was also noted although was not significant.

Model 4 included Local Health District wealth metric as an area SES explanatory variable. Although each of the four wealth categories reported higher odds ratios compared to the wealthiest Local Health District, none of these were significant. While not significant, children from the poorest Local Health District had nearly twice the odds ratio for membership of the permanent SiC_{10} group (OR 2.38) compared to children from the wealthiest Local Health District.

Model 5 incorporated all three SES explanatory variables. The children in the lowest SES categories for each of the three explanatory variables had higher odds ratio for membership of the permanent SiC_{10} group compared to the reference category, the highest SES category. Income remained significant as an explanatory variable in the final model with the lowest income group recording 14 times the odds for membership of the permanent SiC_{10} group (OR 14.52, 95% CI 1.74-121.39) compared to the highest income category. Although the higher odds for membership of the SiC_{10} group were attenuated for the

income and school type explanatory variables, and were mostly not significant, they still remained high.

The AIC was used to assess the best model fit. Model 3, 4 and 5 showed a small increase in AIC compared to the Null model while Model 2 recorded a small reduction in the AIC. However there is little variation between the models.

Table 71: Association between school and area-level factors of permanent SiC_{10} caries in children aged 12 years

	Model 1 Null model		Model 2 Level 1 SES		Model 3 Level 2 SES		Model 4 Level 3 SES		Model 5 L 1, 2, 3 SES	
N=1105			OR	*95%CI*	OR	*95%CI*	OR	*95%CI*	OR	*95%CI*
Fixed effects intercept			-4.53*	*1.01*	-3.59*	*0.73*	-2.67*	*0.49*	-5.99*	*1.45*
Level 1										
Income										
High (ref)			ref						ref	
Mod-High			7.85	*0.94-65.72*					5.97	*0.69-51.45*
Low-mod			7.87	*0.95-65.07*					5.51	*0.64-47.51*
Low			22.47*	*2.82-179.37*					14.52*	*1.74-121.39*
Level 2										
School type										
Independent (ref)					ref				ref	
Catholic					3.46	*0.69-17.42*			4.18	*0.44-39.60*
Public					4.01	*0.85-18.90*			5.47	*0.63-47.19*
Public disadvantaged					7.44*	*1.54-35.86*			7.43	*0.83-66.61*
Level 3										
LHD Wealth SES										
High (ref)							ref		ref	
Mod-High							1.88	*0.48-7.39*	1.27	*0.28-5.78*
Mod							1.62	*0.45-5.75*	1.19	*0.29-4.97*
Low-mod							1.36	*0.36-5.18*	0.90	*0.21-3.94*
Low							2.38	*0.66-8.58*	1.37	*0.32-5.90*
Model statistics		*se*		*se*		*se*		*se*		*se*
Intercept school(area)	0.23	*0.26*	0.14	*0.27*	0.19	*0.25*	0.24	*0.26*	0.22	*0.30*
Intercept LHD	0.03	*0.11*	0.00	*0.00*	0.00	*0.00*	0.05	*0.16*	0.00	*0.00*
Model fit (AIC)	3225		3209		3300		3243		3245	
-2Log Likelihood	3221		3207		3298		3239		3243	

Notes:
OR, Odds Ratio; ref, Reference group; *: p<0.05; *ns*, not significant; *se*, Standard error of estimates; AIC, Akaike Information Criterion (smaller is better)

In summary, when considering the full model with the SES explanatory factors included, individual SES exhibited a significant fixed effect for all three caries measures for both dentitions (Table 72). The children from the lowest income category had significantly higher odds of caries and rate ratios for more severe caries compared to the reference category, the highest SES category, in the multi-level modelling. School SES using school type as a fixed effect explanatory factor was not significant for the majority of the caries measures in the multi-level model. Although the children attending a disadvantaged public school had significantly higher odds of permanent caries severity compared to children who attended Independent schools. Area SES incorporating Local Health District wealth as a fixed effect explanatory factor was not significant in most of the multi-level models. However the LHD with the lowest wealth metric score was significant for deciduous caries prevalence compared to the LHD with the highest wealth metric score.

The multi-level analysis showed that when the nested structure of individuals within schools and schools within areas was accounted for, and the three different SES level explanatory variables were entered into the models simultaneously, many of the significant associations observed for school type categories and area-level categories in previous models and analysis became statistically insignificant. However, the association between income categories and variation in child oral health across the three caries measures remained significant.

Table 72: Summary of findings related to multi-level analysis of SES indicators for caries prevalence, caries severity and SiC_{10}

Explanatory variables	Caries prevalence		Caries severity		SiC_{10}	
	Deciduous	**Permanent**	**Deciduous**	**Permanent**	**Deciduous**	**Permanent**
Individual SES - Income						
High (ref)						
Mod-High	~	~	~	~	~	~
Low-mod	~	~	*	*	*	~
Low	*	*	*	*	*	*
School SES - School type						
Independent (ref)						
Catholic	~	~	~	~	~	~
Public	~	~	~	~	~	~
Public disadvantaged	~	~	~	*	~	~
Area SES - LHD Wealth						
High (ref)						
Mod-High	~	~	~	~	~	~
Mod	~	~	~	~	~	~
Low-mod	~	~	~	~	~	~
Low	*	~	~	~	~	~

Notes: *: p<0.05; ~: not sig.

3.8 MEASURES OF ASSOCIATION AND POPULATION IMPACT

This thesis has examined individual-, school- and area-level SES separately and in multi-level analysis and found significant associations with oral health outcomes. However a key issue is the relevance of such data in service provision and policy setting. It is useful to determine whether the SES indicators could be used as tool for targeting screening and/or clinical services. Tables 74-80 report the distribution of cases, prevalence ratios and population attributable fractions for deciduous and permanent caries prevalence, caries severity and SiC_{10}.

The number of cases of children with dental caries and severe caries (SiC_{10}) per 10,000 children was calculated and attributed to the individual, school or area SES indicators. The total numbers of cases attributed indicated the quantum of disease that could be reduced by the targeting of a dental program on the basis of each level of SES. The contributions of the individual-, school- and area-level socioeconomic categories are quantified using summary measures: Prevalence ratios (PR) and Rate ratios (RR), and Population Attributable Fraction (PAF%) to estimate the population health impact of these SES differences (Rothman et al., 2008). PAF was used to compare the associations of SES indicators with variation in child oral health and the population impact of those factors.

The SES indicator for each level was included in separate models. The models were generated by Poisson distribution (SUDAAN PROC LOGLINK, SAS PROC GENMOD). The adjusted Population Attributable Fraction (PAF) of each SES indicator was estimated as a percentage for each SES indicator as a weighted average [*Overall PA*F= PAF=[1-∑(population/PR)]/population] (Bruzzi et al., 1985, Rowe et al., 2004). Category specific attributable fraction was calculated [PAF each category= (proportion exposed cases)* (RR-1)/RR] to compare the population impact of each level of SES (Boyko, 2000, Rockhill et al., 1998) to the reference category, the highest SES category. PAF estimates indicate the proportion of the disease in the population attributable to that particular factor or sub-group. PAF was considered low if it was less than 25%, moderate between 25-30% and high if it was greater than 35%.

3.8.1 Caries prevalence

In Table 73 there is a variation in distribution of caries prevalence across the levels of each SES indicator with a higher number of cases in the lowest SES groups. Income as an individual SES indicator showed a social gradient in the distribution of cases of caries. School type showed a difference between the two lowest SES categories and the highest SES category. The area SES indicator showed the three middle categories had higher number of cases compared to both the highest and lowest wealth metric categories.

There was a progressively increasing prevalence ratio for the three SES indicators associated with an increasing population attributable fraction across the SES categories, except for the area SES which only showed variation compared to the reference group. Twenty-five per cent of all cases in the population are attributable to household income variation. The population attributable fraction showed a low to moderate population impact for income, school and area (22-25%). Individual income registered the highest burden of disease or population impact for both overall exposure (25%) and for the lowest SES category (12%).

Table 73: Distribution of cases, prevalence ratios and population attributable fraction for deciduous caries prevalence (weighted data)

Table 73a	**% popn**	**No. of cases per 10,000**	**Proportion of cases for each category**	**PR**	**PAF% per category**	**PAF% overall exposure**
Household income						
Over $120,000	18%	**504**	13%	Ref	**Ref**	
$80,001 to $120,000	24%	**722**	18%	1.1 *(0.8-1.4)*	**2%** *(0-6%)*	**25%** *(12-35%)*
$40,001 to $80,000	32%	**1333**	34%	1.5 *(1.2-1.8)*	**11%** *(6-14%)*	
Up to $40,000	26%	**1358**	35%	1.9 *(1.5-2.2)*	**12%** *(9-14%)*	

Table 73b	**% popn**	**No. of cases per 10,000**	**Proportion of cases for each category**	**PR**	**PAF% per category**	**PAF% overall exposure**
School type						
Independent	12%	**337**	9%	Ref	**Ref**	
Catholic	21%	**717**	18%	1.2 *(0.8-1.6)*	**3%** *(0-8%)*	**23%** *(0-41%)*
Public	47%	**1810**	46%	1.3 *(0.9-1.8)*	**11%** *(0-20%)*	
Public PAS/PSP	20%	**1050**	27%	1.8 *(1.3-2.4)*	**9%** *(5-12%)*	

Table 73c	**% popn**	**No. of cases per 10,000**	**Proportion of cases for each category**	**PR**	**PAF% per category**	**PAF% overall exposure**
Area SES						
Highest SES category	15%	**462**	12%	Ref	**Ref**	
Mid-high category	21%	**870**	22%	1.4 *(1.1-1.8)*	**6%** *(2-10%)*	
Mid category	26%	**1050**	27%	1.4 *(1.1-1.8)*	**7%** *(2-11%)*	**24%** *(7-38%)*
Mid-low category	24%	**926**	24%	1.3 *(1.0-1.7)*	**6%** *(0-10%)*	
Lowest SES category	13%	**609**	16%	1.6 *(1.3-2.1)*	**5%** *(3-7%)*	

Notes: Each SES indicator in a separate model
PAF: low <25%, moderate 25-35%, high >35%
Ref: reference group

Table 74 reports the distribution of cases and population impact for permanent caries prevalence where the number of cases across the NSW child population was highest for those children who attended public schools (920 per 10,000 children). A social gradient was observed in the number of cases per 10,000 for the individual SES indicator and although the lowest category SES category reported the highest proportion of cases it was also notable that the three other categories recorded cases that totalled more than the lowest SES category. School type showed variation where the two lowest SES school groups recorded a higher proportion of cases and area SES recorded higher proportion of cases across the three middle wealth categories.

The PAF increased across the SES categories for each SES indicator. However, the lowest category for each SES indicator accounted for only a low burden of disease with a population fraction of 8-11%. The PAF score for permanent caries prevalence was highest for the area wealth metric (PAF 22%) compared to household income (PAF 16%) and school type SES (PAF 17%) although household income registered the highest PAF score for individual categories (11%).

Table 74: Distribution of cases, prevalence ratios and population attributable fraction for permanent caries prevalence (weighted data)

Table 74a	% popn	No. of cases per 10,000	Proportion of cases for each category	PR	PAF% per category	PAF% overall exposure
Household income						
Over $120,000	18%	**286**	14%	Ref	**Ref**	
$80,001 to $120,000	24%	**364**	18%	0.9 *(0.7-1.2)*	**-2%** *(0-4%)*	**16%** *(0-30%)*
$40,001 to $80,000	32%	**652**	32%	1.3 *(1.0-1.6)*	**7%** *(0-12%)*	
Up to $40,000	26%	**721**	36%	1.7 *(1.3-2.1)*	**11%** *(7-14%)*	

Table 74b	% popn	No. of cases per 10,000	Proportion of cases for each category	PR	PAF% per category	PAF% overall exposure
School type						
Independent	12%	**208**	10%	Ref	**Ref**	
Catholic	21%	**385**	19%	1.1 *(0.9-1.4)*	**2%** *(0-6%)*	**17%** *(0-32%)*
Public	47%	**920**	45%	1.2 *(0.9-1.5)*	**7%** *(0-15%)*	
Public PAS/PSP	20%	**538**	26%	1.7 *(1.3-2.1)*	**8%** *(4-10%)*	

Table 74c	% popn	No. of cases per 10,000	Proportion of cases for each category	PR	PAF% per category	PAF% overall exposure
Area SES						
Highest SES category	15%	**247**	12%	Ref	**Ref**	
Mid-high category	21%	**463**	23%	1.4 *(1.1-1.8)*	**6%** *(2-10%)*	
Mid category	26%	**560**	27%	1.4 *(1.1-1.8)*	**7%** *(2-11%)*	**22%** *(5-32%)*
Mid-low category	24%	**438**	21%	1.2 *(0.9-1.5)*	**4%** *(-3-8%)*	
Lowest SES category	13%	**338**	17%	1.6 *(1.3-2.0)*	**5%** *(3-7%)*	

Notes: Each SES indicator in a separate model
PAF: low <25%, moderate 25-35%, high >35%
Ref: reference group

3.8.2 Caries severity

Rate ratios and population attributable fractions for deciduous caries severity for the three SES indicators are shown in Table 75. There was a progressively increasing risk ratio of caries among children across the SES categories for income and school type, whereas the area indicator mainly showed a difference between the reference group and the other categories. The PAF showed a gradient across the categories of SES for both income and school type although there was an apparent threshold effect for the two lowest categories. Area SES recorded higher PAF compared to reference group with the middle category recording the higher PAF. The lowest income group recorded the highest burden of disease (18%). The three SES indicators showed a moderate to high burden of disease where overall household income reported the highest population impact (PAF 44%) compared with areas SES (PAF 39%) and school type (PAF 28%).

Table 75: Rate ratios and population attributable fraction for deciduous caries severity (weighted data)

Table 75a	**% popn**	**RR**	**PAF% per category**		**PAF% overall exposure**
Household income					
Over $120,000	18%	Ref	**Ref**		
$80,001 to $120,000	24%	1.6 *(1.2-2.1)*	**9%**	*(4-12%)*	
$40,001 to $80,000	32%	2.1 *(1.6-2.7)*	**17%**	*(12-20%)*	**44%** *(32-53%)*
Up to $40,000	26%	3.3 *(2.6-4.2)*	**18%**	*(16-20%)*	

Table 75b	**% popn**	**RR**	**PAF% per category**		**PAF% overall exposure**
School type					
Independent	12%	Ref	**Ref**		
Catholic	21%	1.1 *(0.8-1.4)*	**2%**	*(0-6%)*	
Public	47%	1.4 *(1.1-1.8)*	**13%**	*(4-21%)*	**28%** *(9-41%)*
Public PAS/PSP	20%	2.6 *(2.0-3.4)*	**12%**	*(10-14%)*	

Table 75c	**% popn**	**RR**	**PAF% per category**		**PAF% overall exposure**
Area SES					
Highest SES category	15%	Ref	**Ref**		
Mid-high category	21%	1.9 *(1.5-2.5)*	**10%**	*(7-13%)*	
Mid category	26%	2.0 *(1.6-2.5)*	**13%**	*(10-15%)*	**39%** *(28-50%)*
Mid-low category	24%	1.5 *(1.2-2.0)*	**8%**	*(4-12%)*	
Lowest SES category	13%	2.7 *(2.1-3.5)*	**8%**	*(7-9%)*	

Notes:
Each SES indicator in a separate model
PAF: low <25%, moderate 25-35%, high >35%
Ref: reference group

Table 76 reports the rate ratio and population attributable fraction for caries severity in the permanent dentition for NSW children. Household income shows an increased rate ratio for the two lowest SES categories. School type and area SES indicators demonstrate an increased rate ratio across the categories with the lowest SES category reported the highest rate ratio which is then translated into an increased burden of illness for the lowest SES category compared to the other categories for income and school type. Each of the three SES indicators showed a variation in PAF between the categories although the pattern of each varied. The lowest income group reported the highest PAF per category (14%) compared to the highest income group although this was only at a low population impact level. Overall school type (PAF 25%) and LHD wealth metric (PAF 33%) recorded a moderate population impact while household income (PAF 21%) recorded low population impact.

Table 76: Rate ratios and population attributable fraction for permanent caries severity (weighted data)

Table 76a	**% popn**	**RR**	**PAF% per category**		**PAF% overall exposure**
Household income					
Over $120,000	18%	Ref	**Ref**		
$80,001 to $120,000	24%	1.0 *(0.8-1.2)*	**0%**	*(0-4%)*	
$40,001 to $80,000	32%	1.3 *(1.1-1.6)*	**7%**	*(3-12%)*	**21%** *(8-32%)*
Up to $40,000	26%	2.1 *(1.7-2.5)*	**14%**	*(11-16%)*	

Table 76b	**% popn**	**RR**	**PAF% per category**		**PAF% overall exposure**
School type					
Independent	13%	Ref	**Ref**		
Catholic	21%	1.2 *(1.0-1.5)*	**3%**	*(0-7%)*	
Public	47%	1.3 *(1.1-1.6)*	**11%**	*(4-18%)*	**25%** *(12-37%)*
Public PAS/PSP	20%	2.2 *(1.7-2.7)*	**11%**	*(8-12%)*	

Table 76c	**% popn**	**RR**	**PAF% per category**		**PAF% overall exposure**
Area SES					
Highest SES category	15%	Ref	**Ref**		
Mid-high category	21%	1.7 *(1.4-2.1)*	**9%**	*(6-11%)*	
Mid category	26%	1.6 *(1.3-2.0)*	**10%**	*(6-13%)*	**33%** *(21-42%)*
Mid-low category	24%	1.5 *(1.2-1.8)*	**8%**	*(4-11%)*	
Lowest SES category	13%	1.9 *(1.6-2.4)*	**6%**	*(5-8%)*	

Notes:
Each SES indicator in a separate model
PAF: low <25%, moderate 25-35%, high >35%
Ref: reference group

3.8.3 Significant caries

Table 77 shows the distribution of cases of the SiC_{10} group, the prevalence ratios and associated population attributable fractions for each of the SES indicators. Each of the lowest SES categories for income and school type had the highest number of cases per 10,000 children who were in the SiC_{10} group. However, the wealth metric showed that the highest wealth category had considerably lower number of cases compared to the other categories. Household income and school type showed a social gradient. There was an increasing prevalence ratio across the categories for each of the SES indicators. However, the lowest household income group reported the highest prevalence ratio (PR 5.3). The associated population fraction demonstrated a low to moderate burden of disease for the lowest two income groups (PAF 21%) while school type showed a PAF gradient. Area SES showed a range of PAF (8-15%) with the middle wealth category reporting the highest PAF for that SES indicator. Overall there was a variation in the PAF with household income highest (PAF 56%) and school type lowest (PAF 24%).

Table 77: Distribution of cases, prevalence ratios and population attributable fraction for deciduous SiC_{10} (weighted data)

Table 77a	% popn	No. of cases per 10,000	Proportion of cases for each category	PR	PAF% per category	PAF% overall exposure
Household income						
Over $120,000	18%	**57**	6%	Ref	**Ref**	
$80,001 to $120,000	24%	**169**	18%	2.3 *(1.1-4.6)*	**13%** *(3-18%)*	**56%** *(30-69%)*
$40,001 to $80,000	32%	**291**	31%	2.9 *(1.5-5.6)*	**21%** *(10-26%)*	
Up to $40,000	26%	**437**	46%	5.3 *(2.8-10.1)*	**21%** *(17-24%)*	

Table 77b	% popn	No. of cases per 10,000	Proportion of cases for each category	PR	PAF% per category	PAF% overall exposure
School type						
Independent	12%	**72**	8%	Ref	**Ref**	
Catholic	21%	**149**	16%	1.1 *(0.6-2.1)*	**3%** *(0-11%)*	**24%** *(0-53%)*
Public	47%	**362**	38%	1.2 *(0.7-2.2)*	**9%** *(0-25%)*	
Public PAS/PSP	20%	**375**	39%	3.0 *(1.7-5.1)*	**13%** *(8-16%)*	

Table 77c	% popn	No. of cases per 10,000	Proportion of cases for each category	PR	PAF% per category	PAF% overall exposure
Area SES						
Highest SES category	15%	**73**	8%	Ref	**Ref**	
Mid-high category	21%	**240**	25%	2.4 *(1.3-4.5)*	**12%** *(5-17%)*	
Mid category	26%	**279**	29%	2.3 *(1.4-3.9)*	**15%** *(7-19%)*	**44%** *(16-61%)*
Mid-low category	24%	**173**	18%	1.5 *(0.9-2.6)*	**8%** *(-3-15%)*	
Lowest SES category	13%	**193**	20%	3.3 *(2.0-5.5)*	**9%** *(7-11%)*	

Notes: Each SES indicator in a separate model
PAF: low <25%, moderate 25-35%, high >35%
Ref: reference group

Prevalence ratios and population attributable fractions for permanent SiC_{10} prevalence for the three SES indicators are shown in Table 78. Among individual and school type an increased number of cases was associated with decreased SES among children where household income and school type recorded a social gradient while area SES demonstrated a difference between the highest SES area and the other categories. Public schools recorded the highest number of cases. However, there were more cases outside the lowest SES category for each of the income and school type SES indicators. The lowest SES categories for individual and school SES indicators displayed a low population fraction (income PAF 12%, school PAF 11%, area PAF 9%) for SiC_{10} although the overall population fraction was moderate to high for the LHD wealth metric (34%) and low to moderate for school type (PAF 24%) and income (20%).

Table 78: Distribution of cases, prevalence ratios and population attributable fraction for permanent SiC_{10} (weighted data)

Table 78a	% popn	No. of cases per 10,000	Proportion of cases for each category	PR	PAF% per category	PAF% overall exposure
Household income						
Over $120,000	18%	**105**	13%	Ref	**Ref**	
$80,001 to $120,000	24%	**138**	18%	1.0 *(0.7-1.4)*	**-1%** *(-8-7%)*	**20%** *(0-39%)*
$40,001 to $80,000	32%	**251**	32%	1.3 *(0.9-1.9)*	**8%** *(0-15%)*	
Up to $40,000	26%	**294**	37%	1.9 *(1.3-2.6)*	**12%** *(7-16%)*	

Table 78b	% popn	No. of cases per 10,000	Proportion of cases for each category	PR	PAF% per category	PAF% overall exposure
School type						
Independent	12%	**71**	9%	Ref	**Ref**	
Catholic	21%	**142**	18%	1.2 *(0.7-2.0)*	**3%** *(0-10%)*	**24%** *(0-48%)*
Public	47%	**342**	43%	1.3 *(0.8-2.0)*	**10%** *(0-24%)*	
Public PAS/PSP	20%	**241**	30%	2.2 *(1.4-3.5)*	**11%** *(5-14%)*	

Table 78c	% popn	No. of cases per 10,000	Proportion of cases for each category	PR	PAF% per category	PAF% overall exposure
Area SES						
Highest SES category	15%	**80**	10%	Ref	**Ref**	
Mid-high category	21%	**179**	23%	1.7 *(1.1-2.6)*	**9%** *(2-13%)*	
Mid category	26%	**227**	29%	1.8 *(1.2-2.6)*	**11%** *(4-16%)*	**34%** *(7-50%)*
Mid-low category	24%	**171**	22%	1.4 *(0.9-2.1)*	**7%** *(-3-13%)*	
Lowest SES category	13%	**133**	17%	2.0 *(1.3-2.0)*	**7%** *(3-9%)*	

Notes: Each SES indicator in a separate model
PAF: low <25%, moderate 25-35%, high >35%
Ref: reference group

Table 79 summarises the population attributable fraction for each of the SES indicators and caries measures as well as the population fraction for the lowest SES category for each SES indicator. Household income registered the highest impact (overall population attributable fraction) for an SES indicator for the deciduous dentition while area SES was highest for the permanent dentition. When isolating the lowest SES category for each SES indicator household income recorded the highest impact (PAF) for both the deciduous and permanent dentition across all caries measures.

Table 79: Summary of population impact

	Caries prevalence		Caries severity		SiC_{10} prevalence	
	Decid.	**Perm.**	**Decid.**	**Perm.**	**Decid.**	**Perm.**
Household Income						
Impact of SES exposure	25%	16%	44%	21%	56%	20%
Impact of lowest income gp	12%	11%	18%	14%	21%	12%
School (school type)						
Impact of SES exposure	23%	17%	28%	25%	24%	24%
Impact of disadvantaged school gp	9%	8%	12%	11%	13%	11%
Area SEIFA IRSAD						
Impact of SES exposure	24%	22%	39%	33%	44%	34%
Impact of lowest SES area	5%	5%	8%	6%	9%	7%

Notes:
Impact of SES exposure: overall PAF%
Impact of lowest gp: lowest SES category PAF%
PAF: low <25%, moderate 25-35%, high >35%

CHAPTER 4 DISCUSSION

This study was conducted as there were limited contemporary data available on NSW child oral health status and the distribution of child oral health by socioeconomic characteristics. In addition, there was little evidence on the public health approach adopted by NSW school dental services, the targeting of screening to specific school types. The aim therefore was to provide comprehensive information on the distribution of child oral health by individual-, school- and area-level characteristics, to explore the contribution of three SES indicators to variation in child oral health, and ultimately inform oral health policy and service planning. It is important to note changes to the funding and delivery of dental services in NSW since the supplementary study was undertaken. In 2014, the Commonwealth Government introduced the CDBS that provides financial support for basic dental services for children aged 2-17 years who meet eligibility requirements. CDBS is available through both private dental providers and school dental services (COHS, 2014).

Since the focus of the study was exploring the variation by different types and levels of SES indicators, the underlying issue is the strength of association of these indicators with caries. This drives the ability of each SES indicator to measure the burden of disease in the population and determines the impact of using different SES indicators to prioritise dental services. Ultimately this shapes their usefulness in planning (prioritising and targeting) dental services.

This section presents a discussion of the thesis results. The first part investigates the strengths and limitations of the study and appraises the representativeness of the sample. The second part considers the distribution of child oral health by individual-, school- and area-level SES characteristics. The third section explores the independent contribution of the three SES indicators in a model that accounts for the nesting of individuals within schools and schools within areas, individually and in combination. Finally, the usefulness of these indicators for prioritising and implications for policy development is discussed.

4.1 OVERVIEW – STRENGTHS AND LIMITATIONS

The study was a cross-sectional design utilising a stratified 2-stage clustered random sample of NSW children aged 5-12 years. The sampling frame was designed to achieve a representative sample of children from a range of socioeconomic backgrounds and was weighted to adjust for varying probabilities of selection of strata and post-hoc adjusted by age and sex to obtain representative population estimates. Strength of the study is the large

sample (n=5243) which facilitated the ability to explore subgroups of the population and associations with child oral health. The study used oral epidemiological examination data that were obtained in the school setting with the use of a head light, air, mirror and periodontal probe. Examinations were conducted by 25 calibrated examiners. Replicate pairs of examinations were undertaken to assess the reliability of each examiner relative to the principal survey examiner. Inter-rater reliability for the '*Number of decayed, missing, filled or precavitated surface per child'* was high (ICC 0.99). There was strong inter-examiner reliability for '*Decayed, filled or precavitated lesion category of individual surfaces'* with 93.7% agreement (Kappa 0.88) (COHS, 2009). However, the lack of a clinical setting (Assaf et al., 2004) and radiographs (Hopcraft and Morgan, 2005, Poorterman et al., 1999) may lead to an underestimation of the dental caries.

In addition the study compared three different levels of SES indicators that will be useful in debate on the interaction of SES characteristics and usefulness in health policy. Findings support the view that there are different SES level associations (Thomson and Mackay, 2004) for the different dentitions. Life course events have an impact on oral health at different stages (Nicolau et al., 2007, Poulton et al., 2002), which may contribute to variation of the associations for the deciduous and permanent dentition.

There are limitations in the extent to which conclusions can be drawn, as the study is cross-sectional and therefore cannot demonstrate causality. One may question the fact that data examining children's dental behaviours, dietary patterns and fluoride intake was not included. However, the main purpose of the study was to determine the socioeconomic variation using different SES indicators. The design was to explain caries variation by SES indicators that have been or may be used in prioritising dental services. Consequently, by not exploring individual behaviours and prevention, the resultant dataset confined caries variation to SES indicators, giving a clearer picture of the variation with SES.

A common problem with such a study design is the potential bias due to differential response rates. This can arise when the non-respondents are systematically different in oral health status compared to those who complete all the survey data collections. Unfortunately a proportion of the sample did not return the household questionnaire, despite having examination data available. However, the vast majority of participants had complete data and they were sufficient to show variation and allow analyses of the associations.

Many studies describe the impact of non-reporting of income where there are substantially higher rates for missing data for income variables. If non-reporting of income is related to SES, such missing data may adversely affect results. It could be suggested that low-income households might be reluctant to respond to income questions. In this study there was a lower proportion of higher income families who participated in the study and provided complete data compared to the 2006 Census data. Sanders et al. (2006b) and Turrell (2000) also found it was more likely to be the high SES groups who did not report income which may lead to a potential source of bias. However, it is likely that the large number in the sample and the high response rate for the income variable (93.7%) minimises this potential bias.

The sampling for this study was designed to capture representative data on measures of oral health status across the ages of 5 to 12 years. Age is strongly associated with increased caries experience. Sensitivity analysis was undertaken to explore the influence of age (Appendix 6). The sensitivity analysis involved comparing the estimates for the relationship between SES and caries measures across three models in both dentitions to explore the precision of the estimates when removing demographic factors. It was found that age had minimal effect on the relationship between SES and caries (estimate change<10%). This suggests that age did not confound results for the age-group of children in this study, particularly that in children up to 12 years there is a low prevalence of caries.

The examination collected concurrent oral health data and SES status at the individual-, school- and area-levels. Cumulative caries experience could be reflecting an SES status earlier in childhood and not at the time of the data collection. For example, older children who experienced caries in their early years when parents had lower income but at the time of the study parents are older and may have higher income. A focus on SES at the time of the oral epidemiological examination cannot avoid this possibility. Future studies utilising longitudinal life-course design would account for this potential variation.

4.2 PARTICIPATION AND RESPONSE

Parent-completed questionnaires have a number of advantages and disadvantages. Advantages include ease of distribution and the ability to obtain data from a large sample at relatively low cost. However, response rates can be low and some questionnaires may be incomplete (Squires et al., 1997). To enhance response rate, Dillman's (Dillman, 1978) 'Total Design Method' was utilised where a reminder followed the initial mail-out and three further mail-outs were sent if no return was received.

The supplementary study achieved a high response rate (65%) and a large number of participants (5243 children). A differential response may be relevant if there are large differences between the respondents and the non-respondents. These factors should be considered in the interpretation of the results. The supplementary study respondents were compared to the parent Child Dental Health Survey 2007 (COHS, 2009) and the 2006 Census data to establish representativeness. Known characteristics of responders and non-responders common to both surveys were compared. The comparison showed there were fewer children who identified as Indigenous in the supplementary study. While it is acknowledged that Indigenous groups have poorer oral health the sensitivity analysis (Appendix 6) demonstrated little effect on the relationship between SES and oral health outcomes due to the small proportion of the sample who were Indigenous. Therefore it can be assumed that this did not introduce bias. When comparing the supplementary study with the Census data it was found that those that were not born in Australia, were single parent families, had higher household income and lived in a lower SES area were less likely to participate in the survey. Each of these characteristics was associated with caries. However the impact of the under-representation is that the proportion of children with poorer oral health may have been underestimated.

4.3 DISTRIBUTION OF CHILD ORAL DISEASE

The prevalence and severity of deciduous and permanent caries in NSW children were described in detail in this study. In general, dental caries experience in the deciduous and permanent dentition for NSW children were positively skewed; where a high proportion of children examined were caries free (12 year-old children 78%) compared to Brazil 61% (Piovesan et al., 2011) and Australia 56% (Chrisopoulos et al., 2011) . There were higher levels of deciduous caries (mean dmfs 3.18) than permanent caries (mean DMFS 0.61). Those in the SiC_{10} group had substantially higher mean caries compared to: the overall sample mean caries with the SiC_{10} group recording six times the mean dmfs and eight times the mean DMFS; and, those in the remainder of the sample (not in the SiC_{10} group) with 15 times the mean dmfs and 23 times the mean DMFS.

Children from similar age groups can be compared at anchor ages such as 5 years and 12 years. In the present study, 62% of 5 year olds were ‘caries free’ in the deciduous dentition and 68% of twelve year olds were ‘caries free’ in the permanent dentition. This compares with previous research of Australian school dental service children (Ha et al., 2011) where approximately 60% of 5 year old children were free of deciduous caries, and 52% of 12

year olds were free of permanent caries. Children who visited the Australian school dental services also recorded a range of dmft scores where 17% of the children reported a dmft score of 6 or more, and the SiC_{10} group had a mean dmft that was 3 to 5 times higher than the overall mean caries. NSW children in the SiC_{10} group recorded a mean caries over 6 times that of the sample mean caries. In the permanent dentition, Ha et al. (2011) found there were small proportions of children across the DMFT scores, and a mean caries score for the SiC_{10} group that was 3 to 10 times higher than the overall mean DMFT whereas NSW children in the SiC_{10} group in this study reported 8 times the sample mean DMFT.

In this study, poorer oral health was evident for a variety of sub-groups of the population and was consistent with other findings in health research, including; Indigenous (Mejia et al., 2010), those not born in Australia (Slade et al., 2007), single parent children (Hjern et al., 2001), uninsured (Chrisopoulos et al., 2011) and, children whose parent/s were not working (Nicholson et al., 2004). These children were more likely to have experienced caries, have more severe caries and fall in the SiC_{10} group. In the light of such evidence, the future oral health of these sub-groups of the population is a cause for concern. Unless associated barriers are addressed, children from these sub-groups will continue to experience more caries, that will place them at risk for worse oral health outcomes into adulthood, and this pattern of distribution for children will remain.

4.3.1 Distribution of child oral health by the individual-, school- and area-level socioeconomic characteristics

This study focussed on the socioeconomic differences in child oral health using three different levels of SES indicators; individual-, school- and area-levels. The results demonstrated a social gradient in child oral health for each of the three SES indicator levels. A social gradient exists in a child population with low overall levels of caries and across both dentitions. A key element of the study was to explore the three different levels of SES (individual, school and area) to determine if there were associations between SES and caries across the three levels. The lowest SES group represented by household income and parent education at the individual-level, school type and school SES ICSEA score at the school-level, and LHD SEIFA score and LHD wealth metric at the area-level, registered significantly more caries across each of the three caries measures. These findings are consistent with other studies where lower SES has been associated with higher prevalence of caries and higher prevalence of severe caries (Polk et al., 2010, Sagheri et al., 2008). The bivariate differences between the lowest SES group and the highest SES

group were larger in the deciduous dentition than the permanent dentition. This may be due to the fact that the analysis for the permanent dentition accounted for children aged 6 to 12 years where the younger children would have few permanent teeth. These SES differences have sometimes been rationalised as having a behavioural basis through SES-related risk behaviours (Marmot et al., 1997) such as oral hygiene habits, attitudes, and use of preventive interventions (Polk et al., 2010). Although oral health behaviours, such as oral hygiene, prevention and visiting patterns are associated with poorer oral health, research has found that these mediators did not account for the SES differences for caries prevalence, caries severity (Polk et al., 2010) or oral health impact (Sanders et al., 2006b). Therefore focussing solely on oral hygiene and preventive behaviours in children will not eliminate the oral health related SES differences as there are clearly SES influences that act above and beyond these behaviours. Sanders et al. (2006a) explored different SES indicators and proposed the view that relative SES may be more important for higher SES while absolute material measure such as income may be more important for lower SES groups. However, Mulia and Karriker-Jaffe (2012) found that relative deprivation was a key issue for low-income men living in an affluent area when related to alcohol problems. More research on the mechanism and influence of SES is required to understand the policy and service implications for reducing the inequalities.

There were similar patterns in the social gradient for each of the indicators. However, the individual measure of household income demonstrated a greater degree of differentiation between the highest and lowest categories than the other indicators. Subsequent sequential and regression analysis to examine the association for each level of SES found that for the deciduous dentition income was stronger at the individual-level while school type was stronger at school-level SES and LHD SEIFA was stronger at the area-level. However, in the permanent dentition parent education was a marginally stronger indicator at the individual-level with little difference between the school-level indicators and the area-level indicators. These findings demonstrate that income, school and area indicators can be used as a measure of social stratification. However, household income appeared associated with wider differentiation in caries measures between lowest and highest SES groups and with more consistent associations across the three caries measures and dentitions.

Many authors have debated the most appropriate SES indicator to use for health research. One key factor is the accessibility of income-related data and the second is the composite nature of the aggregate measures such as school- and area-level SES. Non-reporting of

income can lead to reduced representativeness of a sample (Hanley and Morgan, 2008, Locker and Ford, 1996) with the potential for results that do not reflect the disease in the different population groups and subsequently diminish the ability to develop appropriate strategies and policies that best meet the needs of the population. School- and area-level indicators are aggregate measures that include a wider range of constructs than an individual-level indicator. However, they do explore the context in which people live and may be useful in identifying geographic locations that could be the basis of a prioritised or targeted approach (Locker and Ford, 1996). Locker (1993) also found there was variability in the indicators used and that the associations were different, reinforcing the notion that each of the different levels of SES may reflect different mechanisms and influences on oral health. Authors now recognise the importance of using a range of indicators that will provide multiple levels of individual and contextual information that can inform and improve health research and health policy (Hanley and Morgan, 2008). A better account of the SES variation, and the many individual and community factors that contribute to poor oral health, can broaden our understanding of oral health and contribute to positive decisions in the planning of preventive strategies and dental services.

4.4 ASSOCIATION ACROSS INDIVIDUAL-, SCHOOL- AND AREA-LEVEL SES INDICATORS

Individual indicators such as income, education and occupation have been used to determine SES status. Children and adolescents have most commonly been allocated socioeconomic status based on an individual measure (income, occupation, education) of the mother or father. Thomson and Mackay (2004) and Locker (2000) have explored area-level and neighbourhood-level characteristics as an alternative approach to measuring SES, which can be measured using aggregate individual data or can be based on the amenities or material assets of the community. Sisson (2007) argues that the individual cannot be disconnected from the context in which they live.

Studies that have explored SES indicators at different levels have found variation between individual and area SES indicators where correlation between them was low to moderate (Thomson and Mackay, 2004) indicating that they measure different aspects of socioeconomic status (Galobardes, 2012). According to the bivariate analysis, dental caries prevalence and severity demonstrated significant associations with all six indicators of socioeconomic status. Subsequently sequential and regression modelling was carried out to determine the strength of association of each of the six SES indicators with the three oral

health outcomes. Household income and school type demonstrated more stable SES differences for the individual- and school-levels. Other studies have also reported that household assets and parent educational status are useful in assessing oral health outcomes (Perera and Ekanayake, 2010, Thomson and Mackay, 2004). Area-based indicators may be useful where individual SES data are not available (Subramanian et al., 2006). As has been shown, SES factors at one level may be nested in the next level confounding their associations with caries measures; therefore multi-level analysis was undertaken to explore the inter-relatedness. Income was significant as an explanatory factor for deciduous and permanent caries while school type was significant for caries severity and SiC_{10} in the permanent dentitions. However income remained the only significant explanatory factor in the full model.

Brennan and Turrell (2012) and Borrell et al. (2006a) found associations between individual and neighbourhood SES and health outcomes, but no evidence of an interaction between individual SES and neighbourhood SES. There were independent effects for individual and neighbourhood SES where adults with a low income living in low SES neighbourhoods had higher odds of poorer health. Cesaroni et al. (2003) found that individual indicators of SES were stronger predictors of asthma in children compared to area-based indicators. However area-based SES still demonstrated a strong correlation with health outcomes. Neighbourhood and individual SES effects were explored in relation to child behaviour problems (Kalff et al., 2001), smoking behaviour (Cohen et al., 2011) and myocardial infarction (Stjarne et al., 2006) and found that the effects of neighbourhood deprivation had an additional effect above and beyond the individual SES level. This may relate to contextual factors such as social cohesion or social exclusion (Mulia and Karriker-Jaffe, 2012).

Locker and Ford (1996) and Thomson and Mackay (2004) explored the use of individual- and area-based indicators in an oral health setting and found that the two combined to provide a richer context incorporating the social environment in which people live as well as personal behaviours and life experiences. In this study, the school- and area-level SES indicators did not provide additional associations or a richer context than the individual-level household income alone when included in the nested model. It may be that the area SES indicators showed minimal effects in comparison to the larger effects of individual socioeconomic indicators (Pickett and Pearl, 2001) or that the two LHD SES indicators did not capture the relevant contextual factors that influence the oral health of children over

and above the individual income effect. The inclusion of more collective resources and area contextual factors such as, social resources and cohesion, local services and resources, facilities and community centres and job opportunities would enhance the understanding of the contextual impact of an area (Mulia and Karriker-Jaffe, 2012, Stafford and Marmot, 2003). This study used area-level SES indicators that were based on the health service districts, a small number of larger areas that may have a more heterogeneous composition. A different hierarchical structure that uses geographical areas of a more homogenous nature may result in different geographical divisions, with varying facilities and support mechanisms, where different measures of area strata may be used to assess the contextual effects. There is a need for qualitative research to more fully understand the relationship between SES and oral health and the experiences and understanding of the different social groups that may better explain the social variation (Sisson, 2007). Qualitative research has the potential to explore the variety of SES-related factors that may have a role in the mechanism or possible pathways between SES and oral health outcomes. Individual, school or area SES inequalities may have an impact on factors such as stress, attitudes, psychological well-being, psychosocial environment and material conditions that influences the incidence of disease (Pattussi et al., 2001, Reisine and Psoter, 2001, Wilkinson and Pickett, 2007). A more detailed understanding of the factors that contribute to the oral health inequalities would provide an opportunity to develop comprehensive strategies for action.

Different SES indicators measure different aspects of social stratification and reflect different causal mechanisms (Perera and Ekanayake, 2010). The individual and contextual effects are complex mechanisms and operate through different pathways (Galobardes, 2012). Given the independent effects of different SES indicators there is the potential for misclassification of individuals in areas or schools (Locker et al., 2004) that may lead to problems if using them as proxy indicators or when analysing the social context of oral health (Galobardes, 2012, Soobader et al., 2001). Single and composite SES indicators have been used. However, the ease of use and applicability for the context is an important determinant for selection of the most appropriate SES indicator. A blend may need to be considered for health promotion and policy development (Brennan and Turrell, 2012, Cohen et al., 2011, Hanley and Morgan, 2008). The preference of SES indicator should relate to the purpose for which links between SES and oral health outcomes are being explored (Galobardes, 2012, Perera and Ekanayake, 2010). Household income has an

advantage over school and area as it is a superior indicator for oral health and used in a number of other aspects to determine eligibility or subsidy. However, school type as an SES indicator is easily accessed and could be considered as a more convenient and less intrusive approach (Tubert-Jeannin et al., 2009) to use as a basis of a health policy approach.

4.5 EFFECTIVENESS OF TARGETING DENTAL SERVICES USING SES INDICATORS

Income, school type and geographic area have been either used or proposed as a measure of targeting health promotion or health services in order to maximise the benefit of prevention or available services. Over the last 15 years limited funding and resources have led to changes in access and costs associated with the provision of school dental services in Australia. Some states and territories have introduced fees, reduced access and implemented screening or targeted approaches for child public dental services. Some researchers believe that SES indicators can be an effective tool in planning and implementing oral health programs and facilitate access to dental services for those most in need (Gillcrist et al., 2001). Targeted screening programs using school SES indicators have been used in NSW (SAP program) and proposed in Germany (Sagheri et al., 2008). It would seem that a targeted approach would provide a useful strategy for a directed vulnerable population sub-group approach, particularly in view of the funding constraints.

This present study demonstrated that SES had a moderate to strong association (using population attributable fraction) for deciduous caries and a low to moderate association for the permanent dentition across all SES indicators at all three levels and all oral health outcomes. However, when applying the population attributable fraction to the lowest SES category, reflecting a targeted population approach, the population impact reduced considerably with all SES indicators recording low impact for all three oral health outcomes. In addition, this is supported by the proportion of children who had experienced caries (prevalence) or a severe level of caries (being in the significant caries group), that would be reached by such an approach where more than 50% of the children with some caries or severe caries would fall outside the target group. Research has suggested that targeted screening programs may identify the majority of low SES children with dental care needs and be effective at increasing attendance (Locker et al., 2004). However, when considering the difference in burden of disease for the most disadvantaged groups compared to the remainder it is clear that many of the children who have severe caries

would be missed. This is supported by Batchelor and Sheiham (2006) who found that a high-risk approach would not reach a large proportion of those in need and would not improve the overall oral health of the child population. Deaton (2002) believes that targeting social groups is problematic in identifying high risk people. The social distribution of caries means that identifying or targeting social groups deemed as high-risk results in high-risk children in higher social groups being missed. A targeted approach may therefore be an ineffective approach in trying to reach those people most in need. In addition, this study and others (Batchelor and Sheiham, 2006, Spencer and Harford, 2007) show that the poor oral health extends well above the most disadvantaged group. The distribution of high-risk children across the SES areas results in limited effectiveness of programs that target based on geographically defined population subgroups (Tickle and Milsom, 2008, Baelum, 2011). As an alternative, Sagheri et al. (2008) supported a combined approach with a targeted dental care program for those in disadvantaged schools and a screening for all others that are not targeted to ensure that those in need would not be missed. The NSW SAP program failed to reach out and identify the majority of children requiring dental care, or those from economically disadvantaged families with high caries needs who were not in a school-level SES target group.

4.5.1 Policy and service provision

Reducing the inequality gap in oral health has become a key issue in the last two decades. There has been an increase in the research exploring the social inequalities. However, the translation of social inequalities research into policy has been more difficult. Some studies have explored specific strategies such as fissure sealant programs (Siegal and Detty, 2010), fluoride programs (Weintraub et al., 2006, Sagheri et al., 2008) and screening programs (Sagheri et al., 2007). While risk assessments and high-risk strategies seek to address the health inequalities, the lack of precision in identification of the high-risk limits the success of such approaches. The majority of approaches focus on the individual, with a preventive and treatment approach, but fail to address the underlying causes of the disease. Targeting downstream behavioural causal factors without taking account of the broader social factors have been largely ineffective (Newton and Bower, 2005). Reisine and Psoter (2001) acknowledge the fact that the broad-based community approaches are more effective in caries reduction.

Health care policies should aim to reduce inequalities in health. Healthcare programs also have an important role in setting minimum standards, implementing health promotion and

preventive programs at both a population and an individual-level, not just treating the disease. Health care settings can contribute to reduction in disease with proven and effective prevention and intervention to benefit those in need. A key theme is the relationship between ill-health and socioeconomic status and the need for social safety nets, where healthcare should promote access and promote health as well as treat disease (McKee, 2002). Screening and difficult to access services can widen the gap (McKee, 2002). When services are difficult to access patients may present in the more advanced stages of the disease process, leading to more extensive treatment. Affordable and easily accessibly health services are an essential element for policies that will reduce health inequalities.

Universal programs are more sustainable. Health care systems that are 'funded from general taxation tend to be more equitable' and mean that the burden of care is founded on pooled resources rather than the individual (McKee, 2002). Only servicing part of the population undermines support for that system and leaves it vulnerable to neglect, interference and individual affordability. Gaughwin et al. (1999) investigated a free universal school dental service with high consent rates and greater proportion of children from disadvantaged backgrounds. The study showed that although there was a social gradient in child oral heath, the children who attended the school dental service had more favourable oral health outcomes than those who were seen by a private dentist. Ultimately the universal program demonstrated a positive effect in reducing the oral health inequalities. Universal coverage may potentially include public-private partnerships which have been shown to contribute to increased provision of services for low-income children (Brickhouse et al., 2006). The Commonwealth Government CDBS is an example of a program that combines private and public dental providers in the delivery of health care services to groups of children who may be at higher risk of dental disease. Children who meet the eligibility requirements can access up to $1000 over a two-year period (COHS, 2014).

A significant issue for health services will be to provide programs that cater to or are proportionate for the social gradient, that is, not just focus on the most disadvantaged. A combination approach has been suggested which has a foundation of universal care but with additional services for targeted groups. An oral health service that is inclusive and accessible to all is a crucial element. However, it may include a complementary approach where disadvantaged groups would receive more services, or alternatively, a tapering of

services for those in the highest income groups. A universal health service program with extra support, care and access to those most in need should be considered and is consistent with the 'proportionate universalism' suggested by Marmot and Bell (2010). Reisine and Psoter (2001) suggest that lower SES groups would benefit from increased preventive services and health promotion activities. However, the provision of treatment to only certain sub-groups does not either identify sufficient children in need, adequately alleviate the SES inequality, or address the underlying social causes of the disease (Watt and Sheiham, 1999).

Health promotion that incorporates oral health and operates at the public policy level is required to effect a reduction in the SES differences in oral health (Sheiham et al., 2011). Policies need to address the 'social, political and environmental causes of oral health' in order to make sustainable change (Watt and Sheiham, 1999). Deaton (2002) supports this approach and believes that focussing on the 'downstream' causes such as health behaviours and service delivery is ineffective unless the 'upstream' causes of the SES differences are addressed. In addition, Spencer and Harford (2007) highlight the fact that inequalities in health can result from a cumulative life course effect including access to care. Thomson et al. (2004) found that child SES and oral health is a strong predictor of adult oral health. Nicolau et al. (2003) highlighted the 'association between socioeconomic and biological factors in early life' and levels of caries in adolescents which may support the need to implement strategies to alter or reverse such a course. Therefore, a program that is designed to improve child oral health and reduce inequalities would have benefits for adult oral health. Policies that improve access and address financial barriers for children can promote more preventive-oriented visiting patterns and care from childhood to adulthood. Sanders et al. (2006a) found that lack of dental visiting was more likely a result of structure and funding for dental care services rather than individual requirements or choices. Brickhouse et al. (2006) found that the structure of different child dental programs influenced access to dental care. The availability of clinical services and dental providers influences use of services and has important policy implications for future oral health of the community.

This research supports a policy initiative for universal coverage for child dental services as well as special initiatives for those most in need, and a proportionate targeting of those children and families who irregularly attended for check-ups. Whole population public health initiatives take into account sociodemographic and neighbourhood differences and

provide priority for additional services for those with poor access. Such initiatives would provide a benefit to the whole community by reducing the burden of disease, while attempting to reduce inequalities in oral health (Wu et al., 2010). Public health efforts and resources should be focussed on upstream policy initiatives while still providing some midstream risk modification and downstream curative interventions (Baelum, 2011). This requires a change at a policy level, involving government and communities, to implement a health care system that is equitable and comprehensive with a proportionate health promotion and prevention focus.

4.5 FURTHER RESEARCH

This research has developed a better understanding of the SES variation in oral health in NSW children aged 5-12 years. It is important to understand the different SES influences at various stages of children's lives. This information may help to determine how SES influences oral health and assist in exploring strategies or interventions that will eliminate oral health inequalities. Research is needed to 'clarify the role' of socioeconomic factors in oral health outcomes, so that appropriate and effective social, economic and health policies can be implemented (Polk et al., 2010).

Future studies to explore the specific characteristics, culture, or services in a neighbourhood, community or school that influence or interact with individual behaviours and characteristics would aid understanding of the role of each and therefore implications for health promotion and public policy. Research using a prospective longitudinal design that could account for: specific life events, family mobility, social mobility and impact of different levels of SES on oral health outcomes would enhance reliability and validity of findings.

CHAPTER 5 SUMMARY AND CONCLUSIONS

This study explored the social gradient in oral health of NSW children aged 5-12 years using individual-, school- and area-level socioeconomic factors. The independent contributions of different indicators within and across three levels of SES were explored to determine their influence on the social gradient. Measures of population impact and burden of disease were used to quantify the effectiveness of SES indicators as a tool for targeting of dental services.

5.1 MAJOR THEMES

5.1.1 Distribution by SES characteristics

The oral health of NSW 5-12 year old children was measured using caries prevalence, severity of caries and significant caries. Just over 60% of NSW children were 'caries free' in the deciduous dentition with the overall dmfs of 3.18; and more than three-quarters of the children were 'caries free' in the permanent dentition with DMFS 0.61. The SiC_{10} group had extensive caries experience, with 15 times the mean caries experience for the deciduous dentition compared to the non-significant caries group, while in the permanent dentition the significant caries group recorded caries experience that was 20 times that of the non-significant caries group. There was significant variation across the three oral health outcomes, caries prevalence, caries severity and proportion who were members of the SiC_{10} group defined by individual-, school- and area-level SES characteristics.

5.1.1.1 Caries prevalence

The lowest SES category had significantly higher caries prevalence compared to the highest SES category for all six SES indicators (household income, education, school type, school ICSEA, LHD SEIFA and LHD Wealth metric) in both the deciduous and permanent dentition. Children from lowest household income group and disadvantaged schools showed the greatest SES difference at nearly twice the percentage of children having experienced caries for both dentitions. Children whose parents had only completed secondary education were more likely to have caries for both the deciduous and permanent dentitions. Meanwhile children who attended a school with lower ICSEA SES score or resided in a LHD with a lower SES ranking demonstrated a greater likelihood of caries for the deciduous and permanent dentition.

A series of models tested SES indicators within each level separately and then in combination. The individual- and school-level explanatory factors demonstrated increasing

prevalence of caries as SES decreased while at the area-level all of the lower categories had higher rates of caries compared to the highest SES category. In both the deciduous and permanent dentition income and education were significantly associated with caries variation when entered in separate models. However, only income remained significant in the final adjusted model that included both SES indicators showing higher caries prevalence of caries for the lowest income group. Both school indicators were significantly associated with variation in caries prevalence when entered in the separate models. The final adjusted model that included both school SES indicators showed that children from disadvantaged schools remained significant and showed a stronger association with caries prevalence across both dentitions. The separate models for area-level SES showed children who resided in lower SES ranked LHDs were more likely to have experienced caries. In the multivariable model the difference was significant for the LHD SEIFA ranking in the deciduous dentition and significant for the LHD wealth ranking in the permanent dentition.

5.1.1.2 Caries severity

A social gradient was apparent for the individual- and school-level SES indicators while the area-level SES showed variation across the categories that did not reflect a consistent pattern. The lowest SES category for individual-, school- and area-level SES all reported significantly higher levels of caries than the highest SES category in both dentitions. For the individual SES indicators in the deciduous dentition, household income showed the greatest variation between highest and lowest SES categories with a three-fold difference in caries severity. For the permanent dentition, income and education both showed a greater than two-fold difference between highest and lowest SES category. School ICSEA SES showed a social gradient while the school type SES showed a greater differentiation for the lowest SES category with the other three SES categories having a small non-significant difference in both dentitions. SES variation when measured by the LHD indicators showed a significant difference between the lowest SES ranked LHD and the highest ranked LHD whether measured by SEIFA score or the wealth metric for both dentitions.

A series of sequential models tested SES indicators within each level separately and then in combination for the deciduous and permanent dentition. Income and education were both significant in the individual models with higher rate of caries for the lower SES groups. In the final multivariable model for the deciduous dentition, only income retained a

significant social gradient while in the permanent dentition, income recorded the stronger association with caries severity. For the school model, school type and school ICSEA were both significant in the separate models showing a higher rate of caries for the lower SES groups in both dentitions. In the final adjusted model, the two school-level SES indicators both remained significantly associated with caries severity across both dentitions. Children's deciduous and permanent caries experience was likely to be more severe in the lowest SES LHDs in each of the separate models and across both dentitions. In the multivariable model for the deciduous dentition, the SEIFA ranking of LHDs was significant across all categories while the LHD Wealth ranking was no longer significant. In the final adjusted model for the permanent dentition, both LHD ranking variables demonstrated significance for the lowest SES category with higher rates of caries.

5.1.1.3 Significant caries group

There were significantly higher proportions of children in the SiC_{10} group from the lowest SES category across all SES indicators in both the deciduous and permanent dentitions. The deciduous dentition showed greater differences between the SES categories with parent education showing a two-fold difference between the highest and lowest SES categories and household income showing a five-fold difference. There was a three-fold difference for school type, school ICSEA, LHD SEIFA and LHD wealth metric indicators. Meanwhile in the permanent dentition there was a two-fold difference between the highest and lowest categories for all SES indicators.

A series of models tested SES indicators within each level separately and then in combination. The individual-, school- and area-level explanatory factors showing the lower SES category had a higher proportion of children who were members of the SiC_{10} group compared to the highest SES category. In both the deciduous and permanent dentition income and education were significantly associated with membership of the SiC_{10} group when entered in separate models. However, only income remained significant in the final adjusted model for the deciduous dentition and parent education remained significant for the permanent dentition. Both school indicators were significantly associated with membership of the SiC_{10} group when entered in the separate models. The final adjusted model that included both school SES indicators showed that children from disadvantaged schools remained significant and showed a stronger association with membership of the SiC_{10} group in the deciduous both dentition while in the multivariable model for the permanent dentition neither of the school-level SES explanatory factors were significant.

The separate models for area-level SES associations showed children who resided in lower SES ranked LHDs were more likely to be members of the SiC_{10} group. The multivariable model showed the LHD SEIFA ranking remained significant in both dentitions while LHD Wealth was no longer significant.

5.1.2 Associations across individual, school and area-level SES indicators

The association across individual-, school- and area-level SES with variation in caries experience in children was examined using multi-level analysis to account for the nested structure. The full model included three SES explanatory factors: income at the individual-level, school type at the school-level and LHD wealth metric at the area-level. In the final models, individual SES based on income was significant for all three caries measures for both dentitions. The children from the lowest income category had significantly higher odds of caries, more severe caries and proportionally more were members of the SiC_{10} group. School SES, using school type as an explanatory factor was significant for the children attending a disadvantaged public school who had significantly higher odds of more severe permanent caries. School SES was not significant in the multi-level model for either caries prevalence or significant caries. Area SES based on the LHD wealth metric as an explanatory factor was not significant in the multi-level model for caries severity and significant caries. However the LHD with the lowest wealth metric score was significant for deciduous caries prevalence.

Relative risk (prevalence ratio and risk ratio) was calculated for caries prevalence, caries severity and SiC_{10} group to determine the strength of association for each of the SES indicators in relation to these oral health outcomes. In the deciduous dentition, lowest household income recorded the highest relative risk with a low to moderate strength of association for caries prevalence (PR 1.9), caries severity (RR 3.3) and SiC_{10} group (PR 5.3) while in the permanent dentition lowest household income and disadvantaged school were significant for caries prevalence (income PR 1.7, disadvantaged school PR 1.7), caries severity (disadvantaged school PR 2.2, income 2.1) and SiC_{10} group (disadvantaged school PR 2.2, income PR1.9). In addition a social gradient was apparent for each of the caries indicators for individual and school SES indicators in both dentitions but was not always significant across all groups.

5.1.3 Effectiveness of targeting dental services by SES indicators

The population impact (using proportion of cases and population attributable fraction) for the three SES indicators were compared to determine if the majority of those children with caries or if the SiC_{10} group could be identified using an SES indicator, and therefore could be used as an approach for a targeted population strategy.

When reviewing the number of cases per 10,000 population, and therefore the proportion of cases, it was found that there were fewer cases of caries and fewer SiC_{10} cases in the lowest SES category than cases outside the designated target group. This was consistent across the three levels of SES indicators and for both caries prevalence and SiC_{10}. In each case there were 55-75% of the children who had experienced caries and severe caries outside the potential target group.

The population attributable fraction was used to determine the burden of illness that can be attributed to the variation in SES and measures the impact on the total population of eliminating the health disparity. Overall 22-25 % of all cases of deciduous caries and 14-16% of cases of permanent caries in the population are attributable to SES variation whether measured by income, school or area. However, only 8-12% of the burden of disease would be eliminated if targeting the lowest SES group across both dentitions. Caries severity and SiC_{10} recorded a higher burden of disease related to each of the SES indicators where income was highest for deciduous (caries severity PAF 44%; SiC_{10} PAF 56%) while school type was highest for permanent (caries severity PAF 25%; SiC_{10} PAF 24%). Although once again, when isolating the lowest SES group the population impact was low (deciduous PAF 18-21%; permanent PAF 11-14%). Overall SES variation contributes to the burden of caries in the population. However, targeting by lowest SES group, no matter which SES indicator was used, does not capture the majority of cases to assist in the reduction of disease burden.

5.2 CONCLUSIONS

This study supports previous research on social gradients in oral health. However, this has been extended to demonstrate SES variation across three levels of SES indicators, including individual-, school- and area-level SES level indicators, and for three caries outcomes. The manifestation of the social differences in caries prevalence and severity varied for the different SES indicators signifying that each of the different SES levels may measure slightly different influences on oral health. However, there are correlations

between the different levels of SES which further complicates their use in identifying vulnerable population groups.

Socioeconomic indicators provided a consistent measure of association or population impact measure between the two dentitions; however, income had a stronger association for deciduous and school type was stronger for the permanent dentition. This finding suggests that there are different influences on the two dentitions. Research (Nicolau et al., 2007, Poulton et al., 2002) suggests that life course events may have an impact on dental caries at different stages of development.

As the caries indices are a historical measure, it coincides with the lifecourse accumulation of risk model where events throughout life influence health (Nicolau et al., 2007, Marmot and Wilkinson, 2006, Sisson, 2007). The oral health status of the deciduous dentition would largely be explained by factors prior to school. SES-related factors such as income and education of the family through early childhood, may influence nutrition, oral health behaviour and visiting practices (Peres et al., 2009). The oral health of the permanent dentition may be influenced by the school environment, such as, school behaviours (smoking, nutrition, aggressive behaviours), self-esteem and school grades (Nicolau et al., 2003, Nicolau et al., 2007). Children move from early childhood to a more independent period through the middle-childhood that also may also influence behaviours, practices, psychosocial attitudes and socialisation. Listl (2012) suggests that a considerable proportion of the inequalities and oral health behaviours are already established at childhood and continue throughout life, while Nicolau et al. (2007) suggests that 'exposures in early life interact with exposures later in life'. The lifecourse approach incorporates individual factors and environmental factors at various stages of the lifecourse that impact on the oral health status.

This research has revealed that, although there was a moderate strength of association between SES and dental caries in children, the lowest SES categories for each of the SES indicators did not identify the majority of children at risk of caries or severe caries. Overall SES recorded a moderate to high population impact on the burden of caries in the population. However, the use of SES indicators to target SES sub-groups would leave the majority of cases unidentified and therefore would provide limited benefit for a directed vulnerable population strategy.

The implications for policy development in relation to targeting of school dental services by socioeconomic characteristics, needs to be explored further. The distribution of caries across the SES categories suggests that a universal approach to oral health services would be more appropriate. Marmot and Bell (2010) proposes that policies and interventions to improve health should be universal, but with a level and intensity that is proportionate to the level of disadvantage that has been termed 'proportionate universalism'. Health promotion should be the cornerstone of the public health approach to caries reduction with greater intensity for those groups with higher levels of disadvantage while maintaining a whole population approach (Pitts et al., 2011). In addition, public health and health promotion efforts should address all factors at both the individual-level as well as the contextual level whether that be school, work or the area people live in. It is important to enhance the resources of the individuals and improve the quality of the areas people live, work or go to school (Marmot, 2001).

These findings on the variation in oral health by socioeconomic status indicate that different levels of SES, that is, individual, school community and residential factors interact to influence dental caries for children. The nature of the interaction and influence will be important to understand to enable the translation of such research into appropriate policy and health service delivery. It is imperative that prevention, public health and policy approaches are evaluated to determine their effectiveness in reducing the burden of disease in the community.

5.3 PRINCIPAL CONCLUSIONS

1. There is considerable variation in child caries, its prevalence, severity or membership of a significant caries group, within the population. Child caries showed associations with SES at an individual-, school- and area-level with a gradient from high SES to low SES.

2. At an individual-level, household income and highest parent education were associated with caries, with income showing a significant association in the presence of parent education in a multivariable model.

3. At a school-level school type and school ICSEA ranking were associated with caries, with school type showing a significant association in the presence of school ICSEA ranking in a multivariable model.

4. At an area-level LHD wealth metric and LHD SEIFA ranking were associated with caries, with LHD SEIFA showing a significant association in the presence of LHD wealth metric in a multivariable model.

5. When the nesting of individuals within schools and schools within areas was accounted for in a multi-level analysis, individual-level household income had a consistent association with caries.

6. When the population impacts of these associations were explored, household income registered the highest impact for the deciduous dentition while area SES recorded the highest impact for the permanent dentition. However the population impact of the lowest SES category recorded a low impact for all SES indicators across all caries measures.

7. The use of SES indicators to target SES sub-groups would leave the majority of cases in the population unidentified and therefore would provide limited benefit for a directed vulnerable population strategy.

8. Policies and interventions to improve health should be universal, but with a level and intensity that is proportionate to the level of disadvantage.

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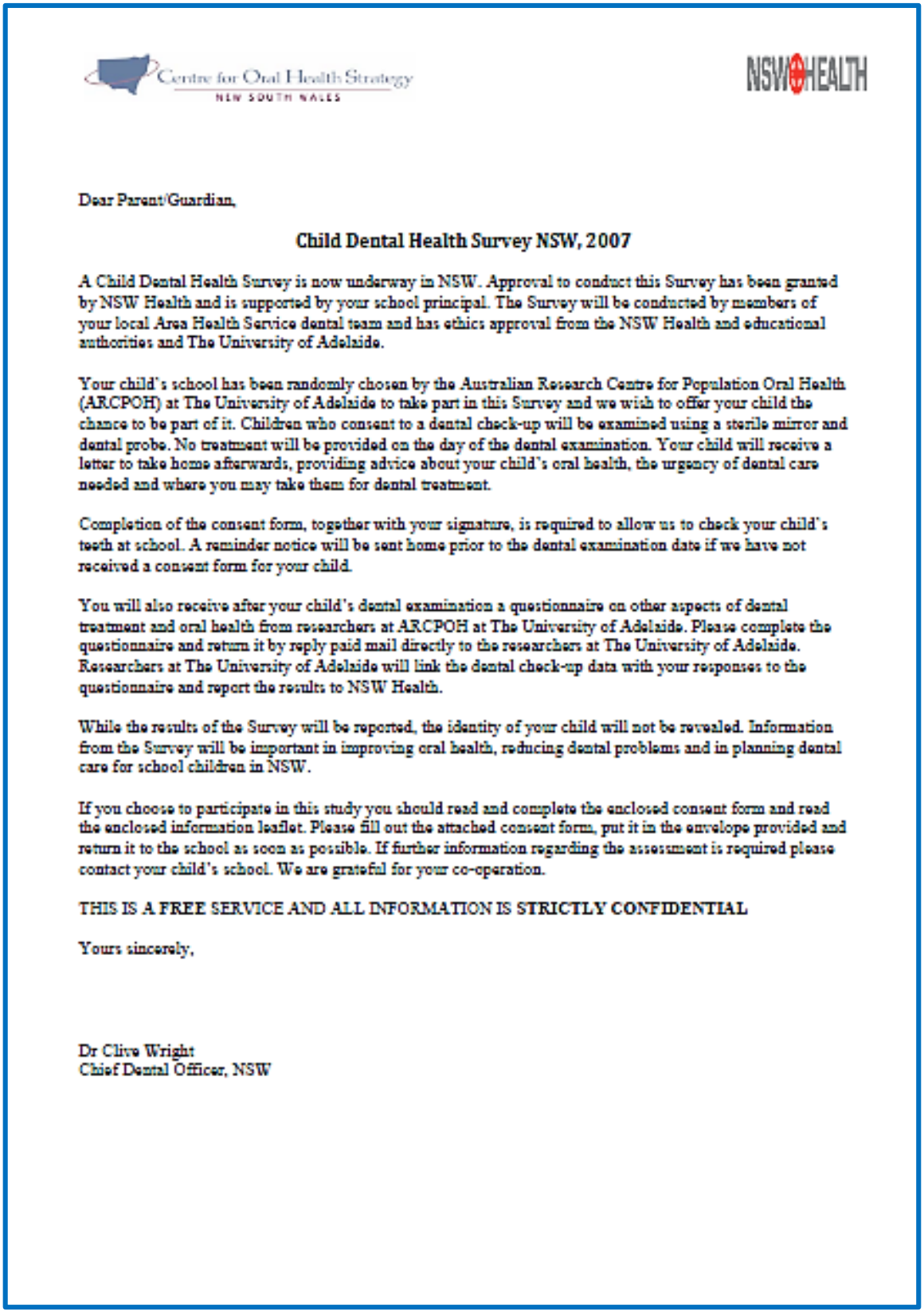
APPENDICES

APPENDIX 1 NSW INFORMATION AND CONSENT FORM



Centre for Oral Health Strategy
NEW SOUTH WALES

NSW HEALTH

Dear Parent/Guardian,

Child Dental Health Survey NSW, 2007

A Child Dental Health Survey is now underway in NSW. Approval to conduct this Survey has been granted by NSW Health and is supported by your school principal. The Survey will be conducted by members of your local Area Health Service dental team and has ethics approval from the NSW Health and educational authorities and The University of Adelaide.

Your child's school has been randomly chosen by the Australian Research Centre for Population Oral Health (ARCPOH) at The University of Adelaide to take part in this Survey and we wish to offer your child the chance to be part of it. Children who consent to a dental check-up will be examined using a sterile mirror and dental probe. No treatment will be provided on the day of the dental examination. Your child will receive a letter to take home afterwards, providing advice about your child's oral health, the urgency of dental care needed and where you may take them for dental treatment.

Completion of the consent form, together with your signature, is required to allow us to check your child's teeth at school. A reminder notice will be sent home prior to the dental examination date if we have not received a consent form for your child.

You will also receive after your child's dental examination a questionnaire on other aspects of dental treatment and oral health from researchers at ARCPOH at The University of Adelaide. Please complete the questionnaire and return it by reply paid mail directly to the researchers at The University of Adelaide. Researchers at The University of Adelaide will link the dental check-up data with your responses to the questionnaire and report the results to NSW Health.

While the results of the Survey will be reported, the identity of your child will not be revealed. Information from the Survey will be important in improving oral health, reducing dental problems and in planning dental care for school children in NSW.

If you choose to participate in this study you should read and complete the enclosed consent form and read the enclosed information leaflet. Please fill out the attached consent form, put it in the envelope provided and return it to the school as soon as possible. If further information regarding the assessment is required please contact your child's school. We are grateful for your co-operation.

THIS IS A FREE SERVICE AND ALL INFORMATION IS STRICTLY CONFIDENTIAL

Yours sincerely,

Dr Clive Wright
Chief Dental Officer, NSW

Centre for Oral Health Strategy
NEW SOUTH WALES

NSW HEALTH

Child Dental Health Survey NSW, 2007

Reminder Letter

Dear Parent/Guardian,

A short time ago you would have received an information package and an invitation to participate in an important child dental health survey which will allow a better understanding of how to protect children's teeth against decay and help in planning dental care for school children in NSW.

If you have already returned the consent form, could you please accept our thanks and ignore this notice. However, if you haven't done so, please complete the attached consent form and return it to your child's school today. Your cooperation will be greatly appreciated.

If by some chance, you did not receive the information package or it was misplaced, please contact your child's school and ask for a replacement package.

ALL INFORMATION IS STRICTLY CONFIDENTIAL

THIS IS A **FREE** SERVICE

Yours sincerely,

Dr Clive Wright
Chief Dental Officer, NSW

Centre for Oral Health Strategy
NEW SOUTH WALES

NSW HEALTH

INFORMATION SHEET TO PARENTS AND GUARDIANS

Child Dental Health Surveys have collected data on children's dental health since 1977. Information from these surveys have been used to provide evidence about regional variations in prevalence of dental disease, describe outcomes from children's dental services, and evaluate the effectiveness of various forms of prevention.

Aim of the Survey
The aim of the Child Dental Health Survey NSW, 2007 is to gather information on primary school aged children in the age range of 5-12 years for the dual purpose of contributing to national population-based information about the oral health of children as well as providing reliable regional information for appropriate planning of dental services in NSW. NSW has not had a survey of this type since 2001 and has therefore lacked a thorough understanding of how dental service needs for children differ in NSW.

Selection of children
Your child's school has been randomly chosen by the Australian Research Centre for Population Oral Health (ARCPOH) at The University of Adelaide.

What is involved
With your consent, specially trained Dental Therapists or Dentists will examine your child at school. The exam involves looking at your child's mouth and teeth to record information on your child's teeth.

The sterile instruments used are a mirror and a standard dental probe. The Survey does not involve any dental treatment and no x-rays will be taken. If you consent you will also be asked to complete a questionnaire which your child will receive at the dental examination. The questionnaire has been prepared by researchers at ARCPOH, The University of Adelaide. You are asked to return the questionnaire in the reply-paid envelope directly to The University of Adelaide. Researchers at The University of Adelaide will link the dental examination data with the questionnaire responses and report on the findings to NSW Health.

You are free to decline to participate in this study or to withdraw from the study at any time.

Ethical approval
The Survey has ethics approval from NSW Health and educational authorities and from The University of Adelaide.

Confidentiality
All information collected for this Survey will be strictly confidential and stored in a safe place while being processed. Only the research team directly involved will have access to any information. The results published from this Survey will only show results for different age and community groups. They will not include names or any information which could possibly identify you, your child or the school.

Information from the survey will be important in the fight against childhood oral health problems such as tooth decay and will help in planning dental care for school children in NSW. Your participation will make a significant contribution to current knowledge on this important issue.

Inquiries
If you have any further enquiries, please contact your child's school.

Centre for Oral Health Strategy
NEW SOUTH WALES

NSW HEALTH

Frequently Asked *Questions and Answers about the Survey*

What is the purpose of the Survey?
The purpose of the Survey is to investigate the impact of dental disease in child populations in NSW. By doing this we hope to identify means of preventing tooth decay and describe outcomes from children's dental services.

How is my child being selected?
The schools chosen for this survey have been randomly selected from a list of all Public, Catholic and Independent primary schools in NSW. Selected students from within these schools will receive a dental examination and their parent complete a questionnaire.

Why is the survey being conducted here?
Child Dental Health Surveys have collected data on children's dental health since 1977. Information from these surveys is used to provide evidence about variations in the level of dental disease and evaluate the effectiveness of dental services and various forms of prevention. NSW has not had a survey of this type since 2001 and wishes to better understand where and how dental services for children differ across the state.

What is involved?
With your consent, specially trained Dental Therapists or Dentists will examine your child at school. The exam involves looking at your child's mouth and teeth to record information on your child's teeth.

The sterile instruments used are a mirror and a standard dental probe. The Survey does not involve any dental treatment and no x-rays will be taken. If you consent you will also be asked to complete a questionnaire which your child will receive at the dental examination. The questionnaire has been prepared by researchers at ARCPOH, The University of Adelaide. You are asked to return the questionnaire in the reply-paid envelope directly to The University of Adelaide. Researchers at The University of Adelaide will link the dental examination data with the questionnaire responses and report on the findings to NSW Health.

You are free to decline to participate in this study or to withdraw from the study at any time.

Should I complete all questions on the consent form and questionnaire?
Every question is important to enable NSW Health to develop as complete a picture of our child population as possible. It is therefore important to complete the consent form to the best of your ability, as even an incomplete form may still be useful.

What if I object to a question?
All personal information is strictly confidential. No individuals will be identifiable from the results of the Survey. If there is a question which presents particular difficulty for you, please telephone the school for clarification.

Why do you want to know personal details like my country of birth and language spoken at home?
At some time or another, nearly all people in Australia have come from overseas. It is known that dental health will reflect the customs and practices of different groups. So for this Survey to be effective it needs to include questions about the home country, language and card holder status.

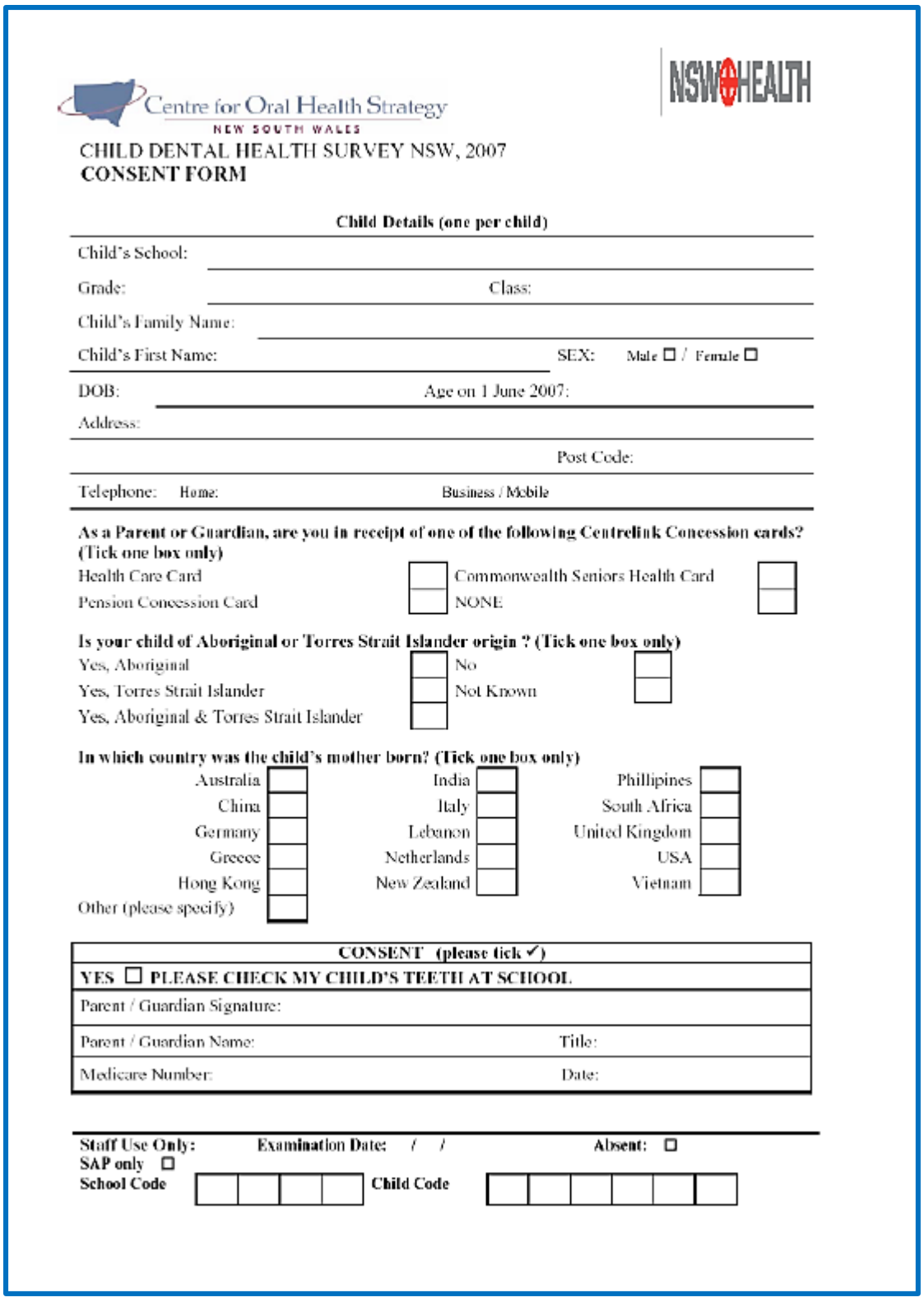
Who gets to know my information?
Only the examination team directly concerned with the project will see the information provided by you. The NSW Department of Health is responsible for keeping this information safe until it is destroyed once the data are processed. No results of the Survey will refer to individuals. While the results will be published and made available to the Department of Health and summaries given to the Ministry of Education and schools in the regions surveyed, no personal information will be identifiable from the results.

Centre for Oral Health Strategy
NEW SOUTH WALES

NSW HEALTH

How is my confidentiality maintained?
All documents will be maintained in a secure environment and destroyed after seven years. Electronic data files including ID only will be stored on computers with password access by the researchers only for up to seven years and then on CD-ROM for further possible analysis. Any change of policy for research purposes will only occur with specific ethics approval.

How will this benefit my child?
The Survey will include a brief report about your child's dental health and information about where to access free dental treatment if treatment is indicated.



Centre for Oral Health Strategy
NEW SOUTH WALES

NSW HEALTH

CHILD DENTAL HEALTH SURVEY NSW, 2007
CONSENT FORM

Child Details (one per child)

Child's School:

Grade: Class:

Child's Family Name:

Child's First Name: SEX: Male ☐ / Female ☐

DOB: Age on 1 June 2007:

Address:

Post Code:

Telephone: Home: Business / Mobile

As a Parent or Guardian, are you in receipt of one of the following Centrelink Concession cards? (Tick one box only)

Health Care Card ☐ Commonwealth Seniors Health Card ☐
Pension Concession Card ☐ NONE ☐

Is your child of Aboriginal or Torres Strait Islander origin ? (Tick one box only)

Yes, Aboriginal ☐ No ☐
Yes, Torres Strait Islander ☐ Not Known ☐
Yes, Aboriginal & Torres Strait Islander ☐

In which country was the child's mother born? (Tick one box only)

Australia	☐	India	☐	Phillipines	☐
China	☐	Italy	☐	South Africa	☐
Germany	☐	Lebanon	☐	United Kingdom	☐
Greece	☐	Netherlands	☐	USA	☐
Hong Kong	☐	New Zealand	☐	Vietnam	☐

Other (please specify) ☐

CONSENT (please tick ✓)	
YES ☐ PLEASE CHECK MY CHILD'S TEETH AT SCHOOL	
Parent / Guardian Signature:	
Parent / Guardian Name:	Title:
Medicare Number:	Date:

Staff Use Only: **Examination Date:** / / **Absent:** ☐
SAP only ☐
School Code ☐☐☐☐ **Child Code** ☐☐☐☐☐☐

APPENDIX 2 SUPPLEMENTARY STUDY - PRIMARY APPROACH LETTER AND QUESTIONNAIRE

NSW Child Dental Health Survey 2007

The Oral Health Status and Access to Services Project

ARCPOH
Australian Research Centre for POPULATION ORAL HEALTH

THE UNIVERSITY OF ADELAIDE AUSTRALIA

Record ID here: →	ID								

Dear Parent/Guardian,

Thank you for agreeing to participate in the **NSW Child Dental Health Survey**. All information you provide will be **strictly confidential**.
All of the questions in the questionnaire that refer to 'your child' concern the child named on the Consent Form for the examination phase of the study. All of your answers are valuable to us, so please complete all questions to the best of your knowledge.

EXAMPLES OF QUESTIONS

Some questions require you to tick one box only. For example:

Has your child ever used mouthrinse?
(Tick one box only)

☑1 Yes ☐2 No ☐3 Don't know

Other questions may allow you to give multiple answers. For example:

When does your child usually brush his/her teeth?
(Tick as many boxes as applicable)

☑1 Before breakfast ☐2 After breakfast ☑3 After lunch ☑4 After dinner ☐5 Immediately before bed ☐6 At other times

Some of the questions ask for information about behaviours as in the following example. For questions like this, please write the number in the box unless indicated otherwise.

A7. In the table below, please write the number of serves of food your child eats in a usual day, AND how many serves s/he usually eats in the last hour before bed. Please use the standard serves as listed below.

	Standard serve	In a usual day (total)	How many of those eaten in a usual day are eaten in the last hour before bed
EXAMPLE FOR FRUIT →	1 medium piece or 2 small pieces	3	1

Some of the questions ask for information about the effects of oral conditions on children's wellbeing and everyday life as in the following example. For questions like this, please circle the appropriate response unless indicated otherwise.

EXAMPLE: During the last 3 months, because of his/her teeth, lips, mouth or jaws, how often has your child been ...

Upset?	Never	Hardly ever	Sometimes	(Often)	Very often	Don't know

AUSTRALIAN RESEARCH CENTRE FOR POPULATION ORAL HEALTH

IF YOU HAVE ANY ENQUIRIES, PLEASE TELEPHONE THE AUSTRALIAN RESEARCH CENTRE FOR POPULATION ORAL HEALTH AT THE UNIVERSITY OF ADELAIDE TOLLFREE ON 1800-007-187

A9. After tooth brushing does your child usually *(tick one box only)*

Just swallow	Rinse and swallow	Rinse and spit	Just spit	Other	Don't know
☐1	☐2	☐3	☐4	☐5	☐6

A10. When does your child usually brush his/her teeth? *(tick as many boxes as applicable)*

Before breakfast	After breakfast	After lunch	After dinner	Immediately before bed	At other times
☐1	☐2	☐3	☐4	☐5	☐6

A11. Has you child ever taken fluoride tablets or drops? *(tick one box only)*

Yes, fluoride drops only	Yes, fluoride tablets only	Yes, fluoride tablets and drops	No	Don't know
☐1	☐2	☐3	☐4	☐5

A12. Has your child ever used fluoride mouthrinse? *(tick one box only)*

Yes	No	Don't know
☐1	☐2	☐3

A13. Has your child ever had fluoride gel/varnish applied to his/her teeth by a dentist/therapist? *(tick one box only)*

Yes	No	Don't know
☐1 _____ times (write number of times) ↑	☐2	☐3

3

DIETARY INTAKE FOR YOUR CHILD

A14. **In the table below, please write the number of serves of food your child eats in a usual day, AND how many of these serves s/he usually eats in the last hour before bed.**

Please use the standard serves as listed below.

EXAMPLE: My child eats 3 serves of fruit in a usual day, with 1 of these 3 serves of fruit eaten in the last hour before the child goes to bed

	Standard serve	Total serves in a usual day	How many of these serves are eaten in the last hour before bed
EXAMPLE FOR FRUIT →	1 medium piece or 2 small pieces	3	1
Enter the number of serves your child eats of each food specified. If s/he does not usually eat the food, write '0'.			
Fruit and natural unsweetened fruit juice	1 medium piece or 2 small pieces or 1 medium glass	.....	.....
Sweetened fruit drinks/juices	1 medium glass	.....	.....
Sweetened (non-diet) soft drinks, mineral waters, cordial, sports drinks or juices	1 medium glass	.....	.....
Artificially sweetened (diet/low calorie) soft drinks, mineral water or cordial	1 medium glass	.....	.....
Plain milk	1 medium glass	.....	.....
Flavoured milk (Milo, chocolate milk, Nesquik, etc.)	1 medium glass	.....	.....
Water	1 medium glass	.....	.....
Sweetened dairy products (sweetened yogurt, ice-cream, custard)	1 cup yoghurt or 2 scoops ice-cream or ½ cup custard	.....	.....
Unsweetened dairy food (cheese or plain yoghurt)	1 cup yoghurt or 2 slices of cheese	.....	.....
Breakfast cereal – please specify main types: 1. ..... 2.	1 cup	.....	.....
Biscuits, cakes or puddings	2 biscuits or 1 slice cake or 1 cup cake	.....	.....
Table sugar (in tea, Milo, on cereal, etc.)	1 teaspoon	.....	.....
Chocolate and sugar-based confectionary	1 bar of chocolate or 4—5 lollies	.....	.....
Syrups, jams and sweet spreads (honey, jam, Nutella, maple syrup, etc.)	1 tablespoon	.....	.....
Muesli bars and health bars	1 muesli bar	.....	.....
Chips/crisps	1 small packet	.....	.....
Vegetables	1 cup	.....	.....
Bread	1 slice or small roll	.....	.....
Meat, fish, poultry, nuts or legumes	65—100g cooked meat or chicken or 1/3 cup nuts or legumes	.....	.....

4

SECTION B: Water intake during child's life

Section B To enable us to form a more complete picture about your child's water intake during their lifetime, please indicate where your child has resided and the usual source of water consumed.

Please read the example below and then complete the table.

Write the name of each suburb, town or location your child has lived in, and the years that s/he lived there. **You are able to list one residence more than once if your usual source of water has changed over time.** Only include places where your child has lived for six months or more.

Consider the average amount of water your child consumes a day and indicate the proportion of drinking water that came from tap or mains supply for each place of residence. Please answer with your best estimate.

EXAMPLE:

- This is an example of a child who currently lives in Glenfield where she drinks tap water at home and school. Therefore, the proportion of drinking water from tap/mains is 100%.
- She lived at Unley, SA from 1995 until 2002 where she used tank water at home and mains water at school. Therefore, the proportion of drinking water from tap/mains is estimated at only 20%.
- Prior to that she lived for two months in Mount Barker. As she lived there for less than six months it is not included in the table.
- She lived for nine months in Newcastle where she used tap water at home. At school she drank spring water. Therefore, the proportion of drinking water from tap/mains is estimated at 80%.
- This child only lived in Newcastle for part of a year, so the same year has been written in the 'From' and 'To' boxes.
- Her details would be filled in as follows:

	Suburb, town or location *(Start at current residence of 6 months or more)*	Country/ Australian State or Territory	Years of residence		Proportion of drinking water from Tap/Mains
			From	To	
1.	*Glenfield*	*NSW*	*2002*	*2007*	*100%*
2.	*Unley*	*SA*	*1995*	*2002*	*20%*
3.	*Newcastle*	*NSW*	*1994*	*1994*	*80%*

We have given you enough spaces for six residences/entries. If you run out of spaces please attach an extra sheet of paper following the same format as in our table.

You are able to list one residence more than once if your usual source of water has changed over time.

Suburb, town or location *(Start at current residence of 6 months or more)*	Country/ Australian State or Territory	Years of residence		Proportion of drinking water from Tap/Mains
		From	To	
1.	.....	.....	.....	.....%
2.	.....	.....	.....	.....%
3.	.....	.....	.....	.....%
4.	.....	.....	.....	.....%
5.	.....	.....	.....	.....%
6.	.....	.....	.....	.....%

5

SECTION C: Use of Dental Services

Section C Asks questions related to your child's use of dental services, where they have received care and for what reason they visited a dental practitioner.

C1. How old was your child when s/he first attended a dentist or dental therapist? *(tick one box only)*

Under 1 year old	1 year but less than 2 years old	2 years but less than 3 years	3 years but less than 4 years	4 years but less than 5 years	5 years but less than 6 years	6 years but less than 7 years	Older than 7 years	Don't know	Never visited a dentist or therapist
☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9	☐10

→ Go to C11

C2. When did your child last see a dentist or dental therapist about his/her teeth? (Please do not include orthodontic specialist visits) *(tick one box only)*

Never	Less than 6 months ago	6 months to less than 12 months ago	12 months to less that 18 months ago	18 months to less than 24 months ago	2 years to less than 3 years	3 years to less than 5 years ago	5 years or more	Don't know
☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

C3. Where was your child's last dental visit? *(tick one box only)*

Private practice	Public hospital/clinic	School dental service	Health fund dental clinic	Don't know
☐1	☐2	☐3	☐4	☐5

C4. What was the reason for your child's last dental visit? *(tick one box only)*

Check-up	Relief of pain	Problem	Other (please specify)
☐1	☐2	☐3	_____

C5. How often does your child **usually** receive dental care or visit a dental professional? *(tick one box only)*

Twice a year	Once a year	Once every 2 years	No regular pattern	Don't know	Other (please specify)
☐1	☐2	☐3	☐4	☐5	_____

C6. Where does your child **usually** receive dental care? *(tick one box only)*

Private practice	School dental service	Both School dental service & private dentist	Public hospital/clinic	Health fund dental clinic	No regular care	Other (please specify)
☐1	☐2	☐3	☐4	☐5	☐6	_____

C7. What is the reason your child **usually** visits for dental care?

Check-up	Relief of pain	Problem	Other (please specify)
☐1	☐2	☐3	_____

6

C8. To enable us to form a more complete picture about your child's dental care experience, please tick where your child has received a course of **routine** dental care (e.g. check-ups, fillings) for the years that your child visited a dental practitioner.

EXAMPLE:

- This is an example of a child who currently receives care from the **School Dental Service** and **Private Practice**
- She started care in 2007.

Year of first visit to a dental practitioner: *2007*

Year	Provider of Dental Care			
2007	☐ School Dental Service	☐ Private Practice	☑ Both School Dental & Private Practice	☐ No Visit

Please write the year that your child first received routine dental care: _____

Please tick where your child has received a course of routine dental care:

Year	Provider of Dental Care			
2007	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit
2006	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit
2005	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit
2004	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit
2003	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit
2002	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit
2001	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit
2000	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit
1999	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit
1998	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit
1997	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit
1996	☐ 1 School Dental Service	☐ 2 Private Practice	☐ 3 Both School Dental & Private Practice	☐ 4 No Visit

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C9. Why did you choose your child's current dental care provider? *(tick as many boxes as applicable)*

Convenient location	Convenient hours	Prompt attention	Emphasis on prevention	Quality of dental care	Personal recommen-dation	Special skills of dentist/clinic	Cost	Attitude of staff	Eligibility	Other (please specify)
☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9	☐10	☐11

C10. What dental treatment did your child receive at his/her last course of care? *(tick as many boxes as applicable)*

Check-up	Dental filling	Relief of pain	Tooth extracted	Gum treatment	Teeth straightened	Teeth cleaned	Other (please specify)
☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8

C11. How would you rate the current dental health of your child? *(tick one box only)*

Excellent	Very good	Good	Fair	Poor
☐1	☐2	☐3	☐4	☐5

C12. On a scale of 1—10, where would you rate the importance of your child's dental health?
e.g. 1=top priority 10 =lowest priority *(Please indicate your response by circling a number)*

Top priority									Lowest priority
1	2	3	4	5	6	7	8	9	10

C13. The following statements concern views on the way that dental care is provided. Please respond to each statement by circling ONE of the numbers in each line to indicate your level of **DISAGREEMENT** or **AGREEMENT** with the following statements.

Statements	Strongly disagree → Strongly agree				
Public dental services for children should be directed only to disadvantaged groups	1	2	3	4	5
It is important to have a choice of dental provider for children	1	2	3	4	5
The community should be responsible for ensuring all children are able to receive dental care	1	2	3	4	5
Children with similar dental problems should be provided with similar dental care	1	2	3	4	5

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SECTION D: Oral Health related Quality of Life

Section E This section is about the effects of oral conditions on children's well-being and everyday life. We are interested in any condition that involves your child's teeth, lips, mouth and jaws. **Please answer each question as accurately as you can.**

1. To answer each question, please **circle a response that best describes your opinion about your child's experience.** If the question does not apply to your child, please answer with 'Never'.
2. Please **do not discuss your responses with your child,** as we are interested only in the parent's perspective in this section of the questionnaire.

EXAMPLE

If your child has often been upset because of problems with his/her teeth, lips, mouth or jaws, choose Often as the appropriate response as shown below. If the child was upset for other reasons, please choose Never.

During the last 3 months, because of his/her teeth, lips, mouth or jaws, how often has your child been ...

Upset?	Never	Hardly Ever	Sometimes	(Often)	Very Often	Don't Know

D	*Please circle one response that best describes your opinion.*				
1. How much is your child's overall well-being affected by the condition of his/her teeth, lips, mouth or jaws?	Not at all 1	Very little 2	Some 3	Quite a lot 4	Very much 5
2. Would you say the colour of your child's teeth is...	Very attractive 1	Quite attractive 2	Just ordinary 3	Quite unattractive 4	Very unattractive 5
3. If it were possible, would you like treatment to change the colour of our child's teeth?	Definitely yes 1	Probably yes 2	Neutral 3	Probably no 4	Definitely not 5
4. Would you say your child's front teeth are ...	Very badly stained 1	Quite badly stained 2	Just slightly stained 3	Not at all stained 4	
5. Are you satisfied with the appearance of your child's front teeth?	Very satisfied 1	Satisfied 2	Neutral 3	Dissatisfied 4	Very dissatisfied 5

The following questions ask about symptoms and discomfort that children may experience due to the condition of their teeth, lips, mouth or jaws.

During the LAST 3 MONTHS, how often has your child had ...						
Please circle one response that best describes your opinion. If it was for another reason, please answer with 'Never'.						
6. Bad breath?	Never 1	Hardly ever 2	Sometimes 3	Often 4	Very often 5	Don't know 6
7. Food caught in or between the teeth?	Never 1	Hardly ever 2	Sometimes 3	Often 4	Very often 5	Don't know 6
8. Difficulty biting or chewing foods such as fresh apple, or firm meat?	Never 1	Hardly ever 2	Sometimes 3	Often 4	Very often 5	Don't know 6
9. Difficulty eating hot or cold foods?	Never 1	Hardly ever 2	Sometimes 3	Often 4	Very often 5	Don't know 6

The following questions ask about the effects that the condition of children's teeth, lips, mouth or jaws may have on your child's feelings and everyday activities.

During the LAST 3 MONTHS, because of his/her teeth, lips, mouth or jaws, how often has your child been?

10. Irritable or frustrated?	Never 1	Hardly ever 2	Sometimes 3	Often 4	Very often 5	Don't know 6
11. Upset?	Never 1	Hardly ever 2	Sometimes 3	Often 4	Very often 5	Don't know 6
12. Avoided smiling or laughing when around other children?	Never 1	Hardly ever 2	Sometimes 3	Often 4	Very often 5	Don't know 6
13. Asked questions by other children about his/her teeth, lips, mouth or jaws?	Never 1	Hardly ever 2	Sometimes 3	Often 4	Very often 5	Don't know 6

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SECTION E: Parental Information

Section E To ensure a wide cross section of the community is represented in this questionnaire, could you please answer a few questions about yourself and your family.

E1. How would you describe your household arrangements? *(tick one box only)*

Spouse/partner & children	Divorced or single parent with children	Share house with other adults (e.g. parents) & children	Other *(please specify)*
☐1	☐2	☐3	_____

E2. What is your age?	Self	Spouse/Partner
	_____ years	_____ years

E3. What is your sex?	Self	Spouse/Partner
	Male ☐1 Female ☐2	Male ☐1 Female ☐2

E4. Are you of Aboriginal or Torres Strait Islander origin?	Self	Spouse/Partner
	Yes ☐1 No ☐2	Yes ☐1 No ☐2

E5. What is your level of education? *(tick one box only per line)*

	Some primary school	Completed primary school	Some secondary school	Completed secondary school	Completed trade/ apprenticeship	Some university or college	Completed university or college	Postgraduate education
Self	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8
Spouse/ Partner	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8

E6. Do you or your spouse currently work in a job or a business?

Self	Yes ☐1	No ☐2	Never worked ☐3
Spouse/ Partner	Yes ☐1	No ☐2	Never worked ☐3

E7. What is your current or most recent occupation?
(e.g. contractor, public service clerk grade…, manager of small business, employed by large builder)

Self, *(please specify)* _____

Spouse/ Partner, *(please specify)* _____

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SECTION F: Health Information

Section F The next questions are about your lifestyle and may identify factors linked with oral health and dental visiting. *Please tick the most appropriate answer for you.*

	Self	Partner
F1. Did you brush your teeth yesterday?	Yes ☐1 No ☐2	Yes ☐1 No ☐2
F2. How many times did you brush your teeth yesterday? *Please specify*	_____	_____
F3. Did you use toothpaste?	Yes ☐1 No ☐2	Yes ☐1 No ☐2

F4. How would you rate your **general health**? *(tick one box only per line)*

	Excellent	Very good	Good	Fair	Poor
Self	☐1	☐2	☐3	☐4	☐5
Spouse/ Partner	☐1	☐2	☐3	☐4	☐5

F5. How would you rate your **oral health**? *(tick one box only per line)*

	Excellent	Very good	Good	Fair	Poor
Self	☐1	☐2	☐3	☐4	☐5
Spouse/ Partner	☐1	☐2	☐3	☐4	☐5

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SECTION G: Social Information

Section G The next questions are about your socio-demographic characteristics. *Please tick the most appropriate answer for you.*

G1. Do you have private dental insurance?	Yes	No	Don't know
	☐ 1	☐ 2	☐ 3

G2. In your household, what is the main source of income? *(Please tick one box only)*

Wages/salary	Austudy/Abstudy	Social Security Pension	Private Pension	Investment/ Interest	No income	Own business/ share in partnership
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7

Job search/ Newstart Allowance	Sickness Allowance/ Special Benefits	Superannuation	Veterans Affairs Service Pension	Other *(please specify)*
☐ 8	☐ 9	☐ 10	☐ 11	_____
				_____

To ensure a wide cross section of the community is represented in this questionnaire, could you please answer the next question related to socio-economic status. Research has shown that socio-economic factors have been linked with oral health.

G3. Into which category does your total household income (before tax) fall? Include any salaries, pensions, allowances, benefits, etc from all persons in the household. *(Tick one box only)*

Household income per year

☐ 1 Up to $20,000	☐ 6 $100,001 to $120,000
☐ 2 $20,001 to $40,000	☐ 7 $120,001 to $140,000
☐ 3 $40,001 to $60,000	☐ 8 $140,001 to $160,000
☐ 4 $60,001 to $80,000	☐ 9 $160,001 to $180,000
☐ 5 $80,001 to $100,000	☐ 10 Over $180,000

G4. How many people (including yourself) are dependent on this income?
Please indicate the number of people less that 15 years AND the number of people 15 years and over.

Number of people
Less than 15 years of age _____

Number of people
15 years and over _____

And the last question....

G5. Questionnaire completed by	Mother	Father	Other (please specify)
	☐ 1	☐ 2	_____

THANK YOU FOR YOUR PARTICIPATION. YOUR HELP IS GREATLY APPRECIATED.

If you have any enquiries regarding this questionnaire or the project in general, please telephone on:

Toll free 1 800 007 187 during business hours.

Please return this survey in the enclosed reply-paid envelope addressed to:

NSW Child Dental Health Survey 2007

Australian Research Centre for Population Oral Health

School of Dentistry

The University of Adelaide

South Australia 5005

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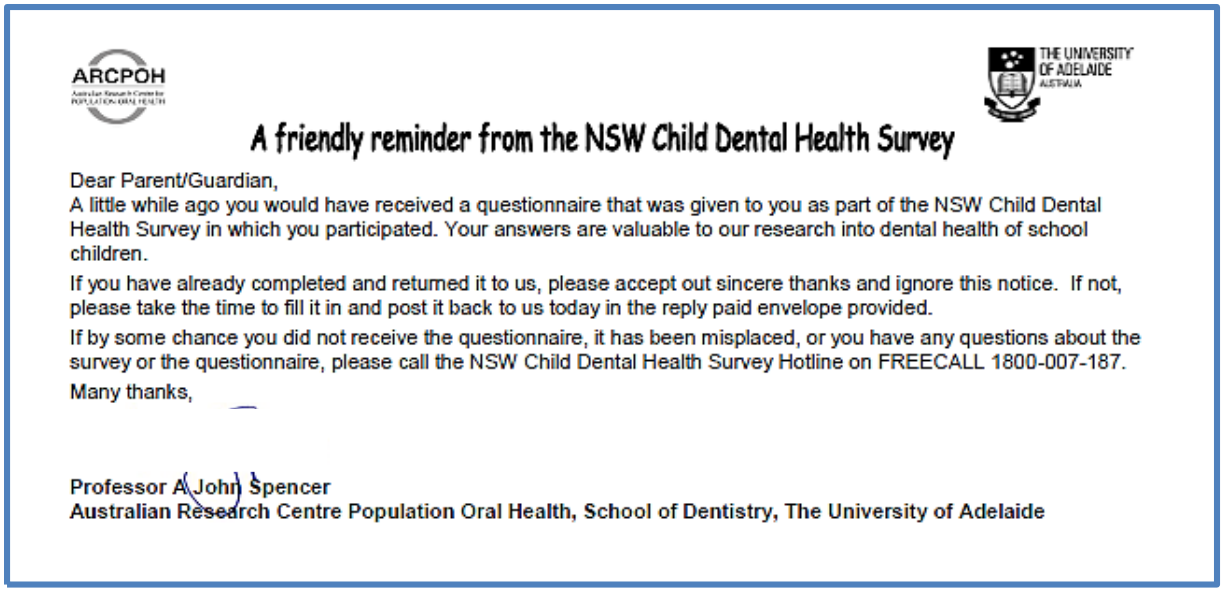
APPENDIX 3 REMINDER CARD AND FOLLOW-UP LETTERS

a. Reminder card

b. 2nd and 3rd Follow-up letters

Appendix 3a Reminder card



ARCPOH

THE UNIVERSITY OF ADELAIDE AUSTRALIA

A friendly reminder from the NSW Child Dental Health Survey

Dear Parent/Guardian,

A little while ago you would have received a questionnaire that was given to you as part of the NSW Child Dental Health Survey in which you participated. Your answers are valuable to our research into dental health of school children.

If you have already completed and returned it to us, please accept out sincere thanks and ignore this notice. If not, please take the time to fill it in and post it back to us today in the reply paid envelope provided.

If by some chance you did not receive the questionnaire, it has been misplaced, or you have any questions about the survey or the questionnaire, please call the NSW Child Dental Health Survey Hotline on FREECALL 1800-007-187.

Many thanks,

Professor A John Spencer
Australian Research Centre Population Oral Health, School of Dentistry, The University of Adelaide

Appendix 3b Follow-up letter two and three

ARCPOH
Australian Research Centre for Population Oral Health

THE UNIVERSITY OF ADELAIDE
AUSTRALIA

AUSTRALIAN RESEARCH CENTRE
FOR POPULATION ORAL HEALTH
SCHOOL OF DENTISTRY
FACULTY OF HEALTH SCIENCES

PROFESSOR A JOHN SPENCER

THE UNIVERSITY OF ADELAIDE SA 5005

TELEPHONE TOLLFREE 1800 007 187

Thank you for your participation in the NSW Child Dental Health Survey. Recently we sent you a reminder asking whether you would be kind enough to complete a questionnaire as part of the NSW Child Dental health Survey 2007. We are writing again in case you did not receive the previous letter or if by some chance you did not receive the questionnaire or it has been misplaced. If you have any questions about the survey or the questionnaire, please call the NSW Child Dental Health Survey Hotline on FREECALL 1800-007-187.

While the purpose of the survey is to provide an overview of the oral health of the child population in NSW, the purpose of the questionnaire is to understand why some people have better oral health than others. Hearing from everyone in the sample helps assure that the Survey results are as accurate as possible.

We also want to assure you that your response to this study is voluntary, and if you prefer not to respond, that is quite acceptable.

Finally, we appreciate your willingness to consider our request as we conclude this effort. Thank you very much.

Yours faithfully

A John Spencer

Professor of Social and Preventive Dentistry
The University of Adelaide

APPENDIX 4 EXAMINATION PROTOCOL AND EXAMINATION FORM

NSW CHILD DENTAL HEALTH SURVEY

2007

Appendix 1

Staff Training Manual

Prepared by: **Centre for Oral Health Strategy, NSW**
Issue Date:

NSWCDHS 2007
Draft Protocol: Appendix
V.6.2: AP; 20.03.07

CONTENTS

Aims of the NSW Child Dental Health Survey

The proposed 2007 NSW Child Dental Health Survey marks the beginning of a more systemic, systematic and cost effective approach to oral health data collections in NSW. Further, the development of the survey protocol foreshadows within it the ability to use recognised population health strategies, to investigate, report and monitor various groups within the NSW population as a whole.

The COHS in partnership with various agencies, particularly NSW Health, Area Health Services and the ARCPOH, aims to use these and any other future proposed data collections to better equip and inform Area Health Services and the community about risks to and improvements in the their oral health and contribute to the State and national 'picture' on Australia's health and oral health on an ongoing basis.

A focus for data to be collected for NSW in 2007 will be on children in the age ranges of 5-6 years and 11-12 years, in support of State and Area Health Services' planning, reporting and performance indicators.

In addition Child Dental Health Survey data for implementing public health practice may be used to assist in;

- The development of policies that seek to target children's dental services to those identified as most in need
- Developing risk-based patient management practices
- Selecting dental prevention strategies that have the maximum population benefit
- Workforce and other resource planning on a local, regional and State basis
- Advocating for the oral health benefits of implementation strategies for community water fluoridation
- Improving the capacity to analyse the impact of socio-economic variations in oral health
- Increasing the sensitivity in measuring and monitoring temporal changes in rates of caries experience
- Collecting data that potentially could inform discussions on National Health Priority Areas.

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Protocol

Following recognised protocol, the Director-General NSW Health Department briefed the Director-General, NSW Department of Education & Training, in order to gain support for the proposal that the Centre for Oral Health Strategy NSW, conduct a comprehensive dental health study in schools under the jurisdiction of their Department. Similar procedures were followed with the Catholic Education Commission and, following contact with the NSW Association of Independent Schools, the Principals of selected individual Independent Schools.

On gaining approval from the Director- General NSW Health and permission from the relevant educational bureaucracies, the Chief Executive Officer of each Area Health Service was contacted formally seeking their agreement to participate. The Senior Manager responsible for individual Area Dental Services was then contacted and their cooperation sought to proceed with the survey, in partnership with and under the direction of COHS.

Briefings were then held by the Project Manager and COHS staff with senior dental personnel appointed from each Area Health Service to coordinate local survey implementation. All necessary ethics and privacy considerations were appropriately addressed for each jurisdiction involved.

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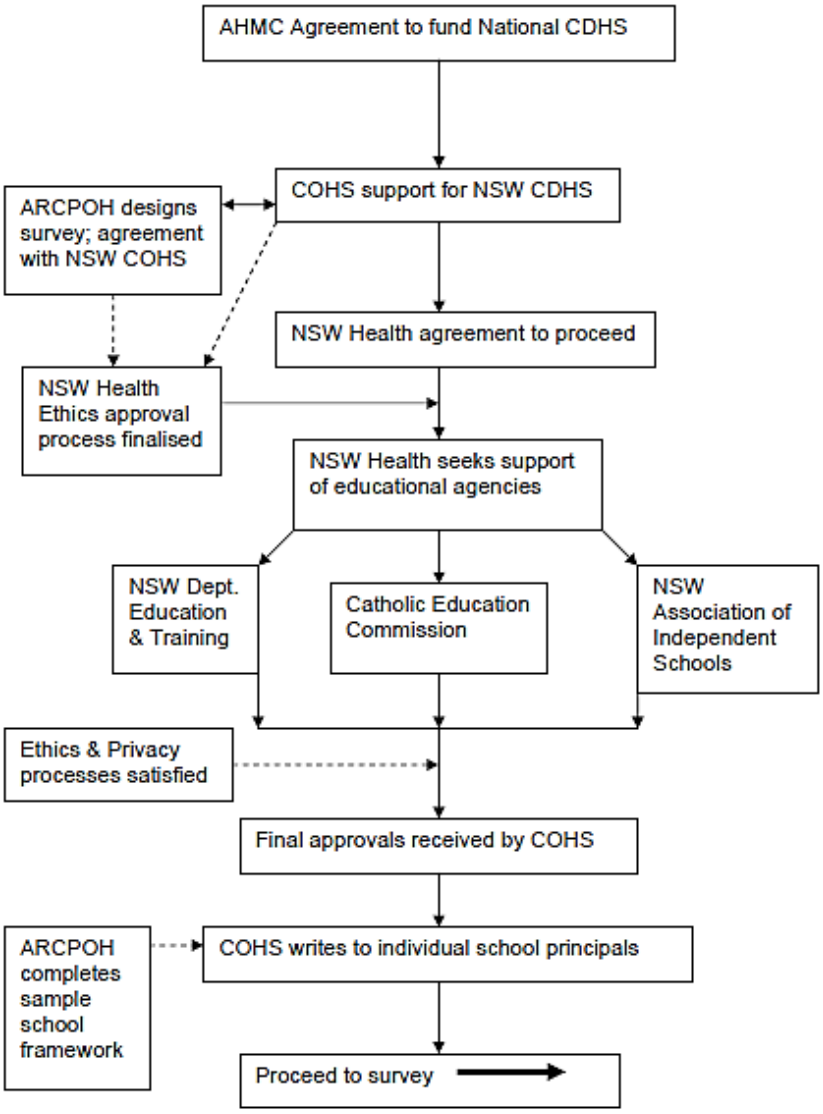
Survey Development Process



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Survey Teams

As well as this, it is anticipated that the senior Area Dental Manager will ensure that dental personnel will be enlisted as part of the proposed survey teams and that appropriate changes to work planning will occur to ensure timely completion of the survey, once commenced. Given the intended ongoing nature of the specific CDHS and a proposed series of regular surveys aimed at different community groups, it is essential that careful consideration be given to the selection of the survey teams; in particular the identification of an Area Survey Coordinator, who could reasonably be expected to assume responsibility for this and like surveys on an ongoing basis.

This proposed survey will require at least two (2) survey teams from each AHS; each Area Survey Team (AST) to consist of at least (1) *Clinical Examiner* (dental therapist), one (1) *Data Recorder* (dental assistant), one (1) and one (1) *Survey Assistant* (dental assistant). In addition, there should be one (1) designated *Area Survey Co-ordinator* for each Area, to handle all local project management and information handling needs. The costs of providing AST's, along with the opportunity costs of time away from clinical practice, will be borne by the Area Health Services.

Examiner Calibration

As it is intended to utilise multiple examiners for the survey it will be necessary to conduct examiner calibrations. A Senior Clinical Examiner will be appointed as part of the NSW state-wide survey team to lead examiner calibrations. The Senior State Examiner (SCE) will initially be calibrated by ARCPOH. Subsequent calibrations will be conducted at sites and a time yet to be determined. A Survey Examiner Calibration Protocol is attached as Appendix M.

Sample Population

Children of primary school age will be invited to participate in the survey. A sample of metropolitan and non-metropolitan schools under the jurisdiction of the NSW Department of Education & Training, The Catholic Schools' Commission and Independent Schools will be randomly selected from within every NSW Area Health Service. The majority of children are expected to be from the 5-11 year age cohorts with a small number of children 4 years and 12 years included in the sample.
It is anticipated that the Minimum sample size required will be approximately 8,000 children across 104 schools in New South Wales (see below for specific details).

Following finalisation of the sampling framework, ARCPOH has provided a list of target schools (see Appx. A). Area Health Services and individual schools were then invited to participate. While it is extremely unlikely that any Area Health Service will not participate, it is possible that individual schools within an Area may choose to decline the opportunity. The sampling methodology employed allows for this eventuality and has the capability to generate 'substitute' schools, in order to ensure the correct unbiased sample is attained.

In recognition of the relative autonomy of school principals in decision making about participation in such surveys and the need for local Area ownership, individual school principals will be contacted by the proposed Area Survey Coordinator.

This is to seek their individual agreement to participate in the dental survey, answer any queries and allay any possible concerns they or parents/guardians may have. Nevertheless, the right of individual schools to decline to participate is respected. In the unlikely event that a school decides not to participate, replacement schools, already identified, will be contacted.

Overview of Survey Work; Processes & Procedures

Principals will be asked to provide current class lists for those primary school children attending their schools. In addition principals will be requested to distribute relevant information to all parents/guardians, via their children. Children invited to participate in the survey will be given an enrolment package to take home for completion by their parent/guardian. The enrolment package includes; a letter to the parent/guardian; an information sheet for parents/guardians; a parent / guardian Consent Form including some socio-demographic questions; a reply envelope marked "*Confidential, Child Dental Health Survey*" and a designated return date. A member of the AST will then be asked to personally follow up these requests one (1) week later and distribute reminder notices for parents to school in one (1) further week. School principals will also be asked to collect (by class) all returned consent forms for collection by AST's.

No child will be examined without evidence of written consent of a parent / guardian. In the event that a child has consented to an examination but is absent on the day of the survey, a return date to provide a second opportunity for the examination to take place may be negotiated, if the sample size has not been reached.

In the event that school numbers fall below those to achieve the required CDHS sample numbers, but the school has agreed to participate and children have enrolled, all children will still receive a SAP or CDHS survey. Additional school/s may then need to be selected and added to the total number of schools to be included in the survey to ensure that the CDHS sample numbers are reached. A back up list fo schools has been selected by ARCPOH to ensure continued validity in the school selection process. Replacement schools will be allocated by COHS as required.

Given the high number of children from diverse ethnic backgrounds resident in NSW and in recognition of the potential for variations in the level of English Language Proficiency (ELP), of some parents / guardians and the use of a language other than English as the primary language in the home setting, brief information will be translated into selected other languages. This information will be placed on the reverse side of the Parent / Guardian Consent Form (see App.G). The selected languages are;

- Vietnamese
- Chinese (Mandarin)
- Khmer
- Lao
- Korean
- Arabic

In the event that a parent requiring language assistance contacts a dental clinic, then AHS policy regarding interpreter services will apply.

Parent / Guardian Tasks

Parents / guardians receive the enrolment package directly from the school clinic via their child. Parents / guardians who choose to allow their child / children to participate in the study complete Consent Form/s for each individual child and return it to school via their child/children by the due date.

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Area Survey Teams (AST's) Tasks

The *Area Survey Co-ordinators* are responsible for ensuring all data quality including an auditing process, from distribution to collection, collation of forms and information contained therein, as well as providing a single point of contact with the Project Manager and COHS staff. Hence prior to the survey they;

- Receive and forward the Enrolment Packages to schools
- Collect and collate completed consent forms from the schools, for those children whose parents / guardians consented for them to participate
- Identify non-participating children and ensure Reminder Letters are forwarded to the parents / guardians
- Compile final enrolment numbers and reconcile class lists
- Collate a single list of all students in each individual school, for each age group (age of student being that on 1 June 2007)
- Complete initial process of allocating students for CDHS exam or SAP exam (see *Student Selection Process for SAP or CDHS Examination* process below)
- Make all necessary arrangements for/coordinates survey teams

Following the SAP / CDHS exam they;

- Ensure Feedback Form is completed for each child following SAP or CDHS exam and is handed to child
- Reconcile class lists with completed SAP and CDHS OMR forms for each individual class and school and ensure Feedback data recorded on class list for each child
- Reconcile school lists, collate OMR forms and forward to COHS

The *Data Recorder* completes the clinical assessment form. Responsibilities include ensuring;

- All relevant consent and socioeconomic data are completed on each form
- Area Examiner, school, child ID, current exam, child sex, DOB, postcode, Country of Mothers Birth, Centrelink Concession Card Status and Aboriginal & Torres Strait Islander Status data have been transcribed from the consent forms onto the OMR survey form
- Completion of all clinical data recording as directed by the *Clinical Examiner*

The *Survey Assistant* is responsible for the coordination of all tasks associated with the effective management of the survey in the school environment and assisting the Data Recorder and Clinical Examiner on a needs basis including;

- Patient flow
- Infection control
- Information management

The *Clinical Examiner*;

- Clinically examines or SAP's those children agreeing to participate in the survey as per the child selection criteria for SAP or full CDHS exam (see below)
- Note: SAP's to determine treatment need as per AHS SAP policy

The CDHS / SAP selection and workflow processes are outlined below.

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Project Timeframe

Milestone	Timeframe	Status
Full Project brief completed and signed off	Sept. 06	Complete
Sign off on 'in-principle' approval to proceed from DOH & AHS	Oct. 06	Complete
Sign off on 'in-principle' approval to proceed from Dept. of Education and Catholic Education Commission	Oct 06	Complete
Survey Protocol developed and approved	End Feb. 07	Final drafting
Complete MOU with ARCPOH and key stakeholders	End March 07	Draft in progress
All ethics approvals obtained	End March 07	In progress
Contracted Senior Clinical Examiner	End March 07	In principle agreement reached
Selected school's agreement to participate	End April 07	Pending
Survey forms and training resources developed	End April 07	Under development
AHS briefings completed	Mid May 07	Pending
AST and examiner calibration completed	Mid May 07	Pending
Sample children contacted and consent obtained	July 07	Pending
Survey conducted	Commence mid July 07	Pending
Data collated and analysed	TBA	TBA
Report writing and publication	TBA	TBA

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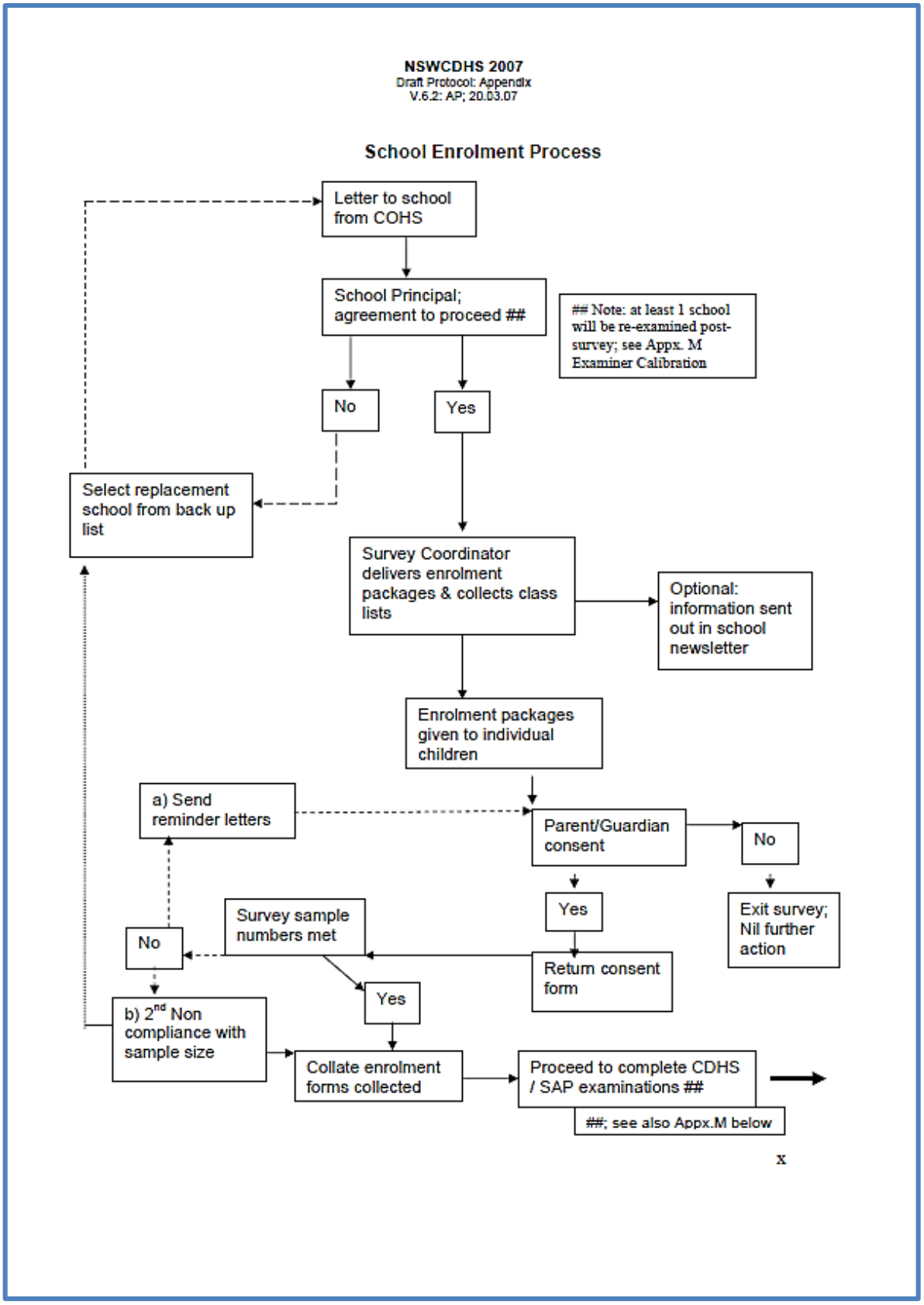
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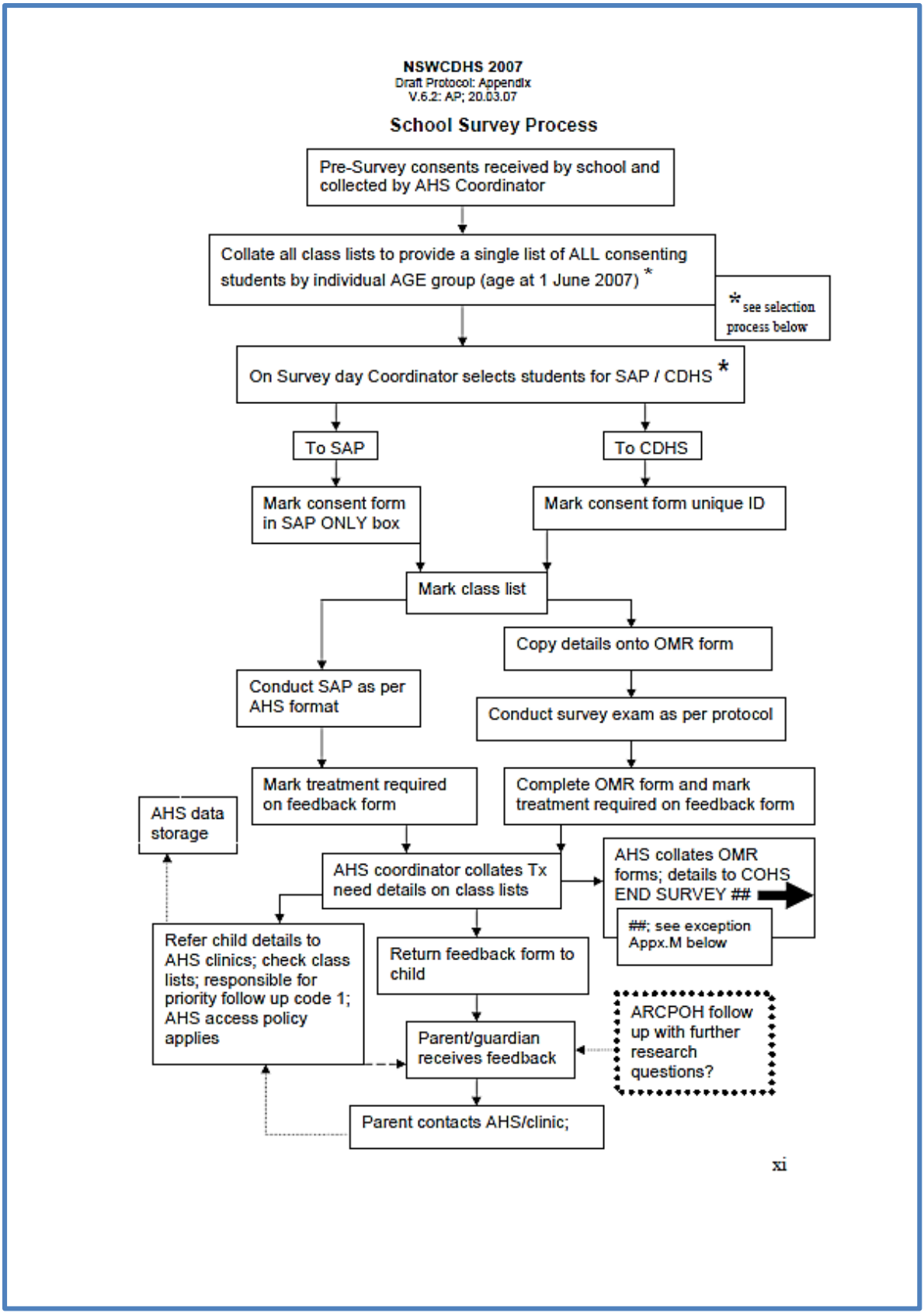
School Enrolment Process
Letter to school from COHS
School Principal; agreement to proceed ##
Note: at least 1 school will be re-examined post-survey; see Appx. M Examiner Calibration
No
Yes
Select replacement school from back up list
Survey Coordinator delivers enrolment packages & collects class lists
Optional: information sent out in school newsletter
Enrolment packages given to individual children
a) Send reminder letters
Parent/Guardian consent
No
Yes
Exit survey; Nil further action
Survey sample numbers met
No
Return consent form
Yes
b) 2nd Non compliance with sample size
Collate enrolment forms collected
Proceed to complete CDHS / SAP examinations ##
##; see also Appx.M below
x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School Survey Process
Pre-Survey consents received by school and collected by AHS Coordinator
Collate all class lists to provide a single list of ALL consenting students by individual AGE group (age at 1 June 2007) *
* see selection process below
On Survey day Coordinator selects students for SAP / CDHS *
To SAP
To CDHS
Mark consent form in SAP ONLY box
Mark consent form unique ID
Mark class list
Copy details onto OMR form
Conduct SAP as per AHS format
Conduct survey exam as per protocol
Mark treatment required on feedback form
Complete OMR form and mark treatment required on feedback form
AHS data storage
AHS coordinator collates Tx need details on class lists
AHS collates OMR forms; details to COHS END SURVEY ##
##; see exception Appx.M below
Refer child details to AHS clinics; check class lists; responsible for priority follow up code 1; AHS access policy applies
Return feedback form to child
ARCPOH follow up with further research questions?
Parent/guardian receives feedback
Parent contacts AHS/clinic;
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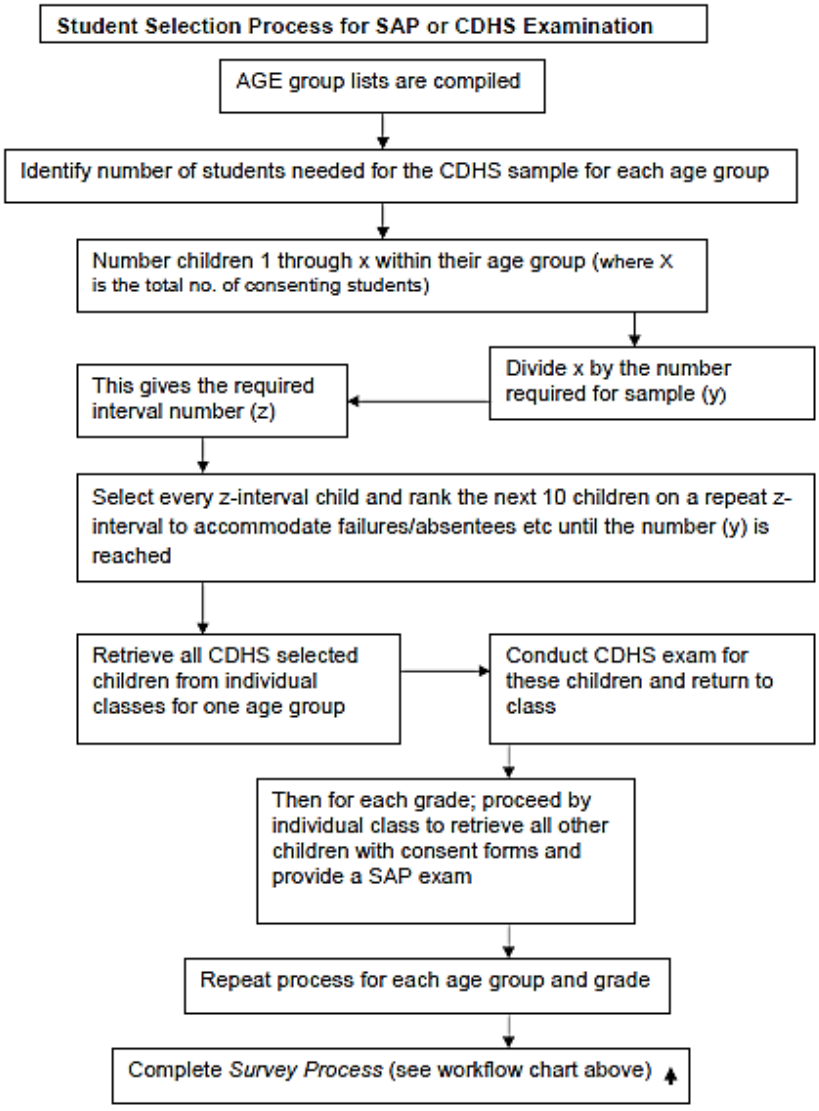

Example ONLY:
If *sample number* for CDHS exam is for example 8 children aged 9 years; Select 8 *(y) children* from the *total children (x)* consented in age group e.g. say total is 93 children.
Therefore *Interval number (z)* is x/y = 93/8 = 11
Selected children will therefore be the: 11th; 22nd; 33rd; 44th; 55th; 66th; 77th; 88th
Additional selections would be 99th or in repeat cycle i.e. 99-93 = 6th; 7th; 28th etc.

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COHS Role

A designated COHS member / project manager will be appointed to liaise with AHS's and ARCPOH to ensure coordination and successful completion of the Survey within the given timeframe and according to protocol.

ARCPOH Role

ARCPOH as a valued partner of COHS, NSW Health will assist in the development of the NSW component of the national CDHS and ensure the validity of the survey protocol. ARCPOH will have printed the necessary OMR forms and deliver these to COHS. ARCPOH will then receive completed survey data from COHS for analysis and reporting, in consultation with and following approval from COHS.

Survey Resources

All AHS's will be provided with a supply of:

- Enrolment Packages (see below for details)
- A4 envelopes (part of the enrolment package),
- Reminder Letters
- OMR Data Collection Forms
- School Reconciliation Forms to collate data
- Feedback Forms

AHS'S are expected to provide all resources not included in the Survey necessary to conduct the SAP process in accordance with local AHS policy.

Enrolment Package

Children will be given an Enrolment Package containing;
- An introductory letter
- A Consent Form to be taken home for completion by their parents / guardians
- A FAQ Information Sheet
- A Reply Envelope
- Oral Health Information Brochure

This information will be enclosed in an A4 envelope.

Following commencement of the enrolment process, a child may return stating they have lost their Enrolment Package. A replacement package may be given out.

Covering Letter from COHS

The letter provides an introduction to the survey and encourages parents / guardians to participate. The letter is enclosed because it is important that participants be assured that the study is being conducted and supervised by those locally responsible for the provision of service and that the significance of the study is sufficient to warrant active participation. The letter also clearly identifies that the child may receive a SAP examination only or a CDHS exam AND that an indication of any immediate treatment need will be provided for each child as guaranteed feedback.

Parent / Guardian Consent

The parent / guardian consent ensures that the vital written consent process is adhered to as well as containing a few brief questions that will allow the researchers to assess the impact of some socio-demographic information on the dental health of children. Parents / guardians will positively self select into the survey by completion of the Consent Form, together with evidence of their signature on the form. Completed Consent Forms will be returned directly to the school in the envelope provided by the due date. Parents / guardians have to right to decline to participate and this right is to be respected.

Reminder Letter

Notwithstanding the right of parents / guardians to decline to participate, should the Area Survey Coordinator be concerned about the numbers of Consent Forms being returned for a particular school, or more generally; reminder letters together with a second consent form, can be provided in to boost the number of children enrolled.

Reply Envelope

Parents / guardians are requested to forward the completed Consent Form directly to the school, via their child, in the reply envelope provided in the Enrolment Package.

Survey / SAP Examination Equipment

The use of portable dental chairs and the provision of adequate lighting will be ensured. The costs of providing these and other resources, including consumables and dental instrumentation, will be met by the Area Health Services or the COHS by negotiation.

Consent & Socio-demographic Data Collection

Consent and student ID

No child will be examined without evidence of written consent of a parent / guardian.

A unique identifying number must be transcribed from the Consent Form into the specified fields on the data collection form.
When a child presents for examination, do the following:

- Check child's name
- Confirm parent / guardian signature on consent form
- Verify information is complete for child's sex, DOB, postcode, Country of Mother's Birth, Centrelink Concession Card Status and Indigenous Status
- Select child for CDHS/ SAP Area Examiner, school, child ID, current exam
    - If child selected for SAP, tick SAP ONLY box on Consent Form
    - If CDHS exam selected then assign a unique child ID to consent form and data collection form
- Ensure examiner ID; date of current exam school ID and child's socio-demographic data as listed below are transcribed onto the OMR form

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Socio-demographic Data

Wherever possible, data collections conform to NSW Health policy regarding the use of definitions and criteria used in the National Data Dictionary and or those data already existing in, or that are compatible with, the ISOH database and the National Child Dental Health Survey data collections.

Sex

Definition: Sex is the biological distinction between male and female. Where there is an inconsistency between anatomical and chromosomal characteristics, sex is based on anatomical characteristics.

Collection methods: Operationally, sex is the distinction between male and female, as reported by a person or as determined by an interviewer.

It is usually a simple matter to infer the sex of the respondent through observation.

Date of Birth

Definition: The date of birth of the person.

Collection methods: Gained through the consent process as a self-reported data collection using (DDMMYYYY).

Indigenous Status

Definition: Indigenous Status is a measure of whether a person identifies as being of Aboriginal or Torres Strait Islander origin.

Collection methods: Gained through the consent process as a self-reported data collection using a standard question for Indigenous Status as follows:
[Are you] [Is the person] [Is (name)] of Aboriginal and / or Torres Strait Islander origin? Mark appropriate box.

- Aboriginal but not Torres Strait Islander origin
- Torres Strait Islander but not Aboriginal origin
- Aboriginal and Torres Strait Islander origin
- Not Aboriginal or Torres Strait Islander origin
- Not Known

Country of Mother's Birth

Definition: The country in which the person's mother was born.
Collection methods: Gained through the consent process as a self-reported data collection. A pre-determined set of countries is specified as part of the question and accompanied by an 'other (please specify)' category.
Q: In which country were you / was the person born?

Australia	China	Italy
Vietnam	United Kingdom	New Zealand
Greece	Germany	Philippines
Netherlands	USA	India
South Africa	Lebanon	Hong Kong
Other (please specify)		

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Child's Residential Postcode

Definition: The numeric descriptor for a postal delivery area, aligned with locality, suburb or place in which the child usually resides.
Collection methods: Gained through the consent process as a self reported data collection; collected separately as a 4 digit response.

Centrelink Concession Card Status

Definition: Parent / Guardian in receipt of at least one of the following Centrelink Concession Cards;

- Health Care Card
- Pension Concession Card
- Commonwealth Seniors Health Card

Collection methods: Gained through the consent process as a self reported data collection. Mark appropriate Box.

Recording Clinical Data

General

- Ensure unique patient ID number is attached to form
- Verify that socio-demographic information is completed
- Proceed to clinical CDHS exam / SAP exam
- On completion of CDHS exam / SAP exam ensure that the status of the child's current treatment needs is recorded and a feedback form given to the child for delivery to their parent/guardian.

Summary of Clinical Codes

- Decayed, Missing and Filled (DMF/dmf) Index
- For the purpose of the NSW Child Dental Health Study, DMF/dmf of tooth surfaces will be recorded
- Molars and premolars are considered as having 5 surfaces and while canine and incisors have 4 surfaces. There are as many as 128 permanent tooth surfaces and 88 deciduous tooth surfaces depending on the number of teeth present. However it is not necessary to record information for each tooth surface.
- The DMFS /dmfs data form records information only for the following conditions:

General

- **U** Permanent/ deciduous teeth that are unerupted
- **M** Missing due to caries
- **O** Missing for reasons other than caries

Coronal Caries Experience

- For every erupted tooth surface;
- **D** Decay: cavitation on previously unaffected tooth surfaces
- **Fc** Filling with caries: visible caries that is contiguous with a restoration
- **P** Pre-cavitated carious decalcification of enamel
- **Fu** Filled unsatisfactorily: a filling placed for any reason in a surface that requires replacement but that has none of the above conditions
- **F** Filling satisfactorily placed to treat decay in a surface that has none of the above conditions
- **FS** Fissure sealant and none of the above conditions
- **S** **Sound** is recorded when none of the above conditions are found.

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D: Decay

Lesions are coded as decayed when cavitation of enamel or dentinal involvement or both are present. Lesions with dentinal involvement are coded D even if the lesion has hardened and appears to have "arrested". Cavitation is defined as a discontinuity of the enamel surface caused by the loss of tooth substance, due to caries. It must be distinguished from factures, erosion and abrasion. Lesions not showing frank cavitation may still be coded as decayed under the following circumstances:

a) Pits and fissures: The surface is coded as decayed when opacity or discolouration indicate caries of dentine that is undermining adjacent enamel.

b) Smooth surfaces on buccal and lingual surfaces: The area is coded as decayed if the surface is etched or there is a white spot and if dentine seems to be involved as indicated by discolouration of dentine.

c) Proximal Surfaces: As in b), Also:

- If marginal ridge shows darkening / shadowing as evidence of caries of dentine, the surface is carious.
- Transillumination (for anterior teeth): caries in dentine may be visualised as a loss of translucency producing a shadow in a calculus free and stain-free proximal surface.

NOTE: Staining and pigmentation are not by themselves evidence of caries. Erosion, abrasion, hypoplasia, attrition, fractures, mottled enamel and enamel opacities on exposed hard surfaces are not classified as carious.

Fc: Filling with recurrent caries.

When a filled surface has caries adjacent to a filling, the surface is coded Fc. The filling may have been placed for caries or for other reasons

P: Pre-cavitated carious decalcification of enamel

P means pre-cavitated decalcification of enamel, representing the early stages of caries disease activity. Demineralised lesions are detected by drying the cleaned surfaces with air from a triplex syringe for up to 30 seconds and examining the surfaces with the aid of good lighting. Procedure for diagnosis:
Clean teeth with gauze or explorer, or both;
Isolate teeth **one quadrant** at a time with cotton rolls;
Dry quadrant for 30 seconds;
Use good lighting.

The diagnosis of **pre-cavitated decalcification** (P) is made if:

- On a smooth tooth surface, all of the following are observed:
    1. No change of surface contour is visible, AND
    2. A chalky white / brown discoloration of **at least** 1mm width is visible AND
    3. Location is in a caries-susceptible area, eg. gingival margin, AND
    4. There is no evidence of dentinal caries
- In pits and fissures demineralisation/chalky white appearance limited to enamel is evident on the sides of the pits and fissures.
- Stained pits and fissures in the absence of the other four criteria (above) should not be coded as P.
- The explorer should be used to clean plaque and debris as an aid to visual diagnosis. The explorer should not be used to make a diagnosis based on the "feel" of the lesion or whether the explorer "catches" in a pit / fissure.

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Fu: Filling placed due to caries that is unsatisfactory for reasons other than caries.

If a restoration meets the criteria for "F", but has a fracture or some other defect without caries, the restoration is coded Fu.

F: Filling

The surface is coded F when it has a permanent restoration that, in the examiner's best judgement, was placed because of caries. This excludes fillings placed for reasons other than caries, such as restorations to repair trauma or aesthetic restoration of non-carious lesions.

On a crowned anterior tooth, the examiner should make a determination of the reason for crown placement. If crown was placed for any reason other than caries, such as fracture, malformation or aesthetics, the tooth is coded as sound. Otherwise all surfaces are coded as filled.

FS: Fissure Sealant

The surface is coded FS when; any part of the surface has a detectable pit/fissure sealant and when there is no evidence of pre-cavitated lesions, decay or fillings.

General Rules for Recording Clinical Data

1) When a filling or a lesion on a posterior tooth or a caries lesion on an anterior tooth extends beyond the line angle onto another surface, then the other surface is also scored as affected. However, a proximal filling on an anterior tooth is not considered to involve the adjacent labial or lingual surface unless it extends at least one third of the distance towards the opposite proximal surface.
2) On anterior teeth, the examiner should make a determination of the reason for crown placement.
3) Teeth that are banded or bracketed for orthodontic treatment are examined in the usual manner and all visible surfaces are scored.
4) Certain teeth, notably first bicuspids, may have been extracted as part of orthodontic treatment. The examiner must make the determination that the teeth were extracted for orthodontic reasons rather than caries.
5) In general, when the same tooth surface is both carious and filled, only the caries is called. Note that only one call may be made for a given surface. If two or more conditions exist on the same surface, then caries receives precedence over a restoration.
6) Fractured or missing restorations are scored as if the restoration were intact. If caries is found within or adjacent to the margins of a fractured or missing restoration, DECAY should be recorded.
7) In case of supernumerary teeth, only one tooth is called or the tooth space. The examiner must decide which tooth is the 'legitimate' occupant of the space.
8) A tooth is considered to be in eruption when any part of its crown projects through the gum.
9) When two or more conditions occur on one surface, code the more severe condition; ("<" means less severe) FS < P < F < Fu < Fc < D
10) When in doubt, code the less severe condition.
    Eg. if uncertain about P versus D, code as P.

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Fluorosis

Measured on buccal surface of maxillary central incisors;

X Tooth excluded
9 Non-fluorotic lesions
0 No discoloration
1 Thin white lines across the surface
2 Lines merged to form small cloudy areas
3 Cloudy areas are frequent, but the lines can still be seen
4 Whole surface is opaque
5 Whole surface is opaque plus loss of enamel of any size

Given the potential complexity surrounding the differential diagnosis of 'white spot' and other tooth discolorations, further details including photographic examples to be used in fluorosis coding, are to be found in the Examiner Calibration Protocol.

Trauma

Single, person-level code based on worst condition observed among 12 anterior Teeth in upper and lower jaws. Visual assessment may require verification by Interview and marked on the OMR;

0: No trauma

1: Treated trauma, any size or involvement (usually with composite)

2: Trauma limited to the enamel and not treated

3: Any of the following;

- Trauma involving at least dentine (treatment required, but not yet treated)
- Tooth discoloration after trauma (verified by interview)
- Avulsed, luxated tooth because of trauma (verified by interview).

Immediate Treatment Need

Mark Yes or No for an individual;

The following guidelines to determine **Immediate Treatment Need** will be used;

- Children who require dental treatment for existing pain
- Children with abscessed teeth (deciduous or permanent)
- Children with grossly decayed teeth (deciduous or permanent) with obvious pulp exposure
- Children with avulsed teeth or fractured teeth requiring immediate treatment of pain or infection
- Cases of Acute Necrotizing Ulcerative Gingivitis
- A life threatening condition (such as oral cancer) or other severe condition with oral manifestations.

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Cases which **do not** require immediate dental treatment;

- Children requiring routine fillings (including pulpotomies) or extractions in teeth that are not currently showing signs of pain or periapical infection and that are unlikely to cause pain or periapical infection within the next four weeks
- Children with fractured teeth which are not currently causing pain or infection and are unlikely to do so within four weeks.

Note: While the OMR Form will be marked as a Y / N response, for the purposes of the Child Feedback Form three possible responses are to be considered, to enure compliance with usual SAP protocol and uniform response to parents / guardians.

- Requires urgent dental care = **Y to Immediate Treatment Need**
- Requires further assessment and may require dental treatment = **N to Immediate Treatment Need**
- Appears to have no dental problems at present = **N to Immediate Treatment Need**

Number of Teeth Present:

A count of the number of erupted teeth in the deciduous dentition and or in the permanent dentition and generated from the OMR; Please ensure all tooth recording boxes are completed.

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APPENDICES

Appendix A: Selected Survey Sites

REGION=Greater Southern AHS

Seln	Name	type	suburb	postcode	School Code	Primary Enrol
1	All Saints Primary	Cathol	TUMBARUMBA	2653	2744	76
2	Batemans Bay Public School	Public	SURFSIDE	2536	0120	485
3	Young North Public School	Public	YOUNG	2594	2228	263
4	Adelong Public School	Public	ADELONG	2729	0006	83
5	St Joseph's Primary	Cathol	LEETON	2705	2532	466
6	Griffith Public School	Public	GRIFFITH	2680	0878	381
7	Goulburn North Public School	Public	GOULBURN NORTH	2580	0845	277
8	Cooma North Public School	Public	COOMA NORTH	2630	0519	344
9	Coleambally Central	Commun	COLEAMBALLY	2707	0482	124
10	The Scots School Albury	Indep	ALBURY	2640	3155	186
11	Queanbeyan South Public School	Public	QUEANBEYAN	2620	1658	588
	TOTAL					3,273

REGION=Greater Western AHS

Seln	Name	type	suburb	postcode	School Code	Primary Enrol
1	Lake Cargelligo Central	Commun	LAKE CARGELLIGO	2672	1145	150
2	Gilgandra Public School	Public	GILGANDRA	2827	0790	258
3	Condobolin Public School	Public	CONDOBOLIN	2877	0507	328
4	Oberon Public School	Public	OBERON	2787	1539	283
5	Mudgee Public School	Public	MUDGEE	2850	1407	511
6	Dubbo Christian School	Indep	DUBBO	2830	2898	297
7	St Pius X Primary	Cathol	DUBBO WEST	2830	2391	208
8	Orange East Public School	Public	ORANGE	2800	1548	239
9	Raglan Public School	Public	RAGLAN	2795	1662	189
	TOTAL					2,463

REGION=Hunter New England AHS

Seln	Name	type	suburb	postcode	School Code	Primary Enrol
1	Manilla Central	Commun	MANILLA	2346	1257	206
2	Tea Gardens Public School	Public	TEA GARDENS	2324	1893	211
3	Forster Public School	Public	FORSTER	2428	0757	716
4	Beresfield Public School	Public	BERESFIELD	2322	0167	367
5	St Patrick's Primary	Cathol	SWANSEA	2281	2725	166
6	Bolwarra Public School	Public	BOLWARRA	2320	0245	299
7	St Francis Xavier's Primary	Cathol	NARRABRI	2390	2611	298
8	Scone Grammar School	Indep	SCONE	2337	3062	155
9	Elermore Vale Public School	Public	WALLSEND	2287	0675	355
10	St John's Primary	Cathol	LAMBTON	2299	2525	207
11	Charlestown Sth Public School	Public	CHARLESTOWN	2290	0439	168
12	Armidale City Public School	Public	ARMIDALE	2350	0040	398
13	New Lambton Public School	Public	NEW LAMBTON	2305	1473	574
	TOTAL					4,120

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REGION=North Coast AHS

SeIn	Name	type	suburb	postcode	School Code	Primary Enrol
1	North Haven Public School	Public	NORTH HAVEN	2443	1498	426
2	St Mary's Primary	Cathol	CASINO	2470	2338	467
3	Bonville Public School	Public	BONVILLE	2441	0260	127
4	South Grafton Public School	Public	SOUTH GRAFTON	2460	1794	625
5	Corindi Public School	Public	CORINDI BEACH	2456	0536	135
6	St James Primary	Cathol	YAMBA	2464	2809	178
7	Bishop Druitt College	Indep	COFFS HARBOUR	2450	2851	388
8	Bellingen Public School	Public	BELLINGEN	2454	0151	278
9	Summerland Christian College	Indep	LISMORE HEIGHTS	2480	3120	152
10	Port Macquarie	Public	PORT MACQUARIE	2444	1634	585
11	St Joseph's Primary School	Cathol	ALSTONVILLE	2477	2242	281
	TOTAL					3,642

REGION=North Sydney Central Coast AHS

SeIn	Name	type	suburb	postcode	School Code	Primary Enrol
1	St Mary's Primary	Cathol	NORAVILLE	2263	2617	368
2	Kanwal Public School	Public	KANWAL	2259	1053	827
3	Ettalong Public School	Public	ETTALONG BEACH	2257	0708	685
4	Our Lady of the Rosary Primary	Cathol	WYOMING	2250	2806	329
5	Curl Curl North Public School	Public	NORTH CURL CURL	2099	0583	520
6	St Charles' Primary	Cathol	RYDE	2112	2687	415
7	Mona Vale Public School	Public	MONA VALE	2103	1354	814
8	Boronia Park Public School	Public	GLADESVILLE	2111	0268	391
9	Killarney Heights Public School	Public	KILLARNEY HEIGHTS	2087	1091	440
10	Belrose Public School	Public	BELROSE	2085	0159	465
11	Epping Public School	Public	EPPING	2121	0697	362
12	Tangara School For Girls	Indep	CHERRYBROOK	2126	3131	363
13	Arden Anglican School	Indep	BEECROFT	2119	2829	371
14	Castle Cove Public School	Public	CASTLE COVE	2069	0418	339
15	Mosman Church of England Prep Sch	Indep	SPIT JUNCTION	2088	2954	317
	TOTAL					7,006

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REGION=South East Sydney Illawarra AHS

Seln	Name	type	suburb	postcode	School Code	Primary Enrol
1	Windang Public School	Public	WINDANG	2528	2140	197
2	St Michael's Primary	Cathol	NOWRA	2541	2626	589
3	Mount Terry Public School	Public	ALBION PARK	2527	1401	650
4	Shoalhaven Heads Public School	Public	SHOALHAVEN HEADS	2535	1776	210
5	St Joseph's Primary	Cathol	RIVERWOOD	2210	2675	393
6	Bexley Public School	Public	BEXLEY	2207	0189	425
7	Carlton South Public School	Public	CARLTON	2218	0406	521
8	The Illawarra Grammar School	Indep	FIGTREE	2525	3147	385
9	Gymea Bay Public School	Public	GYMEA BAY	2227	0902	777
10	Scarborough Public School	Public	SCARBOROUGH	2515	1756	73
11	Oyster Bay Public School	Public	OYSTER BAY	2225	1561	375
12	Claremont College	Indep	RANDWICK	2031	2884	360
13	Vaucluse Public School	Public	VAUCLUSE	2030	2020	275
	TOTAL					5,230

REGION=Sydney South West AHS

Seln	Name	type	suburb	postcode	School Code	Primary Enrol
1	Lansvale Public School	Public	CANLEY VALE	2166	1163	565
2	Ashcroft Public School	Public	ASHCROFT	2168	0049	289
3	Bonnyrigg Heights Public School	Public	BONNYRIGG HEIGHTS	2177	0256	704
4	Greenacre Baptist Christian Community	Indep	GREENACRE	2190	2916	194
5	Condell Park Public School	Public	BANKSTOWN	2200	0505	431
6	Exeter Public School	Public	EXETER	2579	0720	95
7	St Catherine of Siena Primary	Cathol	PRESTONS	2170	2658	532
8	Our Lady Help Of Christians	Cathol	ROSEMEADOW	2560	2681	383
9	St Johns Park Public School	Public	ST JOHNS PARK	2176	1821	819
10	Ingleburn North Public School	Public	INGLEBURN	2565	0999	121
11	Earlwood Public School	Public	EARLWOOD	2206	0653	591
12	St Paul's Anglican Choir School	Indep	GEORGES HALL	2198	3103	342
13	Narellan Vale Public School	Public	NARELLAN VALE	2567	1448	839
14	Bowral Public School	Public	BOWRAL	2576	0260	548
15	St Ambrose' Primary	Cathol	CONCORD WEST	2138	2358	367
16	St Pius' Primary	Cathol	ENMORE	2042	2415	138
	TOTAL					6,958

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REGION=Sydney West AHS

SeIn	Name	type	suburb	postcode	School Code	Primary Enrol
1	Lethbridge Park Public School	Public	LETHBRIDGE PARK	2770	1182	407
2	St Marys North Public School	Public	ST MARYS	2760	1822	368
3	Old Guildford Public School	Public	GUILDFORD	2161	1544	234
4	Berala Public School	Public	BERALA	2141	0166	1031
5	St Aidan's Primary	Cathol	ROOTY HILL	2766	2677	432
6	Tyndale Christian School	Indep	BLACKTOWN DC	2148	3169	438
7	St Joseph's Primary School	Cathol	SCHOFIELDS	2762	2691	389
8	Penrith South Public School	Public	PENRITH	2750	1606	404
9	Holy Spirit Primary	Cathol	ST CLAIR	2759	2712	525
10	Girraween Public School	Public	GIRRAWEEN	2145	0796	458
11	Blackheath Public School	Public	BLACKHEATH	2785	0214	291
12	Quakers Hill Public School	Public	QUAKERS HILL	2763	1652	637
13	Springwood Public School	Public	SPRINGWOOD	2777	1807	378
14	Carlingford West Public School	Public	CARLINGFORD	2118	0404	709
15	Winston Hills Public School	Public	WINSTON HILLS	2153	2154	514
16	Castle Hill Adventist School	Indep	CASTLE HILL	2154	2872	163
	TOTAL					7,378

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Appendix B: Letter to School Principals

Name and address of school here

Date:

Dear Sir / Madam,

Re: National Child Dental Health Survey, 2007

On behalf of NSW Department of Health I am writing to inform you about NSW Health participation in the National Child Dental Health Survey which will commence in June 2007 in NSW. The survey has been approved by and has ethics approval from your educational authority, NSW Health and the Australian Research Centre for Population Oral Health (ARCPOH). Data will be collected on children in the age range of 5-12 years for the purpose of providing reliable regional statistics, as well as contributing to national population based information about the oral health of children.

Your school has been randomly selected by the ARCPOH to participate in this survey in 2007. Please take a few minutes to read the material provided in the attached package which is intended for parents of children at your school. Children who consent to a dental check-up will receive either:

- The complete National oral health examination or..
- The normal NSW health oral health assessment.

The survey examinations / assessments will be carried out by a team of registered Dental Therapist(s) and Dental Assistant(s). No treatment will be carried out on this day. No matter which type of dental check-up they have at school, all of the children will receive a letter to take home afterwards. This letter will provide advice to parents about their child's oral health and where they may take them for dental treatment.
The survey relies on the cooperation of participating schools in the following ways:

- To distribute a survey *Enrolment Package* to each child at the school and advertise support for the survey in the school newsletter;
- To collect the signed consent forms and keep them in a safe place for collection by the survey team; and
- To provide a suitable space and one or two desks and chairs for the survey team. This can be negotiated with the survey team when they contact you. All other equipment will be provided by the survey team.

This is an important survey and we are aware of the need to minimise disruption to your school and to normal teaching activities. If you have any questions about the survey please do not hesitate to contact Claire Phelan, State Coordinator for the Child Dental Survey, on Ph 02 8821 4313. We look forward to working with you on this survey, and acknowledge that before it can proceed your agreement (either verbal or in writing) will be required. Thank you for your cooperation.

Yours Sincerely,

Dr Clive Wright
Chief Dental Officer, NSW

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Appendix C: Letter to Parents / Guardians

Dear Parent/Guardian,

Child Dental Health Survey NSW, 2007

The National Child Dental Health Survey is now underway in NSW. Approval to conduct this survey has been granted by NSW Health and is supported by your school principal. The survey will be conducted by members of your local Area Health Service dental team and has ethics approval from the Australian Research Centre for Population Oral Health (ARCPOH), NSW Health and educational authorities.

Your child's school has been randomly chosen by the ARCPOH to take part in this survey and we wish to offer your child the chance to be part of it. Children who consent to a dental check-up will receive either:

- The complete National oral health examination or..
- The standard NSW Health oral health assessment.

This will involve a dental examination of your child's teeth using a sterile mirror and dental explorer. No treatment will be provided on the day of the dental examination. No matter which type of dental check-up they have at school, your child will receive a letter to take home afterwards, providing advice about your child's oral health, the urgency of dental care needed and where you may take them for dental treatment.

While the results of the survey will be reported, the identity of your child will not be revealed. Information from the survey will be important in improving oral health, reducing dental problems and in planning dental care for school children in NSW.

Completion of the consent form, together with your signature, is required to allow us to check your child's teeth at school. You may also be contacted at a later stage by the ARCPOH, University of Adelaide to complete a questionnaire on other aspects of dental treatment and oral health. A reminder notice will be sent home prior to the dental examination date if we have not received a consent form for your child.

If you choose to participate in this study you should read and complete the enclosed consent form and read the enclosed information leaflet. Please fill out the attached consent form, put it in the envelope provided and return it to the school as soon as possible. If further information regarding the assessment is required please contact your child's school. We are grateful for your co-operation.

THIS IS A FREE SERVICE AND ALL INFORMATION IS STRICTLY CONFIDENTIAL

Yours sincerely,

Dr Clive Wright
Chief Dental Officer, NSW

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Appendix D: Reminder Letter

Child Dental Health Survey NSW, 2007

Reminder Letter

Dear Parent/Guardian,

A short time ago you would have received an information package and an invitation to participate in an important dental survey which will allow a better understanding of how to protect children's teeth against decay and help in planning dental care for school children in NSW.

If you have already returned the consent form, could you please accept our thanks and ignore this notice. However, if you haven't done so, please complete the attached consent form and return it to your child's school today. Your cooperation will be greatly appreciated.

If by some chance, you did not receive the information package or it was misplaced, please contact your child's school and ask for a replacement package.

ALL INFORMATION IS STRICTLY CONFIDENTIAL

THIS IS A FREE SERVICE

Yours sincerely,
Dr Clive Wright
Chief Dental Officer, NSW

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Appendix E: Information Sheet

INFORMATION SHEET TO PARENTS AND GUARDIANS

Child Dental Health Survey NSW, 2007

The National Child Dental Health Survey has collected data on children's dental health since 1977. Information from these surveys have been used to provide evidence about regional variations in prevalence of dental disease, describe outcomes from children's dental services, and evaluate the effectiveness of various forms of prevention. Approval for this study has been received from the Ethics committees of the NSW Department of Education, NSW Department of Health, and the Australian Centre for Population Oral Health, University of Adelaide.

Aim of the Survey
The aim of the survey is to gather information on primary school aged children in the age range of 5-12 years for the dual purpose of contributing to national population based information about the oral health of children as well as providing reliable regional information for appropriate planning of dental services in NSW. NSW has not had a survey of this type before and has therefore lacked a thorough understanding of where and how dental service needs for children differ in the state.

What is Involved
With your consent, specially trained Dental Therapists or Dentists will examine your child at school. The short exam involves looking at your child's mouth and teeth to record information on your child's teeth. Some children will receive the current standard NSW Health oral health assessment and some will receive the National oral health examination. Children will be selected randomly to participate in one or the other exam process.

No X-rays will be taken and no treatment will be carried out during the examination.

The sterile instruments used are a mirror and a standard dental explorer. The survey does not involve any dental treatment and no x-rays will be taken. If you consent you may also be contacted by the University of Adelaide at a later stage and asked to complete a questionnaire. You are free to decline to participate in this study or to withdraw from the study at any time.

Confidentiality
All information collected for this survey will be strictly confidential and stored in a safe place while being processed. Only the research team directly involved will have access to any information. The results published from this survey will only show results for different age and community groups. They will not include names or any information which could possibly identify you, your child or the school.

Information from the survey will be important in the fight against childhood oral health problems such as tooth decay and will help in planning dental care for school children in NSW. Your participation will make a significant contribution to current knowledge on this important issue.

Inquiries
If you have any further enquiries, please contact your child's school.

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Appendix F: Frequently Asked *Questions and Answers about the Survey*

What is the purpose of the survey?
The purpose of the survey is to investigate the impact of dental disease in child populations in NSW. By doing this we hope to identify means of preventing tooth decay and describe outcomes from children's dental services.

How is my child being selected?
The schools chosen for this survey have been randomly selected from a list of all Public, Catholic and Independent primary schools in NSW. Consenting students from within these schools will be randomly selected for either a dental examination or an oral health assessment using routine national or NSW Health protocols.

Why is the survey being conducted here?
The National Child Dental Survey has collected data on children's dental health since 1977. Information from these surveys is used to provide evidence about variations in the level of dental disease and evaluate the effectiveness of dental services and various forms of prevention. NSW has not had a survey of this type and wishes to better understand where and how dental services for children differ across the state.

Should I complete all questions?
Every question is important to enable NSW Health to develop as complete a picture of our child populations as possible. It is therefore important to complete the consent form to the best of your ability, as even an incomplete form may still be useful.

What if I object to a question?
All personal information is strictly confidential. No individuals will be identifiable from the results of the survey. If there is a question which presents particular difficulty for you, please telephone the school for clarification.

Why do you want to know my country of birth and language spoken at home?
At some time or another, nearly all people in Australia have come from overseas. It is known that dental health will reflect the customs and practices of different groups. So for this survey to be effective it needs to include questions about the home country, language and card holder status. None of this information will be identifiable.

Who gets to know my information?
Only the examination team directly concerned with the project will see the information provided by you and the NSW Department of Health is responsible for keeping this safe until it is destroyed once the data is processed. No results of the survey will refer to individuals. While the results will be published and made available to the Department of Health and summaries given to the Ministry of Education and schools in the regions surveyed, no personal information will be identifiable from the results.

How is my confidentiality maintained?
All documents will be maintained in a secure environment and destroyed after seven years. Electronic data files including ID only will be stored on computers with password access by the researchers only for up to seven years and then on CD-Rom for further possible analysis. Any change of policy for research purposes will only occur with specific ethics approval.

How will this benefit my child?
The survey will include a brief report about your child's dental health and information about where to access free dental treatment if treatment is indicated.

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Appendix G: Consent Form

NSW CHILD DENTAL HEALTH SURVEY, 2007 CONSENT FORM	**Office Use: SAP only (tick)**
School Code: ☐☐☐☐ **Child ID** ☐☐☐☐☐☐	☐

Child Details (One per Child)

Child's School: _____

Grade: _____

Class: _____

Child's First Name: _____

Child's Family Name: _____

DOB: _____ Age on 1 June 2007_____

Sex: M : F

Address: _____

_____

Postcode: _____

Telephone: Home:_____:Business:_____

Mobile:_____

As parent or Guardian, are you in receipt of one of the following Centrelink Concession cards? (Tick one box) only):

Health Care Card	☐
Pension Concession Card	☐
Commonwealth Seniors Health Card	☐
None	☐

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NSW CHILD DENTAL HEALTH SURVEY
CONSENT FORM

Is your child of Aboriginal or Torres Strait Islander origin? (Tick one box only)

- Yes, Aboriginal ☐
- Yes Torres Strait Islander ☐
- Yes Aboriginal & Torres Strait Islander ☐
- No ☐
- Not Known ☐

In which country was the mother of this child born? (Please tick only one box)

Australia ☐	China ☐	Italy ☐
Vietnam ☐	United Kingdom ☐	New Zealand ☐
Greece ☐	Germany ☐	Philippines ☐
Netherlands ☐	USA ☐	India ☐
South Africa ☐	Lebanon ☐	Hong Kong ☐

Other (please specify)_____

CONSENT (Please tick one)

YES ( ) PLEASE CHECK MY CHILD'S TEETH AT SCHOOL

NO ( ) NO THANK YOU, I DO NOT WANT MY CHILD'S TEETH CHECKED

Parent / Guardian
Signature:_____

Parent / Guardian Name:_____Title:_____

Medicare
Number:_____Date:_____

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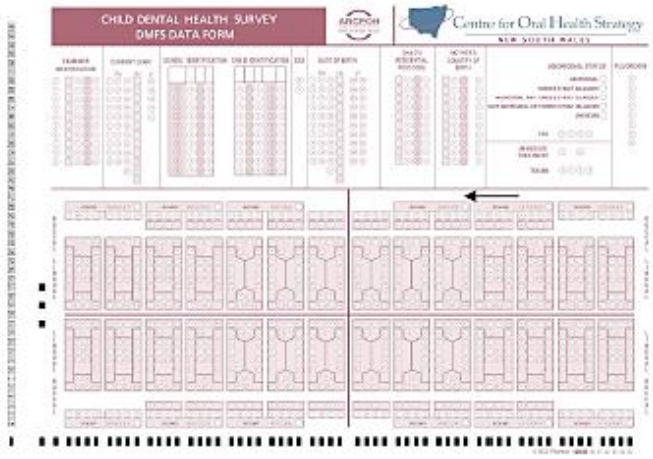
Appendix H: Dental Assessment (OMR) Form

OMR DATA COLLECTION FORM



Technique for recording data on the DMFS Data Form

It is important to complete the DMFS data form using the correct technique in order that errors do not occur when the form is scanned.

Coding MUST be done with a soft lead pencil, such as a 2B. DO NOT USE PEN.

A response is made simply by completely filling in the appropriate numbered circle, being careful not to mark beyond the circle

This is correct:

These will cause errors:

Corrections can be made using an eraser by completely removing the original mark and shading the correct response. DO NOT USE CORRECTION FLUIDS, as this will also cause errors when the sheets are scanned

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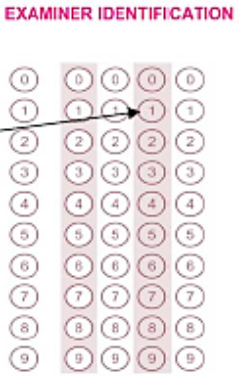
SOCIO-DEMOGRAPHIC AND GENERAL DENTAL INFORMATION

EXAMINER IDENTIFICATION

Record single AHS CODE here (see Appendix L)

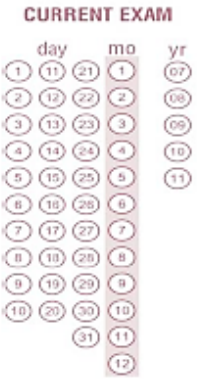
Record 4 digit EXAMINER ID number here

RULE: Examiners are NOT to cross AHS boundaries



CURRENT EXAM

Record day, month and year of current exam



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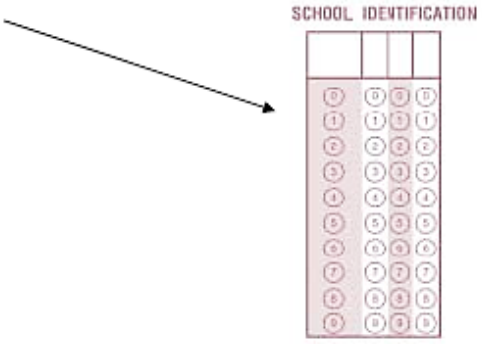
SOCIO-DEMOGRAPHIC AND GENERAL DENTAL INFORMATION

SCHOOL CODE
Record the child's 4 digit School Code

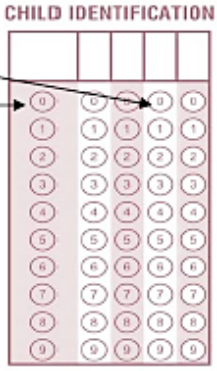


(Refer to list of School Codes in Appendix A).

CHILD IDENTIFICATION

Insert 5 digit CHILD ID number here

IMPT: IN THIS SURVEY, This column will always be ZERO (0)



RULE: each school will have a *Child ID* commencing with 00001
RULE: ensure *AHS* & *School Code* entered BEFORE allocating *child ID*

SEX
Record M or F

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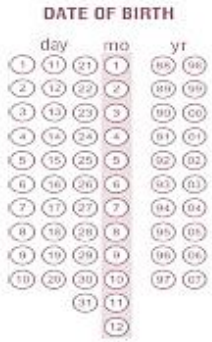
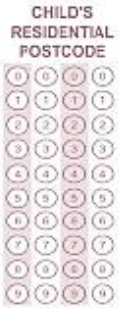
SOCIO-DEMOGRAPHIC AND GENERAL DENTAL INFORMATION

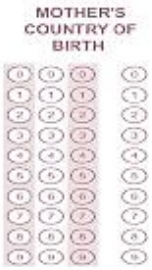
DATE OF BIRTH
Record Child's Date of Birth
dd / mm / yy



RESIDENTIAL POST CODE
Enter 4 digit residential post code



COB MOTHER
Enter 4 digit codes for country of birth of mother
(See Code Table Appendix L)



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SOCIO-DEMOGRAPHIC AND GENERAL DENTAL INFORMATION

ABORIGINAL & TORRES STRAIT ISLANDER STATUS
Mark appropriate box

ABORIGINAL STATUS

ABORIGINAL ○
TORRES STRAIT ISLANDER ○
ABORIGINAL AND TORRES STRAIT ISLANDER ○
NOT ABORIGINAL OR TORRES STRAIT ISLANDER ○
UNKNOWN ○

CENTRELINK CONCESSION CARD STATUS

CCC (0) (1) (2) (3)

0=None

1=Health Care Card

2=Pension Concession Card

3=Commonwealth Seniors Health Card

IMMEDIATE TREATMENT NEED
Enter Y = YES: N = NO

IMMEDIATE TREATMENT (Y) (N)

TRAUMA

Enter code for Trauma

TRAUMA (0) (1) (2) (3)

0: NO Trauma
1: Treated trauma, any size or involvement (usually with composite)
2: Trauma limited to the enamel and not treated
3: Any of the following;
Trauma involving at least dentine (treatment required, but not yet treated)

Tooth discoloration after trauma (verified by interview)

Avulsed, luxated tooth because of trauma (verified by interview).

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FLUOROSIS INDEX

X	Tooth excluded
9	Non-fluorotic lesions
0	No discoloration
1	Thin white lines across the surface
2	Lines merged to form small cloudy areas
3	Cloudy areas are frequent, but the lines can still be seen
4	Whole surface is opaque
5	Whole surface is opaque plus loss of enamel of any size

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TOOTH AND SURFACE STATUS

- **Indicate whether the tooth present is deciduous or permanent.**

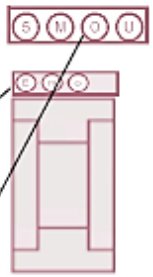
If the tooth is ***permanent***, fill in the number 1 to 7 in this box:

or;

If the tooth is ***deciduous***, fill in the letter A to E in this box:

If both the deciduous tooth and partly erupted permanent tooth occupy the same position record only the permanent tooth status.

- **Decision rules for the status of a deciduous or permanent tooth:**
Consider exfoliation and eruption timing and determine the dental history (from Clinical Treatment Record).



For a DECIDUOUS TOOTH:

- Mark letter (E in example) if the deciduous tooth is present.
- **m** if the deciduous tooth is missing due to caries and no permanent tooth is present.
- o if the deciduous tooth is missing because it was extracted for reasons other than caries and no permanent tooth is present.

For a PERMANENT TOOTH:

- Mark digit (5 in example above) if any part of the permanent tooth is present.
- **M** if the tooth is missing due to caries.
- O if the tooth is missing because it was extracted due to reasons other than caries.
- U if the tooth is unerupted and its deciduous predecessor has been
- YOU MUST FILL IN ONE CIRCLE IN EITHER
  THE UPPER OR LOWER BOX FOR EACH TOOTH

(Unless you can use the present and sound quadrant box
- See next page)

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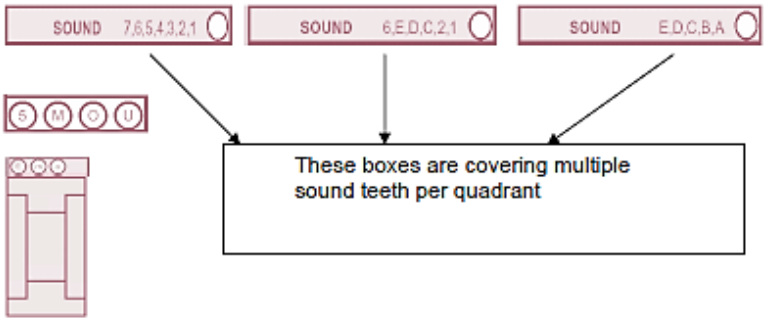
TOOTH AND SURFACE STATUS CONT.

IF ALL TEETH IN ONE QUADRANT ARE PRESENT AND SOUND RECORD ONLY ONE CIRCLE:

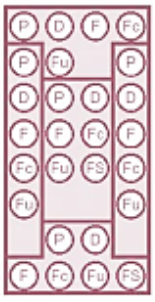


= Mark if all of the teeth in this quadrant are **permanent** AND **present** AND **sound.** This is equivalent to individually marking 7, 6, 5, 4, 3, 2 and 1 on the corresponding tooth status boxes (see last page). Do not make any marks on those individual teeth.

= Mark if all of the teeth in this quadrant are **present** AND **sound**. This is equivalent to making individual marks for 6, E, D, C, 2 and 1. Do not make any marks on those individual teeth. Mark separately the status of the 7.

= Mark if all teeth in this quadrant are **deciduous** AND **present** AND **sound**. This is equivalent to individually marking E, D, C, B and A on the corresponding tooth status boxes (see last page). Mark separately the status of the 6 and 7

IF CARIES OR RESTORATIONS ARE PRESENT:



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P = Pre-cavitated decalcification
D = Primary caries on this surface
F = Filled due to caries with satisfactory, non-carious filling
Fu = Filled due to caries with unsatisfactory, non carious filling
Fc = Filled with recurrent caries
FS = Fissure sealed surface, non filled, non carious

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Appendix I: School Reconciliation Sheet

Child Dental Health Survey NSW, 2007

	AHS	SCHOOL				
NAME						
CODE						
Grade	Total Enrolled	Total Consented	Number Examined CDHS	Met Survey Requirement Y/N	Number SAP	Total SAP + CDHS
K						
1						
2						
3						
4						
5						
6						
TOTAL						

Appendix J: Child Survey Outcome Feedback

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Dear Parent/Guardian,

Results of Child Dental Health Survey NSW, 2007

Your child was given a free dental examination today and:

- ☐ **Appears to have no dental problems at present**
- ☐ **Requires further assessment and may require dental treatment**
- ☐ **Requires urgent dental care.**

This examination report is intended to give only a general assessment of your child's dental needs. No x-rays were taken at this time. This examination is not intended to replace a regular dental check-up.

If the examination indicated that a further dental assessment is necessary or urgent treatment is required, you are advised to seek a dental appointment with your local private dentist or public dental clinic.

Should your child be currently under care or receives regular attention you may wish to wait until your next scheduled dental appointment to clarify the advice given.

However, for those dental assessments marked *urgent* you are advised to seek further advice as soon as possible.

Yours sincerely,

Child Dental Health Survey Team

Appendix K: Information Used in Translations

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Draft Protocol: Appendix
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This consent form is from the NSW Department of Health to seek your permission to examine your child's teeth at school. In order for us to examine your child's teeth you will need to answer the questions, sign the form and return it to the school quickly. Please seek the help of an adult friend or relative who speaks English if you cannot read the letter.

This letter explains your child's dental needs and where you may take them for free dental treatment. Please seek the help of an adult friend or relative who speaks English if you cannot read the letter. When you phone the dental call centre to make an appointment for your child, you may ask for an interpreter to be present on the day.

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Appendix L: Misc. Code Tables

Country of Mother's Birth

Country of Birth Mother	MIS No
AUSTRALIA	*1101*
CHINA	*6101*
ITALY	*3104*
VIETNAM	*5105*
UNITED KINGDOM	*2102*
NEW ZEALAND	*1201*
GREECE	*3207*
GERMANY	*2304*
PHILIPPINES	*5204*
NETHERLANDS	*2308*
USA	*8104*
INDIA	*7103*
SOUTH AFRICA	*9225*
LEBANON	*4208*
HONG KONG	*6102*
OTHER (please specify)	*9999*

Area Health Service

AHS	MIS No	Abr
North Coast	*1*	NC
North Sydney & Central Coast	*2*	NSCC
Hunter & New England	*3*	HNE
Sydney South West	*4*	SSW
South East Sydney & Illawarra	*5*	SESI
Sydney West	*6*	SW
Greater Western	*7*	GW
Greater Southern	*8*	GS
Justice Health	*9*	JH

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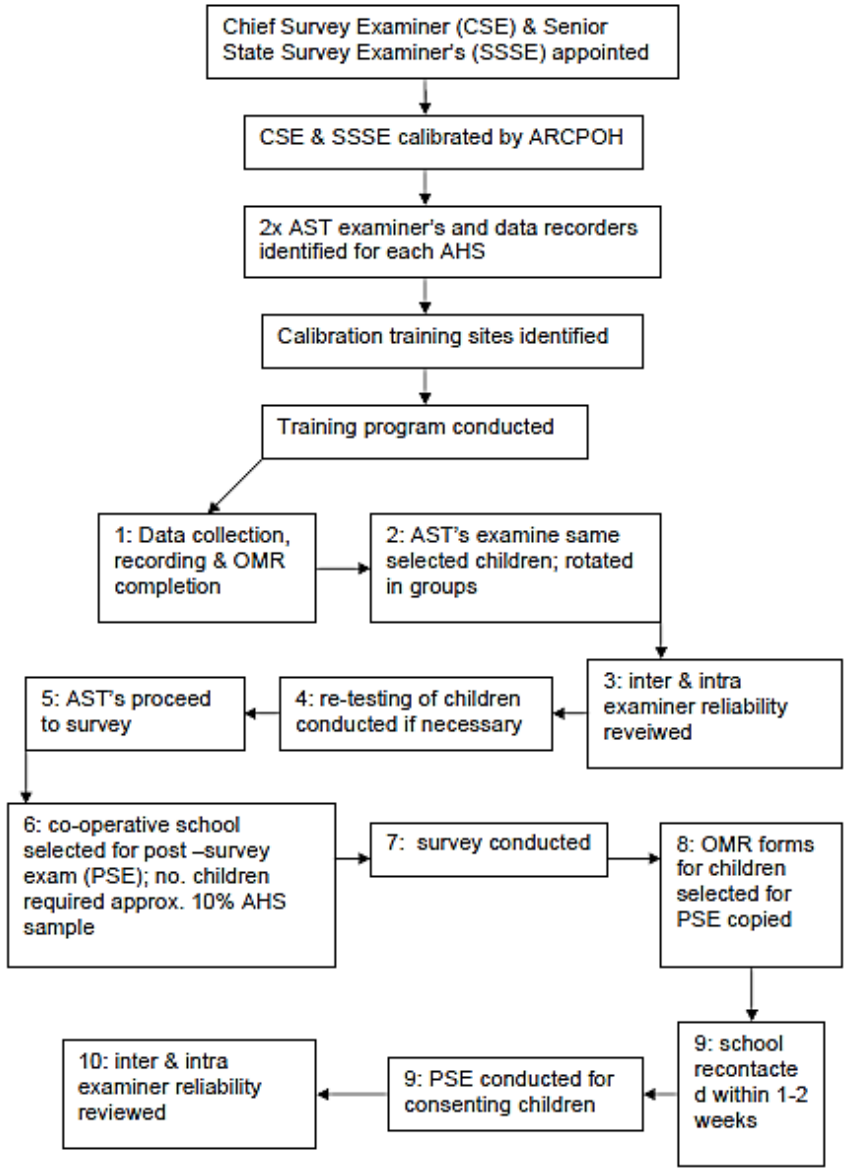
Appendix M: Examiner Calibration Protocol



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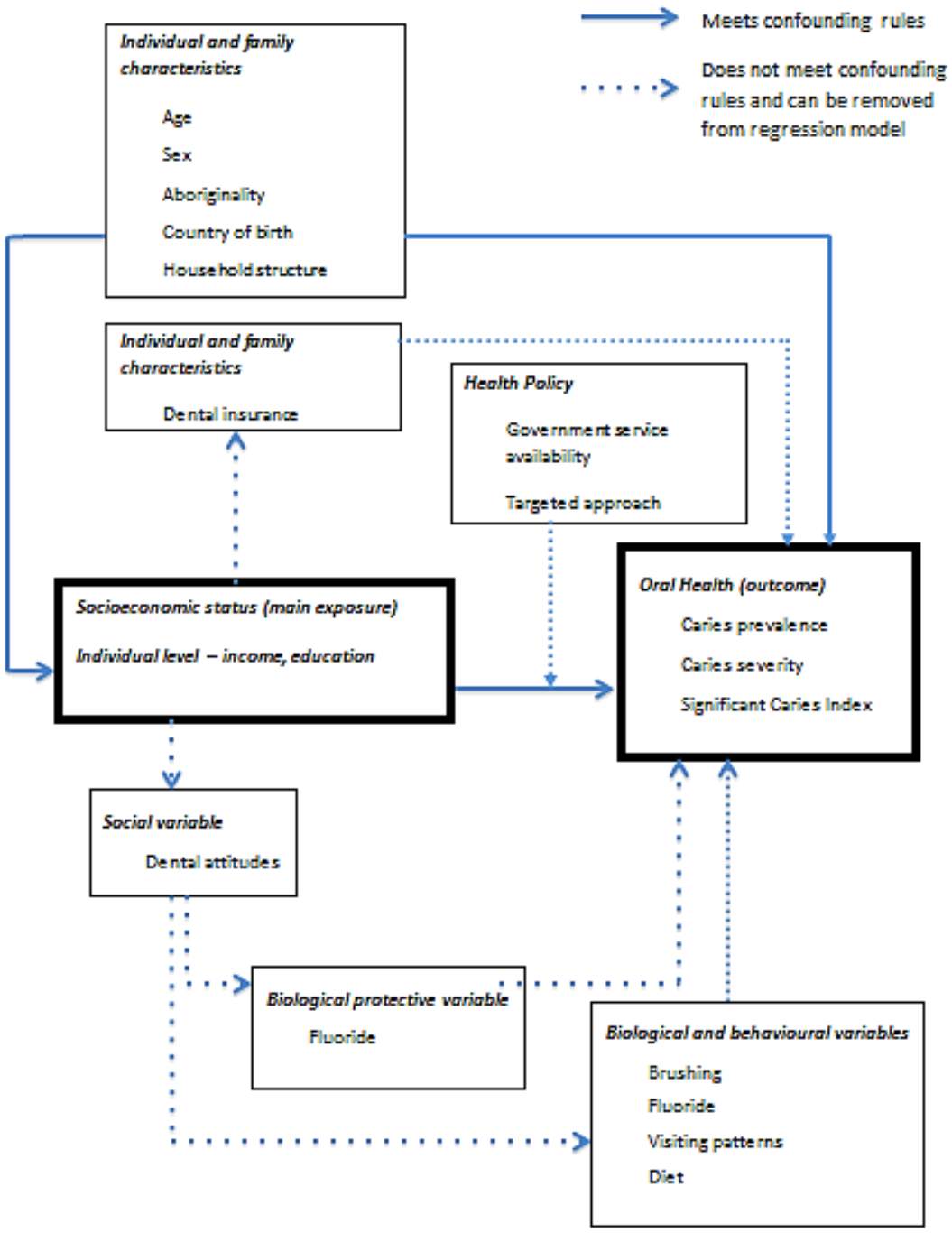
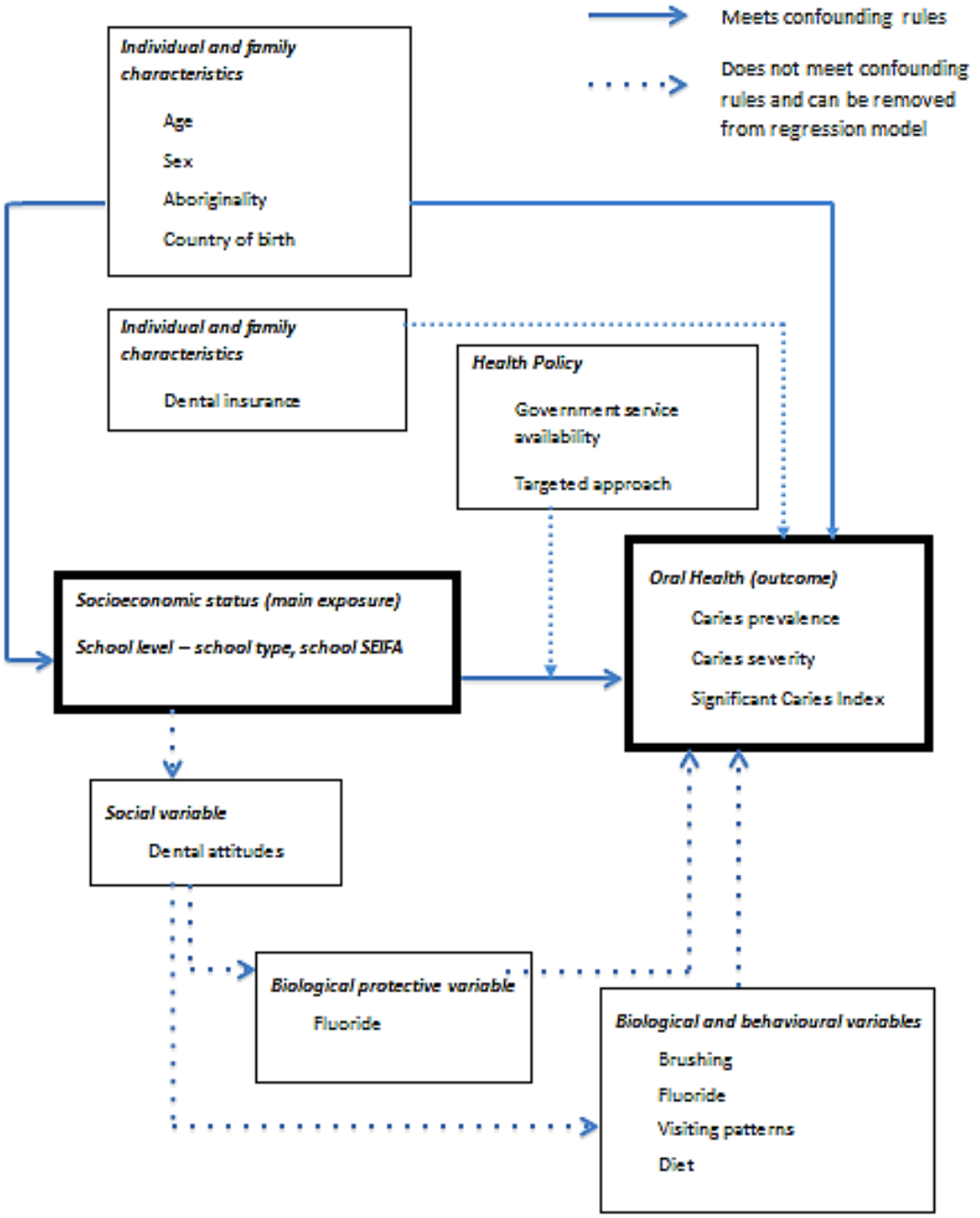
APPENDIX 5 DIAGRAMMATIC ACYCLICAL GRAPH (DAG)

a. individual-level
b. school-level
c. area-level

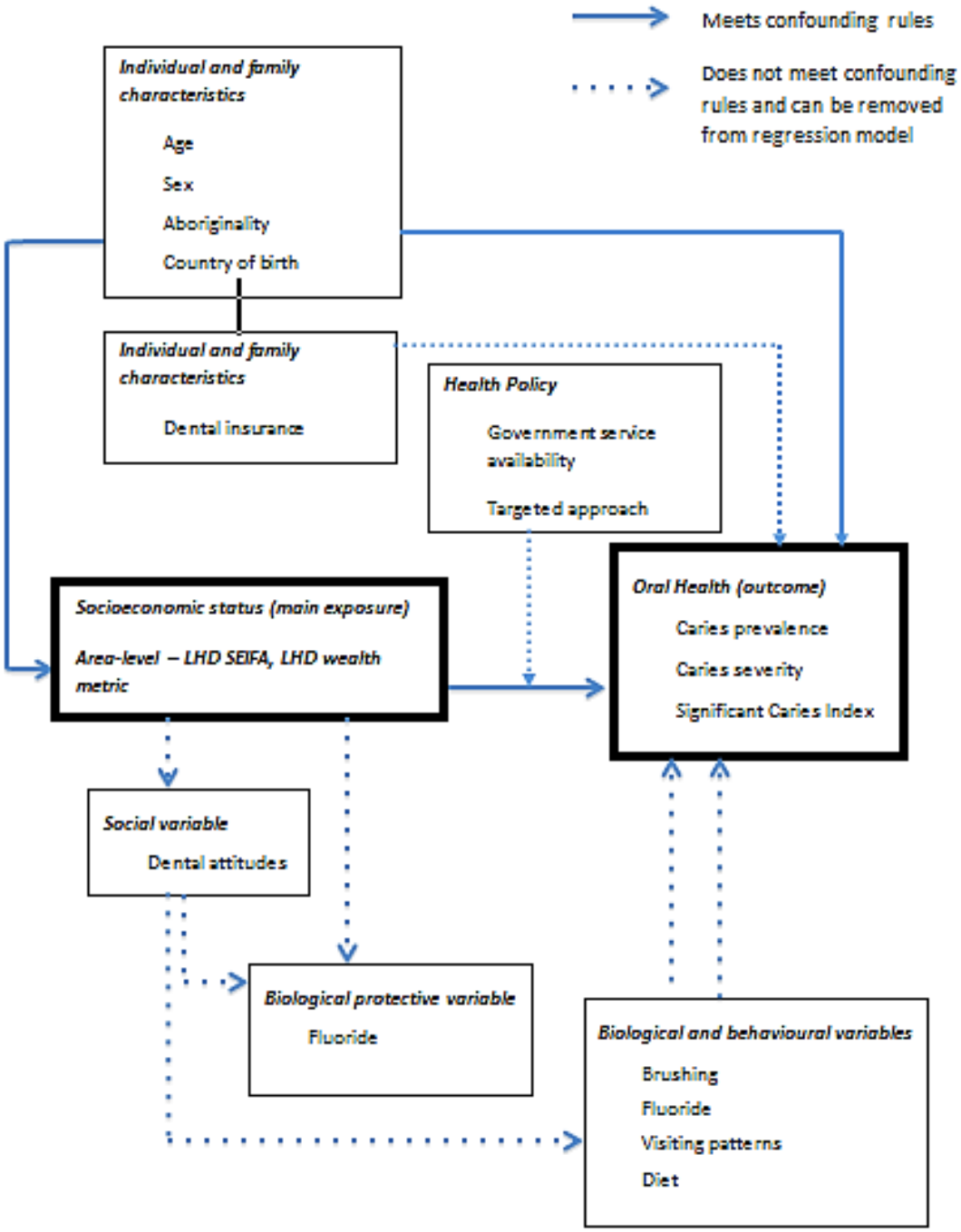
Appendix 5a Diagrammatic Acyclical Graph (DAG) - individual-level



Appendix 5b Diagrammatic Acyclical Graph (DAG) - school-level



Appendix 5c Diagrammatic Acyclical Graph (DAG) - area-level



APPENDIX 6 ESTIMATE VARIATION TABLES (SENSITIVITY ANALYSIS)

a. Model selection for multivariable analysis – deciduous caries prevalence

b. Model selection for multivariable analysis – permanent caries prevalence

c. Model selection for multivariable analysis – deciduous caries severity

d. Model selection for multivariable analysis – permanent caries severity

Appendix 6a Model selection for multivariable analysis – deciduous caries prevalence

	Full Model	Model 2	[ln/model effect]]	Model 3	[ln/model effect]]
N (obs)	2277	2434		2434	
Income (ref: over $120,000)					
PR $80,001 to $120,000 (95%CI)	**1.12** (0.89-1.39)	**1.10** (0.89-1.37)	0.02	**1.10** (0.89-1.37)	0.00
Precision [ln(95%CI)]	*1.56*	*1.54*		*1.54*	
PR $40,001 to $80,000 (95%CI)	**1.46** (1.22-1.76)	**1.48** (1.23-1.79)	0.01	**1.49** (1.23-1.80)	0.01
Precision	*1.44*	*1.46*		*1.46*	
PR Up to $40,000 (95%CI)	**1.95** (1.59-2.40)	**1.87** (1.56-2.24)	0.04	**1.85** (1.54-2.22)	0.01
Precision	*1.51*	*1.44*		*1.44*	
N (obs)	2329	2478		2478	
Education (ref: Postgraduate)					
PR Some/completed uni (95%CI)	**1.08** (0.91-1.29)	**1.02** (0.86-1.21)	0.06	**1.03** (0.87-1.21)	0.01
Precision	*1.42*	*1.41*		*1.39*	
PR Some/complete trade (95%CI)	**1.23** (1.00-1.50)	**1.15** (0.95-1.38)	0.07	**1.16** (0.96-1.39)	0.01
Precision	*1.50*	*1.45*		*1.45*	
PR Completed secondary (95%CI)	**1.46** (1.22-1.75)	**1.43** (1.19-1.70)	0.02	**1.43** (1.20-1.71)	0.00
Precision	*1.43*	*1.43*		*1.43*	
N (obs)	2230	2368		2368	
Income and education					
Income (ref: over $120,000)					
PR $80,001 to $120,000 (95%CI)	**1.11** (0.90-1.38)	**1.11** (0.90-1.37)	0.00	**1.11** (0.90-1.37)	0.00
Precision	*1.53*	*1.52*		*1.52*	
PR $40,001 to $80,000 (95%CI)	**1.42** (1.18-1.70)	**1.48** (1.22-1.78)	0.04	**1.48** (1.22-1.79)	0.00
Precision	*1.44*	*1.46*		*1.47*	
PR Up to $40,000 (95%CI)	**1.82** (1.46-2.27)	**1.80** (1.46-2.21)	0.01	**1.77** (1.44-2.19)	0.05
Precision	*1.56*	*1.51*		*1.52*	
Education (ref: Postgraduate)					
PR Some/completed uni (95%CI)	0.95 (0.80-1.12)	0.89 (0.76-1.05)	0.07	0.90 (0.76-1.06)	0.00
Precision	*1.40*	*1.38*		*1.40*	
PR Some/complete trade (95%CI)	**1.02** (0.83-1.26)	0.96 (0.79-1.17)	0.05	0.97 (0.80-1.18)	0.00
Precision	*1.52*	*1.48*		*1.48*	
PR Completed secondary (95%CI)	**1.14** (0.95-1.37)	**1.06** (0.88-1.28)	0.08	**1.07** (0.88-1.30)	0.01
Precision	*1.44*	*1.46*		*1.48*	
Notes	Full model Including all confounding from DAG.	Removed household structure, child born in Australia, Indigenous identity		Removed age, sex	
Compare to:		Full model		Model 2	
Conclusion:		Precision: -improved for income - improved for education - similar for income/education combined Sociodemographic factors are not confounders (change less than 10%)		Precision: -improved for income - improved for education - similar for income/education combined Age and sex are not confounders (change less than 10%)	
Decision:		Keep model 2		Keep model 3	

Appendix 6b Model selection for multivariable analysis – permanent caries prevalence

	Full Model	Model 2	[In/model effect]	Model 3	[In/model effect]
N (obs)	4105	4419		4461	
Income (ref: over $120,000)					
PR $80,001 to $120,000 (95%CI)	**0.91** (0.71-1.15)	**0.90** (0.71-1.13)	0.01	**0.92** (0.72-1.18)	0.02
Precision	*1.62*	*1.59*		*1.64*	
PR $40,001 to $80,000 (95%CI)	**1.27** (1.01-1.60)	**1.24** (1.00-1.53)	0.02	**1.26** (1.01-1.57)	0.02
Precision	*1.58*	*1.53*		*1.55*	
PR Up to $40,000 (95%CI)	**1.65** (1.30-2.10)	**1.64** (1.32-2.04)	0.01	**1.66** (1.32-2.08)	0.01
Precision	*1.62*	*1.54*		*1.58*	
N (obs)	4231	4537		4537	
Education (ref: Postgraduate)					
PR Some/completed uni (95%CI)	**1.03** (0.93-1.30)	**0.99** (0.83-1.19)	0.04	**1.00** (0.84-1.18)	0.01
Precision	*1.40*	*1.43*		*1.40*	
PR Some/complete trade (95%CI)	**1.17** (1.13-1.59)	**1.09** (0.87-1.38)	0.07	**1.15** (0.91-1.45)	0.06
Precision	*1.41*	*1.53*		*1.53*	
PR Completed secondary (95%CI)	**1.48** (1.16-1.60)	**1.43** (1.15-1.76)	0.03	**1.48** (1.20-1.83)	0.03
Precision	*1.38*	*1.53*		*1.53*	
N (obs)	3984	4263		4263	
Income and education					
Income (ref: over $120,000)					
PR $80,001 to $120,000 (95%CI)	**0.89** (0.88-1.21)	**0.89** (0.69-1.14)	0.00	**0.90** (0.69-1.17)	0.01
Precision	*1.38*	*1.65*		*1.70*	
PR $40,001 to $80,000 (95%CI)	**1.20** (1.04-1.40)	**1.20** (0.94-1.54)	0.00	**1.19** (0.92-1.54)	0.01
Precision	*1.35*	*1.64*		*1.67*	
PR Up to $40,000 (95%CI)	**1.50** (1.20-1.62)	**1.57** (1.19-2.06)	0.06	**1.54** (1.16-2.03)	0.02
Precision	*1.35*	*1.73*		*1.75*	
Education (ref: Postgraduate)					
PR Some/completed uni (95%CI)	**0.94** (0.87-1.24)	**0.89** (0.74-1.09)	0.05	**0.90** (0.75-1.09)	0.01
Precision	*1.43*	*1.47*		*1.45*	
PR Some/complete trade (95%CI)	**1.04** (1.03-1.47)	**0.96** (0.74-1.24)	0.08	**1.03** (0.80-1.33)	0.07
Precision	*1.43*	*1.68*		*1.66*	
PR Completed secondary (95%CI)	**1.21** (0.99-1.38)	**1.08** (0.84-1.40)	0.12	**1.14** (0.88-1.47)	0.06
Precision	*1.39*	*1.67*		*1.67*	
Notes	Full model including all confounding from DAG.	Removed household structure, child born in Australia, Indigenous identity		Removed age, sex	
Compare to:		Full model		Model 2	
Conclusion:		Precision: -improved for income - decreased for education - decreased for income/education combined Sociodemographic factors are not confounders (change less than 10%), except lowest category of education.		Precision: -improved for income - decreased for education - decreased for income/education combined Age and sex are not confounders (change less than 10%)	
Decision:		Keep Model 2		Keep Model 3	

Appendix 6c Model selection for multivariable analysis – deciduous caries severity

	Full Model	Model 2	[ln]model effect[]	Model 3	[ln]model effect[]
N (obs)	2275	2434		2434	
Income (ref: over $120,000)					
PR $80,001 to $120,000 (95%CI)	1.6 (1.2-2.1)	1.6 (1.2-2.1)	0.00	1.6 (1.2-2.1)	0.00
Precision [ln(95%CI)]	*1.75*	*1.75*		*1.75*	
PR $40,001 to $80,000 (95%CI)	2.1 (1.6-2.7)	2.1 (1.6-2.7)	0.00	2.1 (1.6-2.7)	0.00
Precision	*1.69*	*1.69*		*1.69*	
PR Up to $40,000 (95%CI)	3.7 (2.8-4.7)	3.3 (2.6-4.2)	0.12	3.3 (2.6-4.2)	0.00
Precision	*1.68*	*1.62*		*1.62*	
N (obs)	2327	2478		2478	
Education (ref: Postgraduate)					
PR Some/completed uni (95%CI)	1.1 (0.9-1.4)	1.0 (0.8-1.2)	0.01	1.0 (0.8-1.2)	0.00
Precision	*1.56*	*1.50*		*1.50*	
PR Some/complete trade (95%CI)	1.4 (1.1-1.8)	1.2 (1.0-1.6)	0.16	1.2 (1.0-1.6)	0.00
Precision	*1.64*	*1.60*		*1.60*	
PR Completed secondary (95%CI)	2.0 (1.6-2.4)	1.8 (1.4-2.1)	0.11	1.8 (1.4-2.1)	0.00
Precision	*1.50*	*1.50*		*1.50*	
N (obs)	2228	2368		2368	
Income and education					
Income (ref: over $120,000)					
PR $80,001 to $120,000 (95%CI)	1.6 (1.2-2.1)	1.6 (1.2-2.1)	0.00	1.6 (1.2-2.1)	0.00
Precision	*1.75*	*1.75*		*1.75*	
PR $40,001 to $80,000 (95%CI)	2.0 (1.5-2.5)	2.1 (1.6-2.7)	0.05	2.1 (1.6-2.7)	0.00
Precision	*1.67*	*1.69*		*1.69*	
PR Up to $40,000 (95%CI)	3.3 (2.5-4.3)	3.3 (2.5-4.3)	0.00	3.2 (2.5-4.2)	0.03
Precision	*1.72*	*1.72*		*1.68*	
Education (ref: Postgraduate)					
PR Some/completed uni (95%CI)	0.9 (0.7-1.1)	0.8 (0.7-1.0)	0.13	0.8 (0.7-1.0)	0.00
Precision	*1.57*	*1.43*		*1.43*	
PR Some/complete trade (95%CI)	1.1 (0.8-1.4)	0.9 (0.7-1.2)	0.22	0.9 (0.7-1.2)	0.00
Precision	*1.75*	*1.71*		*1.71*	
PR Completed secondary (95%CI)	1.3 (1.0-1.6)	1.0 (0.8-1.3)	0.30	1.0 (0.8-1.3)	0.00
Precision	*1.60*	*1.63*		*1.63*	
Notes	Full model including all confounding from DAG.	Removed household structure, child born in Australia, Indigenous identity		Removed age, sex	
Compare to:		Full model		Model 2	
Conclusion:		Precision: -improved for income - improved for education - similar for income/education combined Sociodemographic factors are potential confounders (change > 10%) Significance changes at one level only for one variable – income still more stable than education Relativity maintained		Precision: -stable for income - stable for education - similar for income/education combined Age and sex are not confounders (change less than 10%)	
Decision:		Keep Model 2		Keep Model 3	

Appendix 6d Model selection for multivariable analysis – permanent caries severity

	Full Model	Model 2	Δln/model effect Δ	Model 3	Δln/model effect Δ
N (obs)	4104	4419		4419	
Income (ref: over $120,000)					
PR $80,001 to $120,000 (95%CI)	**0.9** (0.8-1.2)	**1.0** (0.8-1.2)	0.11	**1.0** (0.8-1.2)	0.00
Precision	*1.50*	*1.50*		*1.50*	
PR $40,001 to $80,000 (95%CI)	**1.3** (1.1-1.6)	**1.3** (1.1-1.6)	0.00	**1.3** (1.1-1.6)	0.00
Precision	*1.46*	*1.46*		*1.46*	
PR Up to $40,000 (95%CI)	**2.0** (1.7-2.4)	**2.0** (1.7-2.4)	0.00	**2.1** (1.7-2.5)	0.05
Precision	*1.41*	*1.41*		*1.47*	
N (obs)	4230	4537		4537	
Education (ref: Postgraduate)					
PR Some/completed uni (95%CI)	**1.4** (1.2-1.7)	**1.3** (1.1-1.6)	0.08	**1.3** (1.1-1.6)	0.00
Precision	*1.42*	*1.46*		*1.46*	
PR Some/complete trade (95%CI)	**1.6** (1.3-2.0)	**1.5** (1.2-1.8)	0.07	**1.6** (1.3-2.0)	0.07
Precision	*1.54*	*1.50*		*1.54*	
PR Completed secondary (95%CI)	**2.4** (2.0-2.9)	**2.2** (1.8-2.6)	0.09	**2.3** (1.9-2.8)	0.05
Precision	*1.45*	*1.44*		*1.47*	
N (obs)	3983	4263		4263	
Income and education					
Income (ref: over $120,000)					
PR $80,001 to $120,000 (95%CI)	**0.9** (0.7-1.1)	**0.9** (0.7-1.1)	0.00	**0.9** (0.7-1.1)	0.00
Precision	*1.57*	*1.57*		*1.57*	
PR $40,001 to $80,000 (95%CI)	**1.1** (0.9-1.4)	**1.1** (0.9-1.4)	0.00	**1.1** (0.9-1.4)	0.00
Precision	*1.56*	*1.56*		*1.56*	
PR Up to $40,000 (95%CI)	**1.5** (1.2-1.9)	**1.6** (1.3-1.9)	0.07	**1.6** (1.3-1.9)	0.00
Precision	*1.58*	*1.46*		*1.46*	
Education (ref: Postgraduate)					
PR Some/completed uni (95%CI)	**1.2** (1.0-1.5)	**1.2** (1.0-1.4)	0.00	**1.2** (1.0-1.5)	0.00
Precision	*1.50*	*1.40*		*1.50*	
PR Some/complete trade (95%CI)	**1.4** (1.1-1.8)	**1.3** (1.1-1.7)	0.08	**1.4** (1.1-1.8)	0.08
Precision	*1.64*	*1.55*		*1.64*	
PR Completed secondary (95%CI)	**1.9** (1.5-2.3)	**1.6** (1.3-2.0)	0.19	**1.7** (1.4-2.1)	0.05
Precision	*1.53*	*1.54*		*1.50*	
Notes	Full model including all confounding from DAG.	Removed household structure, child born in Australia, Indigenous identity		Removed age, sex	
Compare to:		Full model		Model 2	
Conclusion:		Precision: - stable for income - similar for education - improved for income/education combined Sociodemographic factors are potential confounders (change >10%), for a level of each variable. – income still more stable than education Relativity maintained		Precision: -decreased for income - decreased for education - similar for income/education combined Age and sex are not confounders (change less than 10%)	
Decision:		Keep Model 2		Keep Model 3	

APPENDIX 7 TEST FOR MULTICOLLINEARITY – VARIANCE INFLATION FACTOR

Variance Inflation Factor (VIF) for combination of variables in all models	
	VIF
Individual Level 1	
Income	1.294
Education	1.294
School Level 2	
School type	1.246
School ICSEA	1.246
Area Level 3	
LHD SEIFA	2.363
LHD Wealth	2.363
Multilevel	
Income	1.445
Education	1.385
School type	1.365
School ICSEA	1.997
LHD	1.519

APPENDIX 8 ETHICS APPROVAL

THE UNIVERSITY OF ADELAIDE
AUSTRALIA

RESEARCH BRANCH
RESEARCH ETHICS AND COMPLIANCE UNIT

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17 May 2007

Professor AJ Spencer
School of Dentistry

Dear Professor Spencer

PROJECT NO: *Social gradients in child oral health status and access to services*
H-050-2007

I write to advise you that the Human Research Ethics Committee has approved the above project. Please refer to the enclosed endorsement sheet for further details and conditions that may be applicable to this approval.

Approval is current for one year. The expiry date for this project is: 31 May 2008

Where possible, participants taking part in the study should be given a copy of the Information Sheet and the signed Consent Form to retain.

Please note that any changes to the project which might affect its continued ethical acceptability will invalidate the project's approval. In such cases an amended protocol must be submitted to the Committee for further approval. It is a condition of approval that you immediately report anything which might warrant review of ethical approval including (a) serious or unexpected adverse effects on participants (b) proposed changes in the protocol; and (c) unforeseen events that might affect continued ethical acceptability of the project. It is also a condition of approval that you inform the Committee, giving reasons, if the project is discontinued before the expected date of completion.

A reporting form is available from the Committee's website. This may be used to renew ethical approval or report on project status including completion.

Yours sincerely

Professor Garrett Cullity
Convenor
Human Research Ethics Committee