TRENDS IN DENTAL CARIES PREVALENCE AND SEVERITY IN SOUTH AFRICA

by

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DECLARATION

I, Candice van Wyk, declare that this dissertation entitled "Trends in Dental Caries Prevalence and Severity in South Africa", which I herewith submit to the University of Pretoria for a MSc (Odont) in Community Dentistry, is my own original work, and has never been submitted for any academic award to any other institution of higher learning.

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LIST OF ABREVIATIONS

BBB	-	Boost Better Breaks
Chi-sq	-	Chi-square
CI	-	caries increment
CSD	-	Community Service Dentists
Diff	-	difference
DFS	-	decayed, filled surfaces (permanent dentition)
dfs	-	decayed, filled surfaces (primary dentition)
DMFS	-	decayed, missing, filled surfaces (permanent dentition)
dmfs	-	decayed, missing, filled surfaces (primary dentition)
DMFT	-	decayed, missing, filled teeth (permanent dentition)
dmft	-	decayed, missing, filled teeth (primary dentition)
ds	-	decayed surfaces (primary teeth)
DT	-	decayed permanent teeth
dt	-	decayed primary teeth
F	-	Fluoride
FDI	-	Fédération Dentaire Internationale (International Dental Federation)
FT	-	filled permanent teeth
ft	-	filled primary teeth
g	-	gram
HDI	-	Human Development Index
HHI	-	Hypocalcification and Hypoplasia Index
kg	-	kilogram
l	-	litre
MDS	-	Mobile Dental System
mg	-	milligram
MT	-	missing permanent teeth
mt	-	missing primary teeth
n	-	number of subjects
NEIP	-	Nutrition Education Intervention Programme
NFCS	-	National Food Consumption Survey
NOHS	-	National Oral Health Survey
OHE	-	Oral Health Education

OHPSP - Oral Health Preventive School Program
OR - odds ratio
p - probability
PAHO - Pan American Health Organization
ppm - parts per million
sd - standard deviation
SE - Standard error
SES - Socio-economic status
SiC - Significant Caries Index
UTN - Unmet Treatment Need Index
WHO - World Health Organization

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ABSTRACT

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Dental caries is the most common oral disease in the world, and in developed nations, it affects almost everyone. Worldwide, large variations in the trends with regard to the prevalence and the severity of dental caries have been reported[1].

In South Africa, numerous studies to determine the caries prevalence and severity of different population groups have been carried out in the past. However, only three studies were conducted on a national scale; Williams in 1984[2] reported on the dental health status of 12-year-old children representing the whole country, the National Department of Health conducted a National Oral Health Survey in 1988/1989[3] to determine the oral health status of adults and children in the five major metropolitan areas in South Africa, and the most recent National Oral Health Survey was conducted during the period July 1999 to June 2002[4] and was restricted to 4- to 5- year-, 6-year-, 12-year and 15-year-old children in South Africa.

The aim of this study was to determine the trends in dental caries prevalence and severity amongst South African children over a period of time by comparing the results obtained from the 1982/1983 National Oral Health Survey with results obtained from the 1988/1989 National Oral Health Survey and/or with results obtained from the 1999/2002 National Oral Health Survey.

The statistical methods employed, appeared to be useful to determine the trends in dental caries prevalence and severity amongst South African children, over the period 1982 to 2002, in selected (identified) geographical locations and also in terms of age, race and gender.

Although it became evident, through this research, that there is a decline in the prevalence of dental caries amongst all the population groups, from 1982 to 2002, Coloured children presented with a relatively higher prevalence and severity of dental caries when compared with Asian, Black and White children in South Africa. The results mainly showed a higher prevalence and severity of dental caries in the primary than permanent dentition amongst 6-year-old children; and there was

also a significant increase in the prevalence and severity of dental caries from the 12-year-old to the 15-year-old group.

Through this research, it became evident that there is higher dental caries prevalence and severity rates in the coastal regions (Metro Cape, Port Elizabeth and Durban) as compared to an interior region (Bloemfontein).

It was also observed that although the severity (dmft/DMFT) of dental caries decreased during the past 20 years; the percentage of untreated caries in 12-year- and 15-year-old children increased; however, at the same time the percentage of untreated caries in 6-year-old children decreased.

It was found that the number of filled teeth (FT) contributes the most to the caries experience amongst 12-year- and 15-year-old White children. However, more than 70 percent of dental caries, in 6-year-, 12-year- and 15-year-old children, go untreated.

These results obtained from this study entitled: Trends in dental caries prevalence and severity in South Africa; can be useful in attempting to design intervention strategies to address dental caries in South Africa.

CHAPTER 1

1.1 INTRODUCTION / BACKGROUND

Worldwide, large variations in the trends with regard to the prevalence and the severity of dental caries have been reported[1]. The development of caries within populations has followed different patterns in different parts of the world, but in most highly developed countries there was a sharp increase in prevalence and incidence of the disease during the 1920's to 1950's[1]. Caries became recognized as a major oral health problem in these countries, notably in the 1950's and early 1960's, when demand for care increased. Some countries recorded that almost no child was free from caries. Whole populations were affected by a painful and distressing disease to which large amounts of public and private resources were allocated, not only to provide a professional workforce and the finances to treat the disease, but also for the investigation of possible ways to prevent it[1].

As a consequence, mainly due to the increased use of fluorides from all sources, especially toothpastes, a decrease in dental caries among children in highly industrialized countries started to emerge around 1970, and percentages of caries free children in different age categories have increased since then[1]. Certain developing countries, on the other hand, have reported an increase in dental caries in recent years e.g. India and parts of central and South America[1]. This was related to the increased availability and consumption of refined sugars. Concern has also been expressed about the (apparent) relationship between caries and the trend towards urbanization in many developing countries; as people leave established rural conditions and move to large cities, where they are exposed

to modern eating habits, there is an increasing risk of dental caries. There are few resources for curative/restorative intervention, and no infrastructure upon which to base large-scale measures for prevention. Dental caries is therefore potentially of major public health significance in developing countries, and the need to focus on its prevention is a matter of urgency[1].

In South Africa, with its dualistic society very little is known about the trends in dental caries prevalence and severity. South Africa also faces a unique challenge. It has to provide health care systems to cater for the needs of its varied population consisting of a spectrum from highly industrialized first world to underdeveloped third world communities[5]. In order to promote health equity, there is a need for regular surveillance of caries trends in South Africa.

1.2 PROBLEM STATEMENT AND RATIONALE

The new political dispensation in South Africa since 1994 has been associated with improvement in socio-economic status of previously disadvantaged individuals/groups. As a result of this process, oral health interventions for the poorest, historically disadvantaged population groups may need to be different from those designed for middle or high socio-economic status population groups[6]. Failure to recognize this differentiation will mean that intervention strategies are ineffective because they are selected for application in a socio-economic and political context that no longer exists[6]. Thus, knowledge of the trends in dental caries status and severity in South Africa is much needed before attempting to design intervention strategies to address dental caries. To date, only limited information is available on assessment of caries trends in South Africa. In addition, it is important to

examine the influence of the increasing migration of previously disadvantaged groups to urban or metropolitan areas.

1.3 REFERENCE METHOD

The Vancouver referencing method is used in this dissertation.

1.4 FINANCING

This study was funded by the Department of Community Dentistry, University of Pretoria, School of Dentistry.

CHAPER 2

LITERATURE REVIEW

2.1 CARIES TRENDS IN DEVELOPED COUNTRIES

Dental caries is the most common oral disease in the world and, in developed nations it affects almost everyone[7]. Its prevalence worldwide is uneven and caries is relatively rare in some countries and rampant in others[7]. In developed countries such as Great Britain, Canada and the United States a reduction in caries prevalence has been observed[8].

There has been remarkable progress in the reduction of dental caries in the United States over the past 30 years[9]. The existence of children with no dental caries, a rarity in the past, is no longer unusual. The use of fluoride in public water supplies, toothpaste and professional dental products; improved oral hygiene; and increased access to dental care have played major roles in this dramatic improvement[9]. Nevertheless, dental caries remains a significant problem. Nearly 20 percent of children between the ages of 2 and 4 have detectable caries, and by the age of 17 almost 18 percent of young people have had a cavity – a late manifestation of dental caries infection[9]. Caries is also more prevalent and severe in the indigenous populations of the United States than in the general population, but there are indications of a decline in caries in the permanent dentitions of these indigenous groups[10].

While progress has been made in preventing caries among Native Americans[11], the high prevalence and severity at all ages in this rapidly

growing population have resulted in a large backlog of untreated disease with an overwhelming demand on the resources available to provide care. Continued emphasis on dental caries prevention and health promotion is an important part of the solution[11]. New strategies such as aiming preventive services toward individuals and groups with the highest risk of disease, and the use of modern conservative treatment methods to control disease, have been advocated[11]. Full implementation of these strategies, and identification of the resources required will, however, depend upon new and ongoing partnerships among tribes, federal and state governments, and the private sector[11].

The prevalence and severity of dental caries among school children in the United States should continue to decline as long as fluoride use remains around current levels[12]. Use of fluoride toothpaste seems to be increasing. Sugar consumption is stable, although sucrose consumption as a proportion of total sugar consumption is declining[12]. Increased tooth retention is thought to increase the risk of root caries in older persons, but the continued use of fluoride toothpaste may minimize any such increase. The main growth area for fluoride use may be in toothpastes. Monitoring caries trends in the future will require good data on the epidemiology of caries in young and middle-aged adults[12].

A dramatic decline in dental caries prevalence has been noted in recent decades in the majority of industrialized countries which is mostly attributed to the regular use of fluoride, improved oral hygiene and a prudent diet[13].

In Hong Kong, Malaysia and Singapore, for example, prevalence was low (less than 2 DMFT teeth at 12-years of age) in the 1930's and early 1940's, but rose to at least moderate levels in the 1960's (4 or 5 DMFT teeth) and has recently fallen again to previous levels[1]. This has occurred largely because of the early introduction of community programmes which have been based especially on the optimum use of fluorides[1]. Lo and Bagramian[14] reviewed dental health surveys of school children in Singapore from past decades to document reductions in prevalence of dental caries. They came to the conclusion that fluoridation of public water supplies together with the adoption of preventive dental health programmes by the state and professional bodies, are the major factors in caries reduction.

A joint working group of the WHO and FDI was formed in 1981 to investigate the dramatic decrease in dental caries in children and young people that had been observed in a number of industrialized (developed) countries in the 1970's[15]. Nine developed countries showed substantial reductions in caries and the most probable reason for these reductions include: widespread exposure to fluoride in the form of fluoridated water, fluoride supplements and fluoridated toothpastes; the provision of preventive dental health services; increased dental awareness through organized education programmes; and the ready access to dental services[15]. Comparison with Japan, which has not experienced a similar reduction in caries, indicates that the single most important factor was the availability of fluoride toothpaste[15].

Renson[15] reported a rising DMFT figure over a 25 year period (1957-1981) in Japan. However, Morinushi et al[16] indicated that experience and severity of dental caries in 1995 showed a clear decrease from observations in 1980 in

Kaogsima City, Japan. This decline was attributed to several factors such as the qualitative and quantitative improvements in treatment of caries, more regular visits to dental clinics, improved daily oral hygiene, changes in dietary pattern and the availability and widespread use of fluoride dentifrices[15,16].

The declining prevalence of dental caries has continued from childhood to teenage and adolescence, with young adult populations enjoying similar benefits in many highly industrialized nations[1]. In some countries (e.g. the Netherlands) the first age cohorts experiencing conspicuously less caries have probably now reached around 30-years of age, and the expectation is that this trend will continue into later life[1]. Some areas that have more recently undergone industrialization have experienced a different pattern in the prevalence of caries[1].

In the Netherlands the percentage of 6-year-olds with a caries-free dentition increased from 4 percent in 1973 to 47 percent in 1988[17], and for 12-year-olds from 0 percent in 1973 to 45 percent in 1988. The mean dmfs score decreased steeply from 14.4 in 1973 to 3.8 in 1982 and rose slightly to 4.0 in 1988[17]. Truin et al[18] also reported a halt in the decline of caries prevalence in the Netherlands since the mid 1990's among 6-year-olds. According to WHO criteria, 12-year-old children in the Netherlands now have a very low caries experience[18]. Children in Belgium belong to the moderate caries experience category[18]. Recent data from the two countries indicate a further decrease in caries prevalence of 12-year-olds during the last decade[18]. The stability of juvenile oral health does not seem to be due to changes in dietary habits, nor to public health measures, but is mainly due to good oral health and use of fluoride dentifrices by the children[19].

Although widespread use of fluorides and other preventive methods may have reduced the level of dental caries among children in many parts of the world, children in some parts of the world, including Taiwan, appear to experience dental caries at a high rate[20]. A 1960 study comparing the caries experience of Taiwanese and Australian children found that DMFT values for eight, ten and eleven-year-old children in Taiwan were 1.7; 1.8 and 3.8, respectively, while rates for Australian children of the same ages were 3.2; 5.3 and 7.0[20]. Surveys, since the 1970's, monitoring the oral health status of school children attending School Dental Services in Australia, have demonstrated declining rates of caries experience, both in deciduous and permanent teeth[21].

In contrast to many other Western European countries, the prevalence of dental caries in Belgian school children was still high in the early 1980's[22]. More recent data on dental caries in Belgian children show a reduction in caries in 12-year-olds from 1983 to 1998 when investigated cross-sectionally. A reduction of the mean number of teeth affected by dental caries from 7.5 to 1.6 and of tooth surfaces from 11.5 to 2.5 was observed. In addition, the percentage of caries-free children rose from 4 percent to 50 percent[22].

2.2 CARIES TRENDS IN LESS DEVELOPED COUNTRIES

Dental caries is predominantly a disease of children and adolescents[23]. With an increasing number of children in the population, South Africa will have an increasing number of people at risk for this disease.

Cleaton-Jones et al[24] reported on trends in the primary dentition of four South African population groups between 1976 and 1987. Their results showed an increasing dental caries prevalence in the primary dentition of rural Black and urban Black children, and, the fastest rate of increase being observed among urban Indian children. These authors also demonstrated a decreasing dental caries prevalence among White children[24]. In 1982, Walker et al[25] reported an increase in caries prevalence in the permanent dentition of urban Black high school pupils and in Coloured primary school pupils. In particular, a high rate of untreated carious lesions were identified[26]. Brindle et al[27] investigated the rates of dental caries in Hlabisa, KwaZulu Natal - a rural South African community. The results demonstrated that except for the 5- to 6-year-olds the dental caries rates were low and were within WHO targets for the year 2000. However, the authors also reported that most of the caries were untreated and, where present, treatment was by extraction. It is clear that there is an enormous and pressing need for oral care among South African children, especially those that have been historically disadvantaged.

A relationship between a population's level of socio-economic development, as defined by the Human Development Index (HDI), and dental caries has been previously reported[6]. Dental caries is a good proxy measure for socio-economic development and countries in the throes of socio-economic transition have the highest dmft/DMFT scores[6]. Du Plessis et al[28] suggested that socio-economic status plays a major role in caries prevalence and severity in all population groups in South Africa, with sharp declines in caries prevalence in higher socio-economic groups and a possible slow increase in lower socio-economic groups.

Khan and Cleaton-Jones[29] investigated the associations between dental caries prevalence and severity and social factors in 3- to 5-year-old African children. The study showed that the percentages of 3-year- and 4-year-olds, and 5-year-olds with any caries experience were 47 percent and 63 percent, respectively. Lower family education level was negatively associated with caries prevalence (p=0.03) and severity (p=0.008) in a multivariable regression model. The conclusion was made that in the indigenous African group studied, low family education is a disease marker to target in future caries risk evaluations[29].

Bonecker and Cleaton-Jones[30] determined the trends in dental caries prevalence and severity in Latin American and Caribbean children. A systematic review was done of studies published between 1970 and 2000 among 5- to 6-year and 11- to 13-year-old children that used WHO caries diagnostic criteria. Evidence of a decrease in dental caries in Latin American and Caribbean children was demonstrated, although the decrease was less prominent in the past few years[30].

Data on the prevalence and severity of dental caries collected by country members of the Pan American Health Organization (PAHO) were recently summarized to analyze current status and trends of dental caries in the Americas since the 1970's[31]. The mean number of decayed, missing, and filled teeth (DMFT) among 12-year-old children and the relative contribution of each DMFT component were collected from official reports and publications in the scientific literature. Overall, a secular trend toward lower caries prevalence was observed in most countries, more notably among those with large prevention programmes using fluorides[31]. Many countries

have reached the World Health Organization (WHO) year 2000 goal of a mean DMFT of ≤ 3 but others are still far from reaching that goal[31]. Few countries have reached the status of having large proportions of disease prevalence localized in a small percentage of the population, a pattern observed as prevalence decrease. Since 1994, PAHO's Regional Oral Health Program has developed two strategies to address these issues: the introduction and reinforcement of national preventive programmes using fluorides and the introduction of the atraumatic restorative treatment (ART)[31].

A study by Irigoyen and Sánchez-Hinojosa[32] to describe the dental caries experience in 12-year-old students in the State of Mexico and to detect changes after 9 years of salt fluoridation (1988 to 1997) indicated that the oral health status of the State of Mexico students had improved during the previous decade. The proportion of caries-free children was 10.3 percent in 1988 and 27.7 percent in 1997; the mean DMFT index was 4.39 in 1988 and 2.47 in 1997; the caries reduction detected was 43.7 percent[32]. However, there is still a need for further caries reduction[32].

Typical developing countries experience extremes of rich and poor, landed, landless and hyper-fragmented smallholdings, overcrowded cities, inadequate academic education, limited or non-existent health services and a stagnant economy; all these factors influences the prevalence, incidence and rate of progression of dental caries[7].

In South Africa, the 1998 Poverty and Inequality report[33], identified race as one of the most significant indicators of poverty, with 61 percent of Black Africans, 38 percent of Coloured, 5 percent of Indian, and only 1 percent of

the White population categorized as being poor – assessed against consumption-based income poverty lines[33]. Other identified indicators of poverty included female–headed households, unemployment and rural residence. The nine provinces listed in descending order according to poverty rates are; Eastern Cape (71% of residents are poor), Free State (63%), North West (62%), Limpopo Province (59%), Mpumalanga (57%), Northern Cape (55%), KwaZulu-Natal (52%), Western Cape (28%) and Gauteng (17%)[33].

Awadia et al[34] assessed the role of predictors of caries experience among children in urban and rural areas of northern Tanzania. Children of the different communities had varying dietary habits and consumed water with varying fluoride (F) concentration. Subjects (n=256) aged 9 to 14 years were examined in high–F areas (3.6mg F/l, Arusha and Arusha Meru, n=101) and low-F areas (< 0.4mg F/l, Moshi and Kibisho, n=155). Dental caries was assessed under field conditions using the decayed, missing, filled teeth (DMFT) index and the World Health Organization (WHO) criteria (1997). The prevalence of caries was 14 percent. The mean DMFT score was 0.22 (n=256), the range between areas 0.07 – 0.66. Carious lesions were mainly observed in mandibular first molars. Logistic regression analysis indicated that subjects in the high-F and urban Arusha municipality were at a significantly higher risk of dental caries than children in low-F areas (odds ratio (OR) 2.6). Controlling for ethnicity, children in urban areas were at a higher risk for caries (OR 5.4) than children living in low-F rural Kibisho[34].

In most developing low income countries the prevalence of caries is about 80 percent[35] and over 90 percent of caries is untreated; the severity of caries is relatively low[35]. However, a study by Ng'ang'a and Valderhaug[36] showed

that the prevalence of dental caries in Nairobi, Kenya is relatively low. Fifty-four percent of the 6- to 8-year-olds and 50 percent of the 13- to 15-year-olds were caries free[36]. Ayo-Yusuf et al[37] also suggested that caries levels decreased over the years in 12-year-old South African children, although this decline may not have been experienced equitably across all South African social classes as there is demonstrable evidence of socio-economic inequity in dental caries in South Africa.

Cleaton-Jones[38] investigated trends in dental caries in 5-year- to 6-year-old and 11-year- to 13-year-old children in two UNICEF designated regions: Sub-Saharan Africa, and Middle East and North Africa. The results of this study showed that although not significant, the percentage caries prevalence trends were downward in Sub-Saharan Africa for both 5-year- to 6-year-olds and 11-year- to 13-year-olds while in the Middle East and North Africa caries prevalence remained constant over the 30-year review period in both age groups. Mean dmft scores significantly diminished in 5- to 6-year-olds during the study period in Sub-Saharan Africa but the scores remained constant in the Middle East and North Africa. Mean DMFT scores remained constant in 11-year- to 13-year-olds in both Sub-Saharan Africa and the Middle East and North Africa. When the mean dmft and DMFT scores per carious mouth were calculated, both age groups in Sub-Saharan Africa showed clear reductions, the reduction for 11-year- to 13-year-olds being statistically significant. In the Middle East and North Africa the trends in the low age groups remained unchanged[38].

Cleaton-Jones and Fatti[39] determined and reported on the trends in published dental caries rates in South Africa. This study showed a

predominantly downward trend in dental caries which was statistically significant for dmft at age 5- to 6-years and for DMFT at 35- to 44-years. Cleaton-Jones, Williams and Fatti[40] concluded that the percentage of children with a dmft >0 at a preschool in Germiston, South Africa, slowly declined in the absence of organized prevention to produce a secular trend of decreasing caries rates. The authors suggested this may be related to *Streptococcus mutans* species. However, van Wyk et al[41] noted a slight rise in caries in primary teeth amongst 4-year- to 5-year-olds, but a decline in caries in permanent teeth. These authors suggested that the regional differences in caries trend may be related to lower levels of natural fluoride content of drinking water in the coastal areas compared to the interior[41]. Grobler and Dreyer[42] determined the range of fluoride levels in the drinking-water of cities and villages in South Africa during the transition from a very dry (1983) to a wet (1984/85) period. The fluoride levels of the drinking water in the coastal and interior regions was found to be: Cape Town <0.05; Durban =0.05; Bloemfontein =0.21 - 0.35 and Port Elizabeth <0.05.

2.3 URBANIZATION AND HEALTH

Within South Africa, as elsewhere in Africa, there are rural and urban populations as well as populations in transition[43]. Population migration from South Africa's rural areas and small towns to metropolitan centers has been reasonably constant at around 12 percent of the population in each five-year period investigated, namely, 1975-1980, 1992-1996 and 1996-2001. Migration in Africa often occurs to maximize family and household livelihoods by diversifying sources of household income and risks[43].

Sub-Saharan Africa has rates of urban growth of 5 to 6 percent per annum; and the rural to urban migration remains the principal source of urban growth[44]. Many primary centers and some secondary cities have experienced persistent growth of 9 to 11 percent per annum, which means that their populations double in less than a decade. These rates are two to three times higher than the respective national population growth rates, which average 3 to 4 percent per annum, which are themselves among the highest in the world[44].

The prevalence of dental caries in rural or urban sections of a developing country is related to age, socio-economic status and specific location; the caries prevalence is also directly correlated with family consumption of sugar[45]. Recent epidemiological studies in economically developing countries show that the prevalence and severity of dental caries has increased with industrialization and exposure of these populations to western diets[46].

Varenne et al[47] analyzed the oral health status of children in rural and urban areas of Burkina Faso, Africa. The samples included a multistage cluster sampling of households in urban areas, as well as random samples of participants. The selection of both samples was based on the recent population census in rural areas. The clinical oral health data collected, was according to the WHO methodology and criteria[47]. The results showed that 38 percent of the 6-year-olds, had caries, with prevalence higher in urban than rural areas. The mean DMFT of the 12-year-olds was 0.7 and the prevalence significantly higher among urban than rural children[47]. This may

be due to an increased availability of refined sugar products without a concurrent rise in oral health awareness, and a lacking in community-based oral disease prevention and health promotion programmes[47,48].

A high caries prevalence and severity among urban Fijian school children were associated with infrequent brushing, snacking on sugar-containing foods, having seen a dentist before, and having last visited a dentist because of pain[48]. The results showed that the prevalence of dental caries among urban Fijian School children aged between 6 and 8 years was 87.6 percent in the primary dentition and 46.7 percent in the permanent dentition. The mean dfs and mean DFS were 8.43 (sd 7.82) and 2.38 (sd 1.37), respectively. The caries prevalence of the sample was comparable with findings from a national oral health survey conducted in Fiji in 1985/86, but the caries severity was greater[48].

Irigoyen et al[49] compared dental caries experience in Mexican rural and urban settings. The caries prevalence was 91.6 percent in the urban area, and 54.4 percent in the rural area ($p<0.05$). DMFT in the 10-year olds was 1.93 (sd 1.72) and 0.40 (sd 0.76) in urban and rural areas respectively (95 percent CI 1.16 – 1.89). The entire DMFT/dmft indices in the rural group comprised of the decayed component[49]. The authors concluded that there is a large difference in the prevalence and distribution of dental caries between rural and urban Mexican children[49]. The dental treatment background also differs between the rural and urban communities and there is a need to establish distinct preventative and rehabilitative treatment strategies tailored to meet the specific needs of different population groups[49].

Tribal children, 6- to 13-years of age, living in remote villages of Mandu in district Dhar of Madhya Paradesh (Central India) exhibited a low prevalence of dental caries, both in the primary and permanent dentitions, compared to rural as well a urban Indian children of the same age[50]. The point prevalence of dental caries in primary teeth was 28 to 37 percent in the 6- to 8-year-old group and point prevalence of dental caries in the permanent teeth was 6 to 17 percent in the children age 8- to 12-years[50]. The dmft ranged between 0.8 – 1.25 in the 6- to 8-year-olds and the DMFT between 0.5 – 1.4 in the 6- to 12-year-olds. The tribal children showed less caries both in terms of dmft/DMFT and in severity when compared to the rural and urban Indian children. These results suggest that the amount of sugar consumed in the rural and urban areas, can result in the variations of caries prevalence between these areas[50].

El-Nadeef et al[51] wanted to determine the association between urbanization and the prevalence of dental caries among school children in Nigeria's new capital territory. Schoolchildren, with a mean age of 11.4 years, from urban, semi-urban and rural areas were examined. The results showed that the mean number of decayed teeth (DT) in the strata were; 27 percent in the urban, 24 percent in the semi-urban and 12 percent in the rural areas[51]. The authors concluded that urban and semi-urban children had a higher risk for caries than their rural reference group[51].

Cleaton-Jones et al[52] found that urban Coloured and Indian children age 1- to 4-years, have the highest caries prevalence in the primary dentition, and White children the lowest[52]. Dental caries prevalence and experience (DMFS) recorded in 12-year-old Indian and White children living in adjacent urban

communities with the same fluoride concentration in the drinking water (0.21 – 0.33ppm), were significantly higher in the Indian children[53]. The mean DMFS in the Indian children was 3.65 (sd 3.98) and in the White children 2.66 (sd 3.49); 40 percent of the Indian children were affected by dental caries and 30 percent of the White children[53].

Schoolchildren aged 7- to 12-years, from urban and rural areas in Araraquara, SP, Brazil, were examined to assess the prevalence of caries and dental care status[54]. The results showed that the DMFT index was similar in both areas. At 12 years-of-age, the DMFT was 3.8 in urban school children and 4.0 in rural schoolchildren, considered moderate according to WHO criteria[54]. However, the dental care status was different in the urban and rural areas. In the urban area, 82.9 percent of the decayed teeth were filled and in the rural area, only 22.1 percent. The moderate prevalence of dental caries and the high proportion of filled teeth in the urban area suggest that the implementation of primary prevention programmes is necessary, in both, urban and rural populations[54].

2.4 DENTAL HEALTH PROGRAMMES AND DENTAL CARIES PREVENTION

Dental caries is a potentially preventable infectious disease that, if left untreated, can cause significant morbidity requiring costly treatment[55].

2.4.1 Experiences from developed countries

In 2005, Jackson et al[56] wanted to determine whether teacher-supervised tooth brushing, once a day, during term time, with commercial toothpaste containing 1450 ppm fluoride, could reduce dental caries in primary school

children when compared with children from the same community who did not receive this intervention. Class teachers were trained individually by the same dental hygienist in an appropriate tooth brushing technique for young children. Children in the intervention group brushed once a day at school. All examinations were visual assessment only. They found that for children in the intervention group, the overall caries increment (DMFT increase of 2.60) was significantly less (10.9%; $p<0.001$) than for children in the non-intervention group (DMFT increase of 2.92). Among different tooth surfaces, the difference in caries increment between the intervention group (DMFS increase of 0.78) and the non-intervention group (DMFS increase of 1.03) was greatest for the proximal surfaces (21.4%; $p<0.01$)[56]. This study suggests that a programme of daily teacher-supervised toothbrushing with fluoride toothpaste can be effectively aimed at socially deprived communities and significant reduction in dental caries can be achieved especially among caries susceptible children[56].

Davies et al[57] demonstrated that a programme distributing free fluoride toothpaste, containing 1450 ppm F, provides a significant benefit for high caries risk children living in deprived, non-fluoridated districts in the UK. The authors' main outcomes measures were the dmft index, missing teeth and the prevalence of caries experience. A further aim was to compare the effectiveness of a programme using a toothpaste containing 440 ppm F (Colgate gel) with one containing 1450 ppm F (Colgate Great Regular flavour). An analysis of 3731 children who were examined and remained in the programme showed the mean dmft to be 2.15 for the group who had received 1450 ppm toothpaste and 2.49 for the 440 ppm F group. The mean dmft for the control group was 2.57[57]. The 16 percent reduction between the

1450 ppm F and control group was statistically significant ($p<0.05$). The difference between the 440 ppm F group and the control group was not significant.

Pakhomov et al[58] investigated the caries reducing effect of an amine fluoride toothpaste used under real-life conditions in a community preventive program in Geneva, Switzerland. Approximately 1 250 children 3- to 12-years of age were provided with toothpaste (four tubes (360 grams) annually during three years) to be used in kindergartens or schools and once a day at home. The teachers supervised daily toothbrushing sessions. Random samples of children in each of the ages 3-, 6-, 9- and 12-years were selected from the intervention and the reference communities at both the start of the study and after three years, and examined for dental caries experience[58]. The authors concluded that the implemented fluoride toothpaste program is a feasible and practical method of improving the oral health status of children, as the amine fluoride dentifrices seemed to provide a reduction in dental caries prevalence compatible to the most commonly used fluoride dentifrice compounds[58].

Oral Health Education (OHE), in conjunction with a sugar-free chewing gum program, can have a positive effect on the oral health status of children in terms of reduced caries increment[59]. Peng et al[59] randomly chose nine primary schools from one district (PR China) and divided them into three groups: Group E receiving oral hygiene education, Group G receiving oral hygiene education and sugar free chewing gum, and Group C, the control group. All children from grade 1 (Aged 6- to 7-years) were recruited (n=1342). After 2 years, 1143 children remained in the study group at follow-up. The

overall drop-out rate was about 15 percent. Data on dental caries were collected by clinical examination. The results showed that the mean increment of DMFS in group G was 42 percent lower than in groups E and C ($p<0.05$). The mean increments in filled surfaces were higher in Groups G and E than in Group C ($p<0.01$). The authors concluded that the school-based OHE programs had some positive effect in improving children's oral hygiene and, in certain circumstances, children benefited from using polyol-containing chewing gum in terms of reduced dental caries[59].

A study by Freeman et al[60] suggested that heavy consumption of cariogenic snackfoods leads to a high prevalence of childhood dental caries in Northern Ireland. These authors thus developed a policy to promote and facilitate healthier eating. The researchers, together with dental practitioners, and the school community, formed a partnership to create the "Boost Better Breaks (BBB)" School-based policy, a policy developed and supported by dieticians, health promotion officers, teachers, school meal advisors, and local suppliers of school milk[60]. The programme permitted the consumption of only milk and fruit at break time. The results of the first two years were positive and the initial findings indicated that the program had a positive effect in increasing the mean number of sound teeth in children attending schools in areas where socio-economic conditions are poor. Thus, the authors concluded that collaboration can facilitate improvement in children's dental health and that careful implementation of the policy in schools in poor areas, has the potential to narrow disparities[60].

Water fluoridation programs initiated in the 1950's and 1960's in the United States, resulted in reduction of tooth decay in children since its inception[61].

Even in Hong Kong where water fluoridation was introduced in 1961, a continuous, low and stable caries prevalence in children and in adults can be seen[62].

Other professional preventive programmes that includes fluoride varnish application, fluoridated dentifrices[56,63], fluoride supplements, sealants[64] and diet counselling can prevent dental caries, but, the social and economic factors that face many families should also be addressed[63]. Alternatives like sound health education and health activities validated by research, will also form the foundation upon which prevention is organized, implemented and perpetuated[65].

Dental knowledge, attitudes and health behaviour among mothers, and dental knowledge and attitudes of school teachers, and their respective involvement in health education, should also be assessed[62]. Petersen et al[66] found that the level of dental knowledge was higher among teachers than mothers; the mothers were mostly informed through television/radio, while teachers had received information from various sources, including the dentists[66]. The teachers responded positively to prevention of dental diseases among children and should be considered the key persons in dental health education and key contributors aiding to the success of school based dental health programmes[66].

2.4.2 Experiences from developing countries

According to Teng et al[67], there is a need for continuous monitoring and strengthening of activities and cooperation of Oral Health Preventive School Programs among primary schools in Phnom Penh City, Cambodia, to reduce

the prevalence of dental caries among these children. A cross-sectional survey was thus undertaken to assess dental caries status, knowledge, attitude and practice in oral health amongst 12-year-old primary school children participating in the Oral Health Preventive School Program (OHPSP) conducted since 1998 in Phnom Penh City, Cambodia. Schools were stratified into 3 groups by levels of cooperation with the OHPS program (good, partial and poor) and samples of schools were randomly selected from each group. Dental caries status, DMFT and knowledge, attitude and practices in oral health were assessed from 21 January to 5 February 2002. The results showed the overall mean DMFT in school children in Phnom Penh City, Cambodia was 2.33 (95% CI=2.05 – 2.61) while mean DT (Decayed teeth) was 2.31 (95% CI = 1.97 – 2.52) and mean MT (Missing teeth) and mean FT (Filled teeth) were both a low 0.01. Children from schools with good cooperation with the OHPSP had the lowest significant mean DMFT 1.62 (95% CI = 1.25 – 1.98) compared to children from schools with partial and poor cooperation (Mean DMFT = 2.67 : 95% CI = 2.10 – 3.23; and 2.69 : 95% CI = 2.19 – 3.19; respectively)[67]. The authors then concluded that the OHPS program reduced the dental caries prevalence among school children in Phnom Penh City, Cambodia[67].

Lalloo and Solanki[68] investigated the effect of an oral health care programme on the prevalence of dental caries in South African schools that received the programme. The authors evaluated a comprehensive oral health care programme seven years after it had started (in 1986) at a public dental health clinic in Cape Town. Five primary schools served by the clinic were selected for a community trial. Three schools were randomly allocated to receive the programme and two to a non-participating control group. An

evaluation to assess the effectiveness of the programme was carried out by comparing the mean DMFS scores of the experimental (programme) schools with control (non-programme) schools. One hundred and ten (110) children who entered the programme in 1986 and one hundred and two (102) non-programme children of similar age were examined and compared in 1992[68]. In the experimental group the mean DMFS score was 1.94 compared to a DMFS of 6.12 in the control group. The percentage of caries-free children in the experimental group was 62.5 percent and in the control group 37.5 percent. The frequency distribution of the DMFS scores showed that one subject from the programme group had a score of ≥15 and thirteen non-programme subjects had scores ≥15. All the comparisons between the two groups reported above were highly significant ($p<0.005$)[68]. Thus, the authors concluded that an oral health care programme consisting of fluoridated toothpaste, can be very effective in reducing the prevalence of dental caries in schools that received the programme[68].

A study was designed by Josie–Perez et al[69], in Johannesburg, South Africa, to compare the caries status of children 8- to 10-years and 11- to 13-years of age, at schools visited by and schools not visited by the Mobile Dental System (MDS). A total of 918 children from six primary schools participated in the study. For the experimental schools, Noordgesig and Cavendish were paired in Group 1 (curative services and brushing programmes), while Riverlea and Wilhelmina Hoskins were combined in Group 2 (curative services and weekly fluoride mouth rinse programmes). Kliptown II and Ernest Hobbs were grouped together as the control schools (Group 3) where no services were provided by the Mobile Dental System. Dental caries examinations were conducted using the World Health Organization (WHO) criteria (1987).

Statistical analysis was done using chi-square tests, ANOVA and pairwise t-tests. A comparison of mean DMFT scores revealed differences between the control and both experimental groups in the 11- to 13-year-old age group that was significant. Children in the control schools Kliptown II and Ernest Hobbs generally had a lower mean DMFT score (0.84 and 1.16 respectively) than pupils from the experimental schools Noordgesig (DMFT = 1.54); Cavendish (DMFT = 1.47); Riverlea (DMFT = 1.47) and Wilhelmina Hoskins (DMFT = 1.92). Children from the control schools had the least number of fillings. The mean filled component for children 8- to 10-years was 0.28 (Group 1); 0.09 (Group 2) and 0.07 (Control group); and for children 11- to 13-years of age the mean filled component was 0.65 (Group 1); 0.35 (Group 2) and 0.11 (Control group). Statistically significant differences between experimental and control groups for the filled components of the DMFT in both age cohorts were demonstrated. Group 1 appears to have received the most treatment for both age groups in terms of their filled components. The missing component was the smallest component for the DMFT. The mean missing component for Group 1 children (0.31) was almost three times that of control schools (0.11) for the 11- to 13-year-olds ($p < 0.0007$). No statistically significant differences were established in the younger age cohorts. These findings clearly showed the impact of services provided by the Mobile Dental System. There were however, no differences in the decayed component indicating the limitations of the system in preventing or controlling the development of new carious lesions[69].

2.5 SUMMARY

Dental caries is the most common oral disease in the world and it is predominantly a disease of children and adolescents[7,23]. However, there

seems to be a remarkable progress in the reduction of dental caries in developed and developing countries.

From the reviewed literature it seems evident that the prevalence of dental caries is decreasing amongst 12-year-old children in both developed and developing countries. The literature further suggests that this decrease could mainly be attributed to the widespread exposure to fluoride in the form of fluoridated water (including fluoridated water programmes)[14,15,56,57,61,62]; the use of fluoridated toothpastes and fluoride supplements[1,12,13,14,15,16]; the provision of preventive dental health services[15,56,57,61]; increased dental awareness through organized education programmes[59,62,66,67]; and the ready access to dental services[15,68,69].

It also become apparent that socio-economic status[6,28,29,33], as well as urbanization, plays a role in dental health[25,27,34,35]. The literature further suggests that the prevalence and severity of dental caries increased in previously disadvantaged communities[6,28,29,33]; increasing with industrialization[47,48] and exposure of these populations to western diets. These western diets consist mainly of an increase in the consumption of sugar or cariogenic food stuff[13,27,45,46,59,60].

The reviewed literature also suggests a higher prevalence and severity of dental caries in the primary, than in the permanent, dentition amongst 6-year- and 12-year-old children[24,26,27]. An increase in the prevalence and severity of dental caries, amongst the Coloured population in South-Africa, is also suggested[25,26].

The reviewed literature, together with the results extrapolated from the three National Oral Health Survey's in South Africa (1982/1983; 1988/1989 and 1999/2002); will play an integral part in determining the trends in dental caries prevalence and severity amongst 6-, 12- and 15-year-old children in South Africa.

CHAPTER 3

AIM AND OBJECTIVES

3.1 AIM

The aim of this study was to determine the trends in dental caries prevalence and severity amongst South African children, in terms of the dimensions of time, place and person.

3.2 SPECIFIC OBJECTIVES

3.2.1 To determine the trends in caries prevalence and severity over the period 1983 to 2002 in South Africa.

3.2.2 To determine the trends in caries distribution across different geographical regions in South Africa.

3.2.3 To determine trends in dental caries distribution in terms of age, race and gender in South African children.

CHAPER 4

RESEARCH METHODOLOGY

4.1 INTRODUCTION

South Africa is classified as a middle income emerging market with an abundant supply of natural resources and well developed financial, legal, communications, energy and transport sectors[70]. The country which was divided before 1994 into regions and several independent "home lands", is currently demarcated into 9 provinces, with a total population of approximately 45 million people[71]. As in the repealed 1950 Population Act, the population comprises of four main population groups. These four population groups will be referred to in this dissertation. Asians, 2.5 percent of the population; mainly people of Indian descent. Blacks, 79 percent of the population; descendants of African peoples who migrated in a southerly direction from central Africa. Coloureds, 8.9 percent of the population; people of mixed parentage, mainly descendants of the indigenous Khoi Khoi people, the Malayan slaves and the White settlers. Whites, 9.5 percent of the population; descendants of the European settlers, mainly Dutch, British, German, French and Portuguese[72].

4.2 MATERIALS AND METHODS

4.2.1 Literature Survey

The literature survey ranged from 1980 to 2006 and included articles and/or reviews on the following:

- Caries trends in developed countries
- Caries trends in less developed countries

- Dental health programmes and dental caries prevention
- Socio-economic influence on caries trends
- Fluoride containing dentifrices
- Fluoride supplements
- Water fluoridation
- Dietary habits and the influence on dental caries prevalence and severity
- Urbanization and health/oral health

4.2.2 **Data**

Data obtained from the 1982/1983[2], 1988/1989[3] and 1999/2002[4] National Oral Health Surveys was used to determine the trends in dental caries prevalence and severity amongst South African children.

4.2.2.1 Sampling

Sampling for the 1982/1983, 1988/1989 and 1999/2002 National Oral Health Surveys consisted of a research design that was devised for conducting an epidemiological survey amongst a sample of children in the age group 12-years; and in the age groups 6- and 15-years for the 1988/1989 and 1999/2002 National Oral Health Surveys.

4.2.2.2 Methods

- The World Health Organization (WHO 1979)[73] methods and criteria with regard to dental caries were followed for the 1982/1983 National Oral Health Survey (where all "sticky fissures" were recorded as caries).
- The World Health Organization (WHO 1987)[74] methods and criteria with regard to dental caries were followed for the 1988/1989 National Oral Health Survey.

- The World Health Organization (WHO 1997)[75] methods and criteria with regard to dental caries were followed for the 1999/2002 National Oral Health Survey.

4.2.2.3 Diagnostic criteria

Children were examined in good natural light with a mirror and sharp probe. Clinical assessment was done and the data recorded. From this data the following were calculated:

a) Mean number of primary teeth per person.

b) Number and percentage of subjects with caries of the primary dentition; number and percentage of subjects with untreated caries of the primary teeth; number and percentage of subjects with four or more dmf primary teeth.

c) Mean number of decayed primary teeth per person; mean number of filled primary teeth with decay per person; mean number of filled primary teeth per person; mean number of missing primary teeth per person; mean number of dmf primary teeth per person.

d) Mean number of permanent teeth per person.

e) Number and percentage of subjects who have or had caries of the permanent dentition; number and percentage of subjects with untreated caries; number and percentage of subjects with four or more DMF permanent teeth.

f) Mean number of decayed permanent teeth per person, mean number of filled permanent teeth with decay per person; mean number of filled permanent teeth per person; mean number of missing permanent teeth per person; mean number of DMF permanent teeth per person.

4.2.3 Comparison/trends of dental caries prevalence and severity in South Africa: 1982-2002

Descriptive time series analysis was used to determine trends in dental caries prevalence and severity in South Africa.

Changes in the prevalence/severity of dental caries were evaluated by comparing the prevalence/severity in a specific geographical location in either 1982/1983 or 1988/1989 ($time_1$) with the same group in the same area for either 1988/1989 or 1999/2002 ($time_2$). The annual percent change was calculated by dividing the difference in the prevalence/ severity of dental caries between $time_2$ and $time_1$ by the number of years between $time_1$ and $time_2$. The annual percent change in prevalence/severity was calculated by dividing the difference in prevalence/severity between $time_1$ and $time_2$ expressed as a percentage/DMFT/dmft by the number of years between $time_1$ and $time_2$.

For the dimension of place (geographical location) the following variables were compared; equivalent regions in certain provinces, urban/rural and coastal/interior.

Statistical analysis of caries distribution will focus on four equivalent regions within four provinces of South Africa namely: Metro Cape in the Western Cape, Port Elizabeth in the Eastern Cape, Durban in Kwa-Zulu Natal and Bloemfontein in the Free State Province, as only these areas had data consistently available over the study period.

In terms of the dimension person, the variables; gender, age group, and population group were compared.

Using Statistix 8.0 the following statistical tests were performed:

- A two sample proportion test was used to determine if there was a statistical significant change in the prevalence of dental caries or in the percentage of individuals with active caries amongst the different age groups (6-, 12- and 15-year-olds), across gender and across population groups. If a statistical significant difference existed between the above-mentioned parameters, the p-values were recorded.
- An association test, using two by two tables/chi-square, was used to compare the total of a population's severity (dmft/DMFT) of dental caries from 1982/1983 with the total of a population severity (dmft/DMFT) to 1988/1989 and/or to 1999/2002; as well as amongst the various age and gender groups.
- Statistical significance was determined if the calculated p-value was smaller than 0.05 ($p<0.05$).

4.3 NULL HYPOTHESIS

Following the purpose of the research described in Chapter 1 and Chapter 3:

- Severity (DMFT) of dental caries will not be significantly lower in 1999/2002 than in either 1982/1983 and/or 1988/1989 amongst 12-year-old children in South Africa.
- The mean number of decayed teeth (dt/DT) will not be significantly lower in 1999/2002 as compared with the data from 1982/1983 and/or from 1988/1989.

- There will be no significant difference in the trends in dental caries prevalence and severity amongst the Asian, Black, Coloured and White population groups in South Africa, from either 1982/1983 to 1988/1989 and/or to 1999/2002.
- The trends in dental caries prevalence and severity will not be significantly different in the selected geographical locations mentioned in this dissertation.

4.4 LIMITATIONS

- The main limitation of this study is arguably the fact that comparisons/trends in the prevalence and severity of dental caries could only truly be determined amongst 12-year-old children in South Africa, from 1982/1983 to either 1988/1989 and/or to 1999/2002, because only 12-year-old children were examined during the 1982/1983 National Oral Health Survey in South Africa.
- Time difference (years difference) between the three National Oral Health Surveys may have an influence on the prevalence and the severity of dental caries recorded. Between 1982/1983 and 1988/1989 there is 6 years difference; and between 1988/1989 and 1999/2002 there is 13 years difference.
- Calibration and training of examiners: In order to obtain an acceptable level of reliability all examiners were trained and calibrated prior to each National Oral Health Survey. However, the 1988/1989 and 1999/2002 National Oral Health Surveys used the same bench mark for calibration of the examiners, but in the 1982/1983 survey a different standard of calibration was used. This may explain the variation in recording of data from the 1982/1983 National Oral Health Survey to the 1988/1989 and

1999/2002 National Oral Health Surveys where lower levels of dental caries prevalence and severity were recorded.

- Standard deviations (sd) were only available from the data obtained and recorded from 1988/1989, as well as from the data recorded in 1999/2002. Thus, to be able to determine the statistical significance in the severity of dental caries amongst the different age, gender and population groups, from 1982 to 1989 and/or to 2002; two by two tables/chi-square tests (association tests) could only be used.
- The results obtained from the 1999/2002 National Oral Health Survey might be the most complete results on the trends in dental caries prevalence and severity, as all said age groups (6-, 12- and 15-year olds) were examined and standard deviations (sd) are also available in the recorded data.
- All three National Oral Health Surveys were cross-sectional studies; thus limiting the types of statistical analysis that could be performed.
- The findings from the current study is arguably limited by the fact that the study cannot claim to be truly nationally representative because statistical analysis of caries distribution only focused on four equivalent regions within four provinces of South Africa namely: Metro Cape in the Western Cape, Port Elizabeth in the Eastern Cape, Durban in Kwa-Zulu Natal and Bloemfontein in the Free State Provionce, as only these areas had data consistently available over the study period.

CHAPTER 5

RESULTS

5.1 INTRODUCTION

This chapter presents the framework for caries measurement by looking at the severity, prevalence and caries trends over time, place and person in South Africa. The variable time will consist of data mainly obtained from the three National Oral Health Survey's (NOHS's) in South Africa (1982/1983, 1988/1989 and 1999/2002). Statistical analysis of caries distribution will focus on four equivalent/comparable regions within four provinces of South Africa namely: Metro Cape in the Western Cape, Port Elizabeth in the Eastern Cape, Durban in Kwa-Zulu Natal and Bloemfontein in the Free State Province. The variable person will include gender, population group and age.

Results obtained from this study will be presented in tables and figures consisting of the following:

- Sample size per population group per NOHS
- Prevalence of dental caries per NOHS
- Severity profile (DMFT score) of dental caries per NOHS
- Percentage of individuals with active caries per NOHS
- Mean number of decayed teeth (dt/DT) per NOHS
- Mean number of missing teeth (mt/MT) per NOHS
- Mean number of filled teeth (ft/FT) per NOHS
- Severity (dmft/DMFT) of dental caries, across geographical locations
- Number of decayed teeth (dt/DT), across geographical locations
- Number of filled teeth (ft/FT), across geographical locations

5.2 SAMPLE SIZE PER POPULATION GROUP PER NATIONAL ORAL HEALTH SURVEY

The table below contains the sample size (total number of subjects (n)) per National Oral Health Survey. Four Population groups are referred to in this dissertation namely: Asian, Black, Coloured and White. Age include 6-; 12- and 15-year old children.

Table 5.1 Sample size per population group per NOHS

Population	Age		Total Subjects (n) for NOHS 1982/1983			Total Subjects (n) for NOHS 1988/1989			Total Subjects (n) for NOHS 1999/2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	Primary	-	-	-	272	244	516	51	63	114
		Permanent	-	-	-	272	244	516	51	62	113
	12		460	470	930	202	195	397	52	54	106
	15		-	-	-	248	257	505	46	70	116
Black	6	Primary	-	-	-	477	493	970	511	495	1006
		Permanent	-	-	-	477	493	970	482	459	941
	12		180	183	363	481	568	1049	489	488	977
	15		-	-	-	342	610	952	439	570	1009
Coloured	6	Primary	-	-	-	487	479	966	230	231	461
		Permanent	-	-	-	487	479	966	207	204	411
	12		491	492	983	579	629	1208	218	234	452
	15		-	-	-	591	693	1284	200	229	429
White	6	Primary	-	-	-	499	569	1068	102	82	184
		Permanent	-	-	-	499	569	1068	99	77	176
	12		185	183	368	502	503	1005	86	115	201
	15		-	-	-	414	507	921	110	138	248

5.3 PREVALENCE OF DENTAL CARIES PER NATIONAL ORAL HEALTH SURVEY

Table 5.2 Prevalence of dental caries per NOHS

Population	Age		% Prevalence of Dental Caries								
			1982/1983			1988/1989			1999/2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	Primary	-	-	-	-	-	-	70.40	63.90	66.90
		Permanent	-	-	-	4.80	4.60	4.70	0.00	1.30	0.70
	12		79.70	82.00	80.85	42.80	58.20	50.50	45.50	51.70	48.50
	15		-	-	-	65.00	72.50	69.00	35.10	56.50	47.10
Black	6	Primary	-	-	-	68.00	65.00	66.20	61.20	62.00	61.60
		Permanent	-	-	-	11.00	10.00	10.60	5.40	6.50	5.90
	12		53.60	62.10	57.85	50.00	58.00	54.00	39.20	38.20	38.70
	15		-	-	-	70.00	71.00	70.70	61.60	55.40	58.10
Coloured	6	Primary	-	-	-	77.00	76.00	76.10	92.80	84.70	88.80
		Permanent	-	-	-	7.70	7.60	7.65	7.60	11.70	9.60
	12		81.50	83.00	82.25	57.00	66.00	60.50	66.50	64.00	65.20
	15		-	-	-	76.00	80.00	78.20	79.70	77.50	78.60
White	6	Primary	-	-	-	59.00	58.00	58.50	56.60	58.20	57.30
		Permanent	-	-	-	8.00	10.00	8.90	1.50	6.50	3.80
	12		85.00	87.40	86.20	57.00	57.00	56.80	36.50	41.40	39.30
	15		-	-	-	80.00	81.00	80.10	60.40	62.40	61.60
Total Weighted mean	6	Primary	-	-	-	58.08	55.71	56.67	64.09	63.87	63.96
	12	Permanent	60.94	67.82	64.38	51.33	58.69	54.88	41.79	41.57	41.72
	15	Permanent	-	-	-	71.65	73.15	72.53	62.47	58.48	60.24

5.3.1 Trends in the prevalence of dental caries, per age group

Trends in the prevalence of dental caries are shown in Table 5.2; and the percentage change per annum, in the prevalence of dental caries, is shown in Annexure A1.

Figure 1 shows an increase in the prevalence of dental caries in the primary dentition of 6-year-old children, from 56.67 percent in 1988 to 63.96 percent in 2002. This increase was more pronounced in females than in males with females showing an annual increase of 0.68 percent per year and males an increase of 0.50 percent per year (Annexure A1).

Figure 1: Trends in the percentage prevalence of dental caries, in the primary dentition, amongst all 6-year-olds, by gender

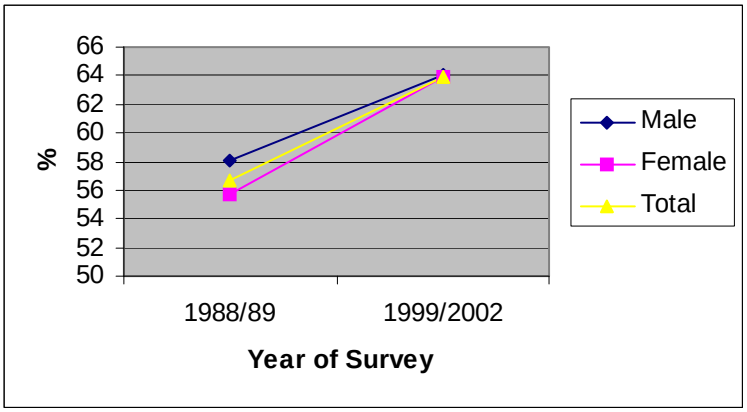
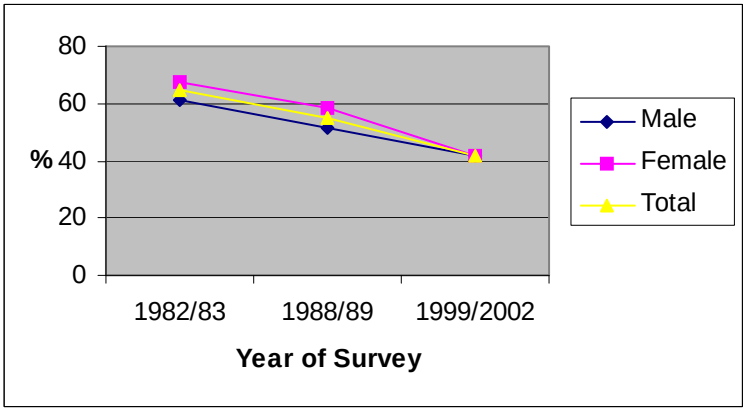


Figure 2 shows a decrease in the prevalence of dental caries amongst 12-year-old children, from 64.38 percent in 1982, 54.88 percent in 1988 to 41.72 percent in 2002. A total of 22.66 percent over a 20 year period or 1.13 percent per year (Annexure A1).

Figure 2: Trends in the percentage prevalence of dental caries, amongst all 12-year-olds, by gender



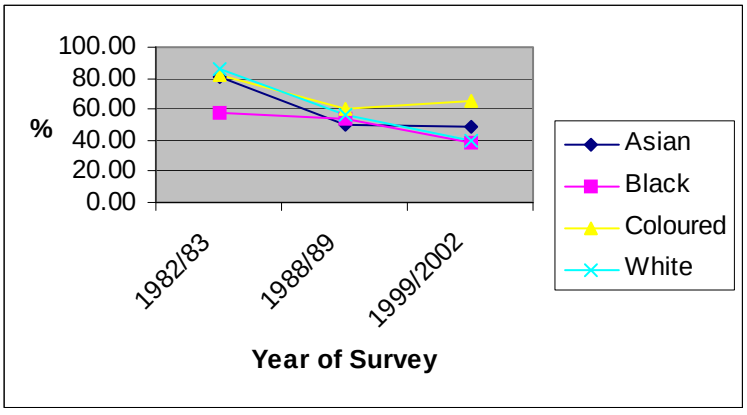
A decrease in the prevalence of dental caries was observed amongst 15-year-old children, from 1988 (72.53 percent) to 2002 (60.24 percent) (Table 5.2). A decrease of 12.29 percent over the 20 year period or 1.02 percent per year (Annexure A1). In both the 12- and 15-year-olds the decrease was more pronounced in females than in males.

5.3.2 Trends in the prevalence of dental caries, per population group

A statistical significant (p<0.05) decrease is shown in the prevalence of dental caries, in the primary dentition of 6-year-old Black children, from 1988 (66.20 percent) to 2002 (61.60 percent); but a statistical significant (p<0.05) increase is shown in the prevalence of dental caries, in the primary dentition of 6-year-old Coloured children, from 1988 (76.10 percent) to 2002 (88.80 percent) (Annexure A2).

Amongst 12-year-old Asian, Black, Coloured and White children, a statistical significant (p<0.05) decrease is also observed in the prevalence of dental caries, from 1982 to 2002 (Annexure A3). Trends in the percentage prevalence of dental caries, amongst all 12-year-olds by population group, per National Oral Health Survey, are shown in Figure 3.

Figure 3: Trends in the percentage prevalence of dental caries, amongst all 12-year-olds, by population group



	1982/83	1988/89	1999/2002
Asian	80.85	50.50	48.50
Black	57.85	54.00	38.70
Coloured	82.25	60.50	65.20
White	86.20	56.80	39.30

White 12-year-old children experience the largest decrease of 46.90 percent, followed by Asian (32.35 percent), Black (19.15 percent) and Coloured (17.05 percent) children, during the period 1982 to 2002. Although Coloured 12-year-old children show an overall decrease during the period 1982 to 2002, a slight increase (4.70 percent) was observed during the period 1988 to 2002 (Annexure 3).

A statistical significant ($p<0.05$) decrease is also observed in the prevalence of dental caries amongst 15-year-old Asian, Black and White children, from 1988 to 2002 (Annexure A4). Asian 15-year-old children showed the largest decrease of 21.90 percent, followed by White (18.5 percent) and Black (12.60 percent) children. The prevalence of dental caries in 15-year-old Coloured children virtually remains the same over the period 1988 to 2002.

5.3.3 Trends in the prevalence of dental caries, by gender

The results show an increase in the prevalence of dental caries, in the primary dentition of 6-year-old male children, from 1988 (58.08 percent) to 2002 (64.09 percent); and from 55.71 percent in 1988 to 63.87 percent in 6-year-old female children in 2002 (Table 5.2; Figure 1).

A decrease is shown in the prevalence of dental caries amongst all 12-year-old male and female children, from 60.94 and 67,82 percent for male and female respectively in 1982 to 41.79 and 41,57 percent for male and female respectively in 2002 (Table 5.2; Figure 2); and amongst all 15-year-old male and female children, from 71.65 and 73.15 percent for male and female respectively in 1988 to 62.47 and 58,48 percent for male and female respectively in 2002 (Table 5.2).

6-, 12- and 15-year-old male and female children by population group: A statistical significant ($p<0.05$) decrease is shown in the prevalence of dental caries, in the primary dentition of 6-year-old male Black children, from 1988 to 2002 (Annexure A5). But, significant ($p<0.05$) increases are observed in the prevalence of dental caries, in the primary dentition of 6-year-old male and female Coloured children, from 1988 to 2002 (Annexures A5 and A8).

Statistical significant ($p<0.05$) decreases are also observed in the prevalence of dental caries amongst 12-year-old Asian, Black, Coloured and White male and female children, from 1982 to 2002 (Annexures A6 and A9); and amongst 15-year-old Asian, Black and White male; and Asian and Black female children, from 1988 to 2002 (Annexures A7 and A10).

In 2002, the prevalence of dental caries was the highest amongst 12-year-old female Coloured children (64.00 percent); followed in descending order by 12-year-old female Asian children (51.70 percent); 12-year-old female White children (41.40 percent); and 12-year-old female Black children (38.20 percent) (Table 5.2).

In general the results of the surveys show a slight increase in the prevalence of dental caries in the 6-year-old group and a decrease in the prevalence of dental caries in the 12-year- and 15-year-old groups. The highest prevalence of dental caries was recorded in the coloured group.

5.4 SEVERITY (dmft/DMFT) OF DENTAL CARIES PER NATIONAL ORAL HEALTH SURVEY

Table 5.3 Severity profile (mean dmft/DMFT) of dental caries per NOHS

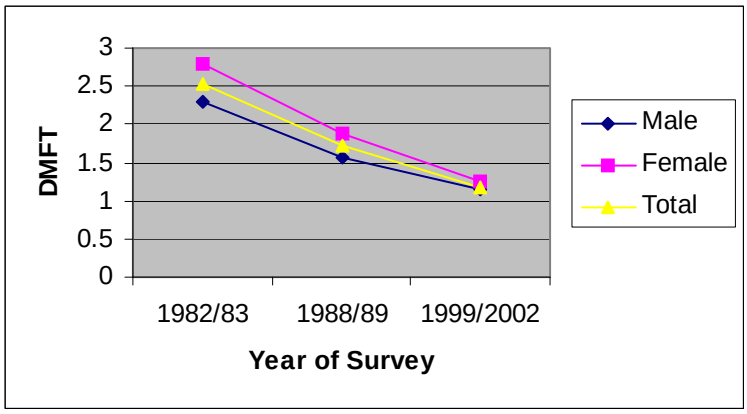
Population	Age		Severity profile (mean dmft/DMFT)								
			1982/1983			1988/1989			1999/2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	dmft	-	-	-	4.40	3.70	4.10	3.21	3.74	3.49
		DMFT	-	-	-	0.10	0.10	0.10	0.00	0.03	0.01
	12	DMFT	2.80	3.10	2.95	1.10	1.60	1.30	0.97	1.16	1.06
	15	DMFT	-	-	-	2.20	2.90	2.50	0.74	1.84	1.36
Black	6	dmft	-	-	-	3.20	3.00	3.10	2.95	2.81	2.88
		DMFT	-	-	-	0.20	0.20	0.20	0.09	0.13	0.11
	12	DMFT	1.90	2.40	2.15	1.50	1.90	1.70	1.11	1.05	1.08
	15	DMFT	-	-	-	2.70	3.20	3.00	2.38	2.14	2.25
Coloured	6	dmft	-	-	-	4.20	4.00	4.10	6.17	5.41	5.79
		DMFT	-	-	-	0.30	0.30	0.30	0.23	0.33	0.28
	12	DMFT	3.50	4.00	3.75	2.00	2.00	2.00	2.13	2.02	2.07
	15	DMFT	-	-	-	4.20	4.20	4.20	3.97	3.43	3.69
White	6	dmft	-	-	-	2.60	2.40	2.50	2.24	2.46	2.34
		DMFT	-	-	-	0.10	0.20	0.15	0.04	0.22	0.12
	12	DMFT	3.60	4.10	3.85	1.70	1.90	1.80	0.70	1.14	0.95
	15	DMFT	-	-	-	3.80	4.20	4.00	1.75	2.31	2.07
Total Weighted mean	6	dmft	-	-	-	3.27	3.05	3.16	3.19	3.06	3.13
	12	DMFT	2.29	2.79	2.54	1.56	1.89	1.73	1.16	1.25	1.17
	15	DMFT	-	-	-	2.97	3.41	3.23	2.42	2.28	2.35

5.4.1 Trends in the severity of dental caries, per age group

The severity of dental caries, as expressed as the mean dmft and DMFT, for 6-year-, 12-year-, and 15-year-old children, is shown in Table 5.3.

Figure 4 shows a decrease in the mean DMFT amongst 12-year-old children, from 1982 (DMFT=2.54) to 2002 (DMFT=1.17).

Figure 4: Trends in the DMFT, for all 12-year-olds, by gender



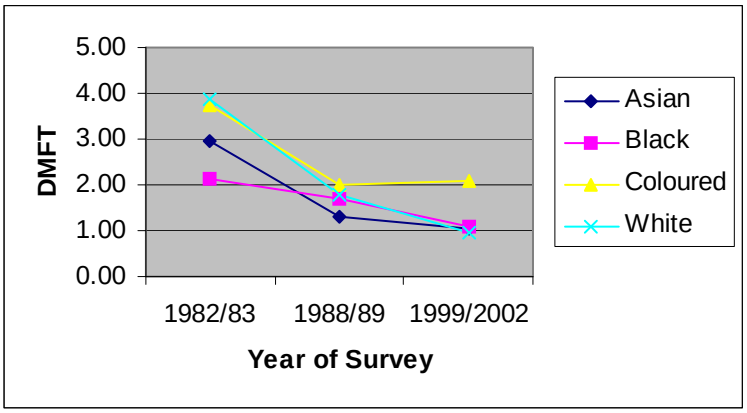
5.4.2 Trends in the severity of dental caries, per population group

The severity of dental caries, as expressed as the mean dmft/DMFT, per population group, per National Oral Health Survey, is shown in Table 5.3.

A statistical significant ($p<0.05$) increase is shown in the severity (dmft) of dental caries, in the primary dentition of 6-year-old Coloured children, from 1988 (4.10) to 2002 (5.79) (chi-sq=31.23; p=0.00) (Annexure A11).

However, a statistical significant ($p<0.05$) decrease is observed in the severity (DMFT) of dental caries, from 1982 to 2002, amongst 12-year-old Asian (chi-sq=57.25; p=0.00); 12-year-old Black (chi-sq=79.90; p=0.00); 12-year-old Coloured (chi-sq=78.42; p=0.00); and 12-year-old White children (chi-sq=156.50; p=0.00) (Annexure A12). Trends in the mean DMFT amongst 12-year-olds, by population group, per National Oral Health Survey, are shown in Figure 5.

Figure 5: Trends in the mean DMFT amongst 12-year-olds, by population group



	1982/83	1988/89	1999/2002
Asian	2.95	1.30	1.06
Black	2.15	1.70	1.08
Coloured	3.75	2.00	2.07
White	3.85	1.80	0.95

In 2002, the highest mean DMFT was found in 12-year-old Coloured children (2.07); followed in descending order by 12-year-old Black (1.08); 12-year-old Asian (1.06); and 12-year-old White children (0.95) (Table 5.3; Figure 5).

A statistical significant ($p<0.05$) decrease is observed in the severity (DMFT) of dental caries amongst 15-year-old Asian (chi-sq=21.26; p=0.00); 15-year-old Black (chi-sq=29.32; p=0.00); 15-year-old Coloured (chi-sq=4.27, p=0.04); and 15-year-old White children (chi-sq=60.74; p=0.00), from 1988 to 2002 (Annexure A13).

5.4.3 Trends in the severity of dental caries, by gender

A decrease is observed in the mean dmft in 6-year-old male children, from 1988 (dmft=3.27) to 2002 (dmft=3.19) (Table 5.3). The mean change per annum, in the severity profile (dmft score) of dental caries, per National Oral Health Survey, is shown in Annexure A14.

A decrease is also recorded in the mean DMFT of dental caries, from 1982 (DMFT=2.29) through 1989 (DMFT=1.56) to 2002 (DMFT=1.16) amongst 12-year-old male children; and amongst 15-year-old male children, from 1988 (DMFT=2.97) to 2002 (DMFT=2.42) (Table 5.3).

The severity of dental caries amongst female children is shown in Table 5.3; and the mean number change per annum, in the severity profile (dmft/DMFT score) of dental caries, per National Oral Health Survey, is shown in Annexure A14.

A decrease is recorded in the mean DMFT amongst 12-year-old female children, from 1982 (DMFT=2.79) to 2002 (DMFT=1.25); and amongst 15-year-old female children, from 1988 (DMFT=3.41) to 2002 (DMFT=2.28) (Table 5.3).

While the severity of dental caries in the primary dentition virtually remain the same over the study period, the severity of dental caries in the permanent dentition show marked reductions from their levels in the case years.

5.5 ACTIVE CARIES PER NATIONAL ORAL HEALTH SURVEY

Table 5.4 Percentage of individuals with active caries (decayed component of the dmft/DMFT) per NOHS

Population	Age		Percentage of individuals with active caries								
			1982/1983			1988/1989			1999/2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	dt	-	-	-	77.27	75.68	75.61	73.21	78.88	76.50
		DT	-	-	-	100.00	0.00	100.00	0.00	100.00	100.00
	12	DT	67.86	70.97	69.42	63.64	62.50	69.23	63.29	75.00	60.38
	15	DT	-	-	-	50.00	48.28	52.00	74.32	64.67	67.65
Black	6	dt	-	-	-	87.50	86.67	87.09	83.73	85.05	84.38
		DT	-	-	-	100.00	100.00	100.00	88.89	76.92	81.82
	12	DT	84.21	83.33	83.77	73.33	84.21	82.35	89.19	78.09	83.33
	15	DT	-	-	-	77.78	71.88	76.67	89.49	85.98	87.56
Coloured	6	dt	-	-	-	100.00	100.00	100.00	67.91	73.19	70.47
		DT	-	-	-	33.33	33.33	33.33	43.48	36.36	39.29
	12	DT	60.00	65.00	62.50	60.00	60.00	60.00	66.67	73.76	70.53
	15	DT	-	-	-	52.38	52.38	52.38	58.94	59.48	59.35
White	6	dt	-	-	-	42.31	50.00	44.00	76.79	62.60	70.09
		DT	-	-	-	100.00	50.00	66.66	100.00	13.64	25.00
	12	DT	30.56	31.71	31.14	23.53	21.05	22.22	34.29	37.72	36.84
	15	DT	-	-	-	23.68	19.05	20.00	49.71	31.17	37.19
Total Weighted mean	6	dt	-	-	-	83.02	83.27	82.87	81.00	80.99	81.04
	12	DT	74.86	74.93	74.89	65.73	73.56	72.51	78.97	72.72	75.78
	15	DT	-	-	-	67.92	62.88	66.70	81.21	76.11	78.09

5.5.1 Trends in the percentage of individuals with active caries, per age group

The mean percentage of 6-, 12- and 15-year-old children with active caries, per National Oral Health Survey, is shown in Table 5.4; and the percentage change per annum, in the mean percentage of 6-, 12- and 15-year-old children with active caries (decayed component of the dmft/DMFT), per National Oral Health Survey, is shown in Annexure A15.

A decrease is recorded in the mean percentage of 12-year-old children with active caries, from 1982 (74.89 percent with active caries) to 1989 (72.51 percent with active caries). However, an increase is observed in the mean percentage of 12-year-old children with active caries, from 1988 (72.51

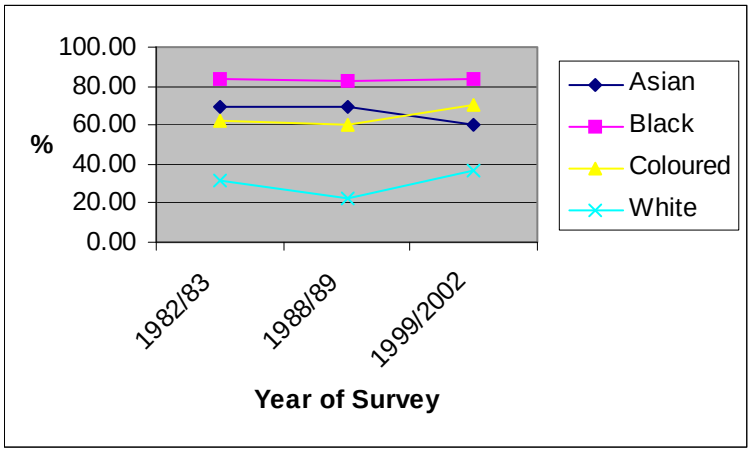
percent with active caries) to 2002 (75.78 percent with active caries) (Table 5.4; Annexure A15).

An increase is also observed in the mean percentage of 15-year-old children with active caries, from 1988 (66.70 percent with active caries) to 2002 (78.09 percent with active caries) (Table 5.4; Annexure A15). A mean percentage change of 0.95 percent per annum is shown in the percentage of 15-year-old children with active caries, from 1988 to 2002 (Annexure A15).

5.5.2 Trends in the percentage of individuals with active caries, per population group

The percentage of individuals with active caries (decayed component of the dmft/DMFT), per National Oral Health Survey, per population group, is shown in Table 5.4. Trends in the percentage of 12-year-old individuals with active caries per population group, per National Oral Health Survey, are shown in Figure 6.

Figure 6: Trends in the percentage of active caries, per subject, amongst 12-year-olds, by population group



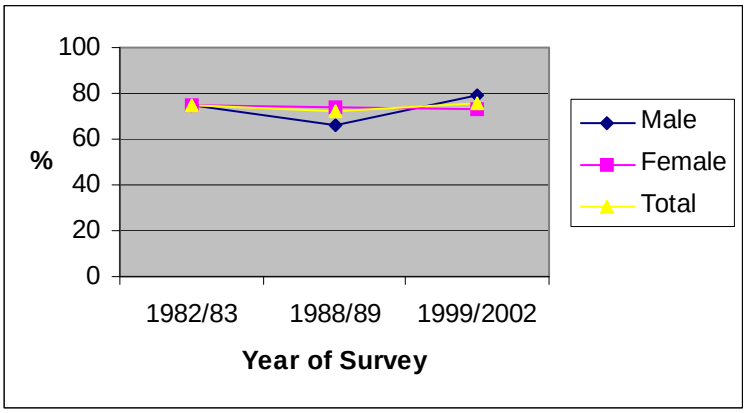
	1982/83	1988/89	1999/2002
Asian	69.42	69.23	60.38
Black	83.77	82.35	83.33
Coloured	62.50	60.00	70.53
White	31.14	22.22	36.84

In 2002, the results of the study show that 83.33 percent of 12-year-old Black children in South Africa have active caries; followed in descending order by 12-year-old Coloured (70.53 percent with active caries); 12-year-old Asian (60.38 percent with active caries); and 12-year-old White children (36.84 percent with active caries) (Table 5.4; Figure 6). A statistical significant ($p<0.05$) increase is recorded in the percentage of 12-year-old Coloured children with active caries, from 1982 (62.50 percent with active caries) to 2002 (70.53 percent with active caries) (SE=0.03; p=0.00) (Annexure A16); and in the percentage of 15-year-old Asian, Black, Coloured, and White children with active caries, from 1988 to 2002 (Annexure A17).

5.5.3 Trends in the percentage of individuals with active caries, by gender

Figure 7 shows a decrease in the percentage of 12-year-old male children with active caries, from 1982 (74.86 percent with active caries) to 1989 (65.73 percent with active caries); but an increase is recorded from 1988 (65.73 percent with active caries) to 2002 (78.97 percent with active caries) in the same group. A decrease is also observed amongst 12-year-old female children with active caries, from 1982 (74.93 percent with active caries) to 1989 (73.56 percent with active caries); and to 2002 (72.72 percent with active caries) (Figure 7).

Figure 7: Trends in the percentage of active caries, for all 12-year-olds, by gender



However, in Table 5.4 an increase is shown in the percentage of 15-year-old male children with active caries, from 1988 (67.92 percent with active caries) to 2002 (81.21 percent with active caries); and amongst 15-year-old female children with active caries, from 1988 (62.88 percent with active caries) to 2002 (76.11 percent with active caries).

In general the results of the study show a slight decrease in the percentage of active caries in the 6-year-old group, but an increase in the percentage active caries in both the 12-year- and 15-year old group.

5.6 MEAN NUMBER OF DECAYED TEETH (dt/DT) PER NATIONAL ORAL HEALTH SURVEY

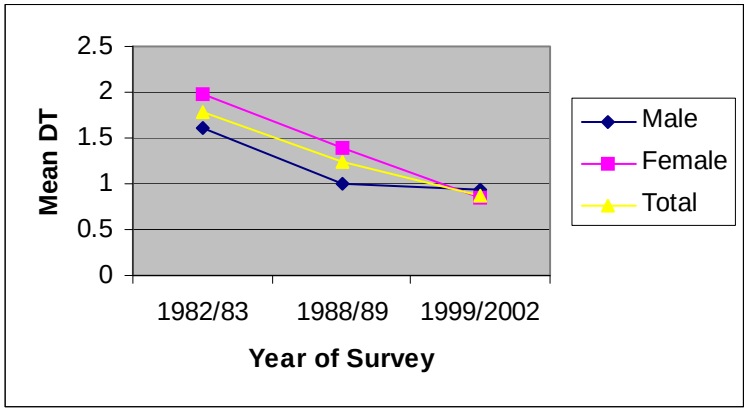
Table 5.5 Mean number of decayed teeth per NOHS

Population	Age		Mean number of decayed teeth (dt/DT)								
			1982/1983			1988/1989			1999/2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	dt	-	-	-	3.40	2.80	3.10	2.35	2.95	2.67
		DT	-	-	-	0.10	0.00	0.10	0.00	0.03	0.01
	12	DT	1.90	2.20	2.05	0.70	1.00	0.90	0.42	0.87	0.64
	15	DT	-	-	-	1.10	1.40	1.30	0.55	1.19	0.92
Black	6	dt	-	-	-	2.80	2.60	2.70	2.47	2.39	2.43
		DT	-	-	-	0.20	0.20	0.20	0.08	0.10	0.09
	12	DT	1.60	2.00	1.80	1.10	1.60	1.40	0.99	0.82	0.90
	15	DT	-	-	-	2.10	2.30	2.30	2.13	1.84	1.97
Coloured	6	dt	-	-	-	4.20	4.00	4.10	4.19	3.96	4.08
		DT	-	-	-	0.10	0.10	0.10	0.10	0.12	0.11
	12	DT	2.10	2.60	2.35	1.20	1.20	1.20	1.42	1.49	1.46
	15	DT	-	-	-	2.20	2.20	2.20	2.34	2.04	2.19
White	6	dt	-	-	-	1.10	1.20	1.10	1.72	1.54	1.64
		DT	-	-	-	0.10	0.10	0.10	0.04	0.03	0.03
	12	DT	1.10	1.30	1.20	0.40	0.40	0.40	0.24	0.43	0.35
	15	DT	-	-	-	0.90	0.80	0.80	0.87	0.72	0.77
Total Weighted mean	6	dt	-	-	-	2.76	2.58	2.66	2.55	2.46	2.51
	12	DT	1.60	1.98	1.79	1.01	1.39	1.25	0.93	0.84	0.88
	15	DT	-	-	-	1.94	2.08	2.08	1.96	1.71	1.82

5.6.1 Trends in the mean number of decayed teeth (dt/DT), per age group

The mean number of decayed teeth (dt/DT) per age group, per National Oral Health Survey, is shown in Table 5.5; and the mean number change per annum, in the mean number of decayed teeth (dt/DT), per National Oral Health Survey, is shown in Annexure A18. In figure 8, a decrease is shown in the mean number of decayed teeth (DT) amongst 12-year-old children from 1982 (1.79) to 2002 (0.88).

Figure 8: Trends in the number of decayed teeth (DT), per subject, amongst 12-year-olds, by gender



The change per annum, in the mean number of decayed teeth, for 12-year-old children, is shown as -0.09 (from 1982 to 1989); -0.03 (from 1988 to 2002); and –0.02 (from 1982 to 2002) (Annexure A18).

A decrease is recorded in the mean number of decayed teeth (DT) amongst 15-year-old children, from 1988 (2.08) to 2002 (1.82) (Table 5.5). The change in the mean number of decayed teeth amongst 15-year-old children, from 1988 to 2002, is shown as -0.02 per annum (Annexure A18).

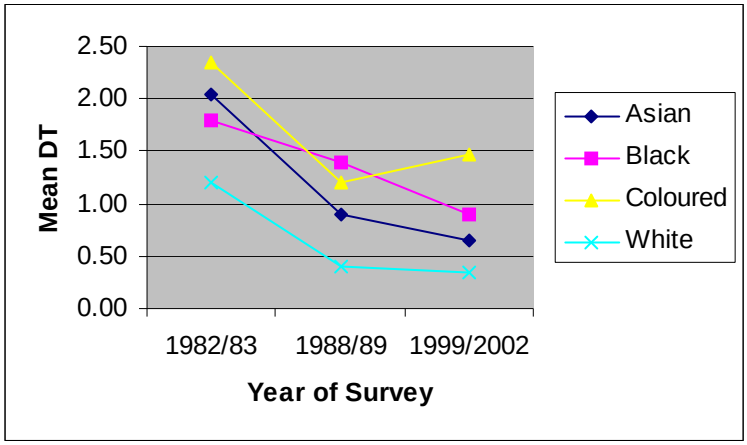
5.6.2 Trends in the mean number of decayed teeth (dt/DT), per population group

The highest mean number of decayed teeth (dt), in both 1988 and 2002, was recorded in 6-year-old Coloured children, 4.10 and 4.08 respectively; while White 6-year-old children had the lowest number of decayed teeth (dt) (Table 5.5).

In Figure 9 a decrease is shown in the mean number of decayed teeth (DT) amongst 12-year-old Asian, Black, Coloured, and White children, from 1982 to

2002. However, an increase is observed in the mean number of decayed teeth (DT) amongst 12-year-old Coloured children, from 1988 (1.20) to 2002 (1.46). The highest mean number of decayed teeth in the most recent survey (1999/2002), in the 12-year-old group, was again recorded in the Coloured group, 1.46; followed by the Black group, 0.90; and the Asian group, 0.64. White 12-year-old children again showed the lowest mean number of decayed teeth, 0.35 (Figure 9).

Figure 9: Trends in the number of decayed teeth (DT), for all 12-year-olds, by population group



	1982/83	1988/89	1999/2002
Asian	2.05	0.90	0.64
Black	1.80	1.40	0.90
Coloured	2.35	1.20	1.46
White	1.20	0.40	0.35

The results show a decrease in the mean number of decayed teeth (DT) amongst 15-year-old Asian, Black, Coloured, and White children, from 1988 to 2002 (Table 5.5); while Coloured (2.19) and Black (1.97) children again showed the highest mean number of decayed teeth in the most recent survey (1999/2002) (Table 5.5).

5.7 MEAN NUMBER OF MISSING TEETH (mt/MT) PER NATIONAL ORAL HEALTH SURVEY

Table 5.6 Mean number of missing teeth (mt/MT) per NOHS

Population	Age		Mean number of missing teeth (mt/MT)								
			1982/1983			1988/1989			1999/2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	mt	-	-	-	0.80	0.80	0.80	0.79	0.76	0.77
		MT	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00
	12	MT	0.70	0.60	0.65	0.10	0.10	0.10	0.37	0.16	0.26
	15	MT	-	-	-	0.40	0.40	0.40	0.07	0.27	0.18
Black	6	mt	-	-	-	0.40	0.40	0.40	0.46	0.41	0.44
		MT	-	-	-	0.00	0.00	0.00	0.02	0.02	0.02
	12	MT	0.30	0.40	0.35	0.30	0.20	0.30	0.12	0.18	0.15
	15	MT	-	-	-	0.60	0.70	0.60	0.23	0.26	0.25
Coloured	6	mt	-	-	-	0.00	0.00	0.00	1.86	1.35	1.60
		MT	-	-	-	0.20	0.20	0.00	0.07	0.19	0.13
	12	MT	1.20	1.20	1.20	0.50	0.50	0.50	0.49	0.33	0.41
	15	MT	-	-	-	1.30	1.30	1.30	1.12	1.01	1.06
White	6	mt	-	-	-	0.40	0.30	0.30	0.05	0.32	0.17
		MT	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00
	12	MT	0.20	0.30	0.25	0.20	0.10	0.10	0.09	0.05	0.07
	15	MT	-	-	-	0.20	0.30	0.20	0.07	0.01	0.04
Total Weighted mean	6	mt	-	-	-	0.37	0.36	0.36	0.56	0.50	0.53
	12	MT	0.39	0.47	0.43	0.30	0.22	0.29	0.16	0.18	0.17
	15	MT	-	-	-	0.62	0.70	0.62	0.29	0.30	0.30

5.7.1 Trends in the mean number of missing teeth (mt/MT), per age group

The mean number of missing teeth (mt/MT) per age group, per National Oral Health Survey, is shown in Table 5.6; and the mean change in the mean number of missing teeth (mt/MT), per annum, per National Oral Health Survey, is shown in Annexure A19.

An increase is shown in the mean number of missing teeth (mt), in the primary dentition of 6-year-old children, from 1988 (0.36) to 2002 (0.53) (Table 5.6).

However, a decrease is recorded amongst 12-year-old children, in the mean number of missing teeth (MT), from 1982 (0.43) to 2002 (0.17); and amongst 15-year-old children, from 1988 (0.62) to 2002 (0.30) (Table 5.6).

5.7.2 Trends in the mean number of missing teeth (mt/MT), per population group

The largest mean number of missing teeth for 1999/2002 was recorded in 6-year-old Coloured males (1.86) followed by 15-year-old Coloured males (1.12) (Table 5.6); while the lowest mean number of missing teeth (permanent teeth in 6-year-old children excluded) was recorded in 15-year-old White females (0.01), followed by 6-year-old White females and 12-year-old White males (0.05) (Table 5.6). The largest change in the mean number of missing teeth per annum in 12-year-old children, for the period 1982 to 2002, was recorded in Coloured children (-0.04) (Annexure A19). This reduction could either be attributed to a reduction in the prevalence of dental caries or a reduction in the services rendered (extractions) or a combination of the above.

5.8 MEAN NUMBER OF FILLED TEETH (ft/FT) PER NATIONAL ORAL HEALTH SURVEY

Table 5.7 Mean number of filled teeth (ft/FT) per NOHS

Population	Age		Mean number of filled teeth (ft/FT)								
			1982/1983			1988/1989			1999/2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	ft	-	-	-	0.10	0.20	0.20	0.07	0.03	0.05
		FT	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00
	12	FT	0.20	0.30	0.25	0.20	0.40	0.30	0.18	0.14	0.16
	15	FT	-	-	-	0.70	1.10	0.90	0.12	0.37	0.27
Black	6	ft	-	-	-	0.00	0.00	0.00	0.02	0.02	0.02
		FT	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00
	12	FT	0.00	0.00	0.00	0.10	0.00	0.05	0.01	0.05	0.03
	15	FT	-	-	-	0.00	0.10	0.05	0.02	0.05	0.03
Coloured	6	ft	-	-	-	0.00	0.00	0.00	0.12	0.09	0.11
		FT	-	-	-	0.00	0.00	0.00	0.06	0.01	0.03
	12	FT	0.20	0.20	0.20	0.30	0.30	0.30	0.22	0.19	0.20
	15	FT	-	-	-	0.70	0.70	0.70	0.51	0.38	0.44
White	6	ft	-	-	-	1.10	1.00	1.10	0.47	0.60	0.53
		FT	-	-	-	0.00	0.10	0.05	0.00	0.19	0.09
	12	FT	2.30	2.50	2.40	1.20	1.30	1.20	0.36	0.66	0.53
	15	FT	-	-	-	2.70	3.10	2.90	0.80	1.57	1.25
Total Weighted mean	6	ft	-	-	-	0.14	0.13	0.14	0.09	0.09	0.09
	12	FT	0.30	0.33	0.32	0.26	0.19	0.22	0.08	0.14	0.11
	15	FT	-	-	-	0.41	0.55	0.43	0.16	0.27	0.23

5.8.1 Trends in the mean number of filled teeth (ft/FT), per age group

Trends in the mean number of filled teeth (ft/FT) per age group, per National Oral Health Survey, is shown in Table 5.7; and the mean number of change per annum, in the mean number of filled teeth (ft/FT) per age group, per National Oral health Survey, is shown in Annexure A20.

A decrease is shown in the mean number of filled teeth (ft), in the primary dentition of 6-year-old children, from 1988 (0.14) to 2002 (0.09); in the mean number of filled teeth (FT) amongst 12-year-old children, from 1982 (0.32) to 2002 (0.11); and in the mean number of filled teeth (FT) amongst 15-year-old children, from 1988 (0.43) to 2002 (0.23) (Table 5.7). These figures indicate a

reduction in the amount of restorative dental services rendered to children between 1988 to 2002.

The largest change in the mean number of filled teeth per annum in 12-year-old children, for the period 1982 to 2002, was recorded in the White group (-0.10). This huge reduction could either be attributed to a reduction in the prevalence of dental caries or a reduction in the services rendered (restorations) or a combination of the above (Annexure A20).

5.8.2 Trends in the mean number of filled teeth (ft/FT), per population group

In 2002, in all age groups, the highest mean number of filled teeth (ft) were recorded in the dentition of White children; followed in descending order by Coloured, Asian and Black children (Table 5.7).

5.9 TRENDS ACROSS GEOGRAPHICAL LOCATIONS

5.9.1 Severity (dmft/DMFT) of dental caries, across geographical locations

Table 5.8 Severity (dmft/DMFT) of dental caries across geographical locations

Age	dmft/DMFT (Total Weighted Mean)	Metro Cape			Port Elizabeth			Durban			Bloemfontein		
		1982	1988	2002	1982	1988	2002	1982	1988	2002	1982	1988	2002
6	dmft	-	4.08	5.09	-	3.48	3.86	-	3.89	3.42	-	2.19	2.47
12	DMFT	3.61	1.94	1.86	3.01	2.18	1.37	2.56	2.42	1.33	1.98	1.01	0.73
15	DMFT	-	3.52	4.05	-	4.02	2.00	-	4.38	1.92	-	1.92	1.95

Trends in the severity (dmft/DMFT) of dental caries, across geographical locations, are shown in Table 5.8.

An increase is recorded in the mean dmft of dental caries amongst 6-year-old children in Metro Cape, Port Elizabeth and Bloemfontein, from 1988 to 2002 (Table 5.8). However, a decrease is recorded in the mean dmft of dental caries amongst 6-year-old children in Durban, from 1988 (3.89) to 2002 (3.42) (Table 5.8). In 1988, the highest mean dmft for dental caries is shown amongst 6-year-old children in Metro Cape (4.08); followed in descending order by 6-year-old children in Durban (3.89); Port Elizabeth (3.48); and Bloemfontein (2.19) (Table 5.8). In 2002, the highest mean dmft for dental caries was recorded amongst 6-year-old children in Metro Cape (5.09); followed in descending order by 6-year-old children in Port Elizabeth (3.86); Durban (3.42); and Bloemfontein (2.47) (Table 5.8).

A decrease is observed in the mean DMFT for dental caries amongst 12-year-old children in Metro Cape, Port Elizabeth, Durban and Bloemfontein, from 1982 to 2002 (Table 5.8). In 2002, the highest mean DMFT for dental caries is shown amongst 12-year-old children in Metro Cape (1.86); followed in descending order by 12-year-old children in Port Elizabeth (1.37); Durban (1.33); and Bloemfontein (0.73) (Table 5.8).

A decrease is recorded in the mean DMFT, from 1988 to 2002, amongst 15-year-old children in Port Elizabeth (4.02 to 2.00) and Durban (4.38 to 1.92) (Table 5.8); but, the results show an increase in the mean DMFT of dental caries, from 1988 to 2002, amongst 15-year-old children in Metro Cape (3.52 to 4.05) and Bloemfontein (1.92 to 1.95) (Table 5.8). The highest mean DMFT in 2002, was recorded in15-year-old children in Metro Cape (4.05); followed in descending order by 15-year-old children in Port Elizabeth (2.00); Bloemfontein (1.95); and Durban (1.92) (Table 5.8).

5.9.2 Number of decayed teeth (dt/DT), across geographical locations

Table 5.9 Number of decayed teeth (dt/DT), across geographical locations

Age	dt/DT (Total Weighted Mean)	Metro Cape			Port Elizabeth			Durban			Bloemfontein		
		1982	1988	2002	1982	1988	2002	1982	1988	2002	1982	1988	2002
6	dt	-	3.12	2.89	-	2.09	2.61	-	3.58	2.79	-	1.74	2.12
12	DT	2.15	1.25	1.07	1.89	1.51	0.64	1.69	2.13	1.19	1.47	0.56	0.62
15	DT	-	1.91	3.41	-	2.31	0.96	-	3.30	1.59	-	1.19	1.76

Trends in the number of decayed teeth (dt/DT), across geographical locations, are shown in Table 5.9.

A decrease is observed in the mean number of decayed teeth (dt), from 1988 to 2002, amongst 6-year-old children in Metro Cape (3.12 to 2.89) and Durban (3.58 to 2.79) (Table 5.9). However, an increase is shown in the mean number of decayed teeth (dt), from 1988 to 2002, amongst 6-year-old children in Port Elizabeth (2.09 to 2.61) and Bloemfontein (1.74 to 2.12) (Table 5.9). In 2002, the highest mean number of decayed teeth (dt) was recorded amongst 6-year-old children in Metro Cape (2.89); followed in descending order by 6-year-old children in Durban (2.79); Port Elizabeth (2.61); and Bloemfontein (2.12) (Table 5.9).

The results also show a decrease in the mean number of decayed teeth (DT) amongst 12-year-old children in Metro Cape, Port Elizabeth, Durban and Bloemfontein, from 1982 to 2002 (Table 5.9). In 2002, the highest mean number of decayed teeth (DT) was recorded amongst 12-year-old children in Durban (1.19); followed in descending order by 12-year-old children in Metro Cape (1.07); Port Elizabeth (0.64); and Bloemfontein (0.62) (Table 5.9).

A decrease is also shown in the mean number of decayed teeth (DT), from 1988 to 2002, amongst 15-year-old children in Port Elizabeth (2.31 to 0.96) and Durban (3.30 to 1.59) (Table 5.9). However, an increase is recorded in the mean number of decayed teeth (DT) amongst 15-year-old children in Metro Cape (1.91 to 3.41) and Bloemfontein (1.19 to 1.76) (Table 5.9). In 2002, the highest mean number of decayed teeth (DT) was recorded amongst 15-year-old children in Metro Cape (3.41); followed in descending order by 15-year-old children in Durban (1.59); Bloemfontein (1.76); and Port Elizabeth (0.96) (Table 5.9).

5.9.3 Number of filled teeth (ft/FT), across geographical locations

Table 5.10 Number of filled teeth (ft/FT), across geographical locations

Age	dt/DT (Total Weighted Mean)	Metro Cape		Port Elizabeth		Durban		Bloemfontein	
		1988	2002	1988	2002	1988	2002	1988	2002
6	ft	0.16	0.03	0.13	0.07	0.15	0.15	0.14	0.10
12	FT	0.24	0.10	0.17	0.22	0.18	0.10	0.32	0.04
15	FT	0.49	0.19	0.41	0.19	0.60	0.30	0.46	0.19

Trends in the number of filled teeth (ft/FT), across geographical locations, are shown in Table 5.10.

Apart from a slight increase in the mean number of filled teeth in the 12-year-old group in Port Elizabeth, and no change in the mean number of filled teeth in the 6-year-old group in Durban, reductions were recorded in the mean number of filled teeth in all geograpic locations and age groups. These figures indicate a reduction in the amount of restorative services rendered to children in the period 1988 to 2002. In 2002, the highest mean number of filled teeth were recorded in 15-year-old children in Durban (0.30); while the lowest

mean number of filled teeth were recorded for 6-year-old children in the Metro Cape (Table 5.10).

CHAPTER 6

DISCUSSION

Although the findings from the current study may arguably be limited by the fact that the study cannot claim to be truly nationally representative, because of missing data from regions in the missing five provinces (North West, Limpopo, Mpumalanga, Northern Cape and Gauteng); trends in the aggregated data presented may not be different from the national picture[2,3,4].

6.1 PREVALENCE AND SEVERITY OF DENTAL CARIES

A very positive observation, in terms of dental caries, in this study, is the huge reduction in dental caries prevalence (Table 5.2) and severity (Table 5.3) in the permanent teeth of children during the past twenty years. This reduction may be attributed to the widespread use of fluoridated toothpaste in South Africa[41]; or it might be due to the use of varying diagnostic thresholds[76] where lower levels in caries prevalence and severity are reported, which otherwise might not be the case[76].

Most epidemiological caries studies employ criteria in which a tooth, or tooth surface, is only recorded as decayed when cavitation is obvious, and which ignore all caries present at a less severe level[76,77,78,79]. In 1981, the Federation Dentaire Internationale (FDI) adopted a number of "Global goals for oral health" which proposed that by the year 2000 the global average for Decayed, Missing, and Filled teeth (DMFT) in 12-year-olds should be no more than three[80]. Clinical caries was to be diagnosed at the level at which clinical intervention was required, which is commonly

taken to mean when clinical cavitation has occured[80]. The workshop on Epidemiology of Dental caries set up by the British Association for the study of Community Dentistry in 1982 also recommended one, relatively gross, level of diagnosis: "caries at the cavitation level, i.e., involving dentine", for prevalence studies, since this would conform to the criteria in current use and, they hoped, allow for a higher degree of reproducibility between and among examiners[81]. Few studies have considered the extent to which inclusion or exclusion of pre-cavitation lesions ("initial" and "enamel" lesions, to use the World Health Organization terminology[82]) may affect DMFT counts, particularly after the decline in caries prevalence.

In cases where the presence of "early" lesions as well as cavities has been scored and reported, it has been shown that large differences may occur between DMFT calculated including early lesions; and the DMFT calculated when the criteria for recognition of Decayed teeth (DT) are limited to cavitation[76,83]. These differences, if not considered, can hide or confuse important findings[76,83]. In epidemiologic surveys, the relative contribution made by pre-cavitation and incipient lesions to the total caries experience (which may change with falling prevalence) will be unknown unless sensitive diagnostic thresholds are employed[76].

There is a chance that the apparent underestimation of disease prevalence which arises when insensitive thresholds are used may be misinterpreted by research workers, dentists, and health planners[76]. It is evident that the use of criteria which might be misinterpreted as being similar, when in fact they use differing effective diagnostic thresholds, can

dramatically influence the reported level of dental caries, and considerable care should therefore be taken in use of the term "caries-free" when diagnostic thresholds which ignore precavitation lesions have been employed[76].

Calculation of various reproducibility indices suggests that there may be only minimal loss of intra-examiner reproducibility when the more sensitive diagnostic criteria are employed on low caries prevalence groups[76,84].

Ayo-Yusuf et al[37] suggested, that with equity in focus, the use of the traditional expression of caries severity by the mean DMFT alone, may not be a good indicator of caries impact in South Africa. The use of the traditional expression of caries severity by the mean DMFT has recently been complemented with the introduction of the significant Caries Index (SiC)[85]. The SiC index (the mean DMFT for one-third of the population with the highest DMFT), brings attention to those children with highest caries scores in each population. However, it has been suggested that because changes in caries experience occur throughout the population, and are not limited to "at risk" individuals, the high-risk approach may fail to deal with majority of new lesions[86]. In deciding upon the choice of a caries prevention strategy, it is fundamental to consider whether or not, a large number of people exposed to a small risk will generate many more cases than a small number of people exposed to a high risk[87].

6.1.1 Prevalence and severity of dental caries, per age group

Analysis of the prevalence (Table 5.2) and severity (Table 5.3) of dental caries amongst 6-year-old children, in the current study, show dental caries to be more severe in the primary than in the permanent dentition. The results also show an increase in the prevalence of dental caries, in the primary dentition of 6-year-old children, from 1988 (56.67 percent) to 2002 (63.96 percent) (Table 5.2: Prevalence of dental caries; Figure 1). The severity (Table 5.3) of dental caries recorded amongst 6-year-old children, in the current study, remains quite high. However, these findings seem to be consistent with other studies done in South Africa and on the African continent[3,49,88].

Studies suggest that caries of the primary dentition is associated with early protein-energy malnutrition[89,90,91,92,93]. Social, demographic and lifestyle factors relating to the mother have also been shown to influence the early eating patterns of children[90]. These were: the addition of sugar to the child's comforter and the number of times per day this is done, how often the child is put to sleep with a bottle, whether the child is breast-fed or not and the length of time the child was breast-fed, the giving of "mutis" (common and traditional medicines)[89], number of mutis given and the frequency of giving them, and the addition of milk only or milk plus sugar to cereal[89,90].

Psoter et al[93] also suggested that enamel hypoplasia, salivary glandular hypofunction and saliva compositional changes, may be mechanisms through which malnutrition may be associated with caries; while altered

eruption rates may create a challenge in the analysis of age-specific caries rates.

In South Africa, rapid urban growth has been accompanied by massive urban poverty[94]; social barriers to population movement have disappeared[95]; and urbanization (the movement of people from rural to urban areas)[89] has increased at an exceptionally high rate[96]. Forty percent of the population of the Third World was urban at the end of the 20th century[97,98], and this is estimated to increase to 57 percent by 2025[97]. Although considerable attempts have been made in developing countries to restrict, redirect or control the rate of urbanization; these measures have largely failed and unprecedented growth of urban populations continues[99].

It is also not surprising that with an increase in urbanization there is an increase in the use of sugar and the frequency of this habit[89]. Therefore, by implication, the rapid rate of urbanization[94], and the increase of sugar consumption[89,90,91,92,93], might explain the high prevalence (Table 5.2; Figure 1) and severity (Table 5.3) of dental caries found in the primary dentition of 6-year-old urban children, in the current study.

In South Africa, climatic, geographic and socio-political circumstances differ and, in the latter context, communities vary from Third to First World with distinct cultural differences for infant feeding and diet as well as dietary habits, often modified by economic factors[95].

It has also been illustrated that low social capital may lead to adoption of maladaptive behaviours such as smoking and excessive drinking as stress coping methods[37]; and it has been previously reported[100] that there is a significant increase in primary tooth caries risk among children exposed to environmental tobacco smoke[100]. Therefore it might not be surprising that high dental caries prevalence (Table 5.2) and severity (Table 5.3) rates were observed, in the current study, in the primary dentition of 6-year-old children.

Analysis of the severity (DMFT levels) (Table 5.3; Figure 4) of dental caries amongst 12-year-old children, in the current study, show a reduction in the severity (DMFT) of dental caries. However, the DMFT increased dramatically from the 12-year-olds to the 15-year-olds (Table 5.3: Severity of dental caries). In other studies[28,88] it was found that this increase could mainly be attributed to caries on the second permanent molar. As children get older there is an increased exposure to cariogenic agents, this fact combined with the position of the second permanent molar in the mouth make it more vulnerable to caries attack[28,91,101].

Nel and Steyn[102] reported that the intake of added sugar of adolescents (aged ≥ 10 years) amounts to 5.9 percent of the total energy intake in rural areas and 12.3 percent in urban areas (twofold difference) (Table 6.1).

Table 6.1: Energy distribution of macronutrients in adolescents[102] in South Africa

MEAN PROPORTION OF TOTAL ENERGY SOURCE			
PARTICIPANTS AGED ≥ 10 YEARS			
Energy Source	South Africa (n=3535)	Rural (n=1167)	Urban (n=2368)
Protein	14.1 (4.6)	13.2(2.3)	14.8 (4.0)
Fat	23.3 (12.5)	16.1 (5.6)	29.5 (9.1)
Carbohydrate	62.2 (14.4)	70.0 (6.7)	55.5 (10.7)
Added sugar	9.4 (8.6)	5.9 (3.9)	12.3 (7.3)

Values in parentheses are standard deviations

The results in table 6.1 show that in urban areas consumption of sugar is much higher than in the rural areas[102]. The World Health Organization (WHO) recommends a sugar intake of less than 10 percent of total energy intake[103] for the prevention of caries, however, the consumption of sugar, in people in urban areas of South Africa, exceeded the 10 percent recommended by WHO[102,103]. Although sugar consumption in South Africa, expressed as a percentage of the total energy intake, is currently slightly higher (11 percent) than the benchmark of 10 percent, sugar consumption remains relatively low in comparison to that in countries such as the United States of America[91].

Steyn et al[91] illustrated a dose-response relationship between the level of dental caries and the intake of sugars. A dramatic rise in the prevalence and severity of dental caries is seen as the intake of sugars increase from around 15kg to 35kg per person per year[104,105,106]. Sheiham[107] recommends that in the presence of fluoride, a safe intake of sugars would be up to

15kg per person per year, and in the absence of fluoride, up to 10kg per person per year.

Every effort should be made to encourage and promote the positive dietary habits of the population. It is important to limit the frequency of cariogenic snacks and drinks through aggressive health education and positive anti-sugar policies. As stated previously, the World Health Organization (WHO) recommends a sugar intake of less than 10 percent of total energy intake[103] for the prevention of dental caries; however, only 23 countries currently comply and have this as a set objective, South Africa not being one of these countries[108].

It is conceivable that with decreasing social cohesion or social capital, there would be lower capacity for caregivers within a community to cope with environmental stress to the extent that it may consequently result in neglect of children's oral hygiene and/or dietary habits, and so increasing the risk for dental caries[37,94,95].

Decreasing social cohesian or social capital may also lead to adoption of maladaptive behaviours, such as smoking and excessive drinking, as stress coping methods[37]. Bruno-Ambrosius et al[109] reported on a significant increase in permanent teeth caries among teenagers who smoke and have irregular eating habits, even after controlling for toothbrushing frequency.

It might therefore be concluded that smoking and a resultant high sugar intake[109] as well as decreasing social cohesion or social capital[37], may be

associated with the increased levels of dental caries prevalence (Table 5.2) and severity (DMFT) (Table 5.3) from the 12-year-olds to the 15-year-olds, as recorded in the current study.

6.1.2 Prevalence and severity of dental caries, per population group

The results of the study show a decrease in the prevalence (Table 5.2; Figure 3) and severity (Table 5.3; Figure 5) of dental caries in all population groups amongst 12-year-old children, from 1982 to 2002.

However, compared to 12-year-old Asian, Black and White children, 12-year-old Coloured children present with higher dental caries prevalence (Table 5.2; Figure 3) and severity (Table 5.3; Figure 5) rates. This is confirmed by a previous report on dental caries being highest amongst the Coloured population in South Africa[28,110].

Hargreaves et al[110] completed a study in 1985/86, which examined the dental health of pre-school children from different population groups and communities in South Africa: rural Black, urban Coloured, urban Indian and urban White. Enamel defects were recorded in primary teeth by use of the Hypocalcification and Hypoplasia Index (HHI), an index developed to measure hypocalcification and hypoplasia. The findings showed that Coloured children had the greatest number of enamel defects. The teeth most commonly affected were the maxillary anterior teeth and the mandibular molar teeth. The authors concluded that the cause of the enamel defects, in the primary dentition of Coloured children, could be associated with the nutritional health of the individual[110].

The literature also show that low social capital may lead to adoption of maladaptive behaviours such as smoking and excessive drinking as stress coping methods[37]; and studies have consistently shown smoking prevalence as the highest amongst the Coloured population in South Africa[111,112]. It has also been previously reported[100] that there is a significant increase in primary and permanent tooth caries risk amongst children exposed to environmental tobacco smoke.

These reported findings[100,110,111,112] may explain the higher caries prevalence and severity trends (and higher caries risk) amongst the Coloured population, found in the current study.

Another explanation for the higher caries prevalence (Table 5.2; Figure 3) and severity (Table 5.3; Figure 5) trends observed in the current study amongst Coloured children, might be due to higher plaque acidogenic response/Streptococci counts in Coloured children[113].

A study by Pollard et al[113] suggests that there is a higher plaque acidogenic (pH) response to carbohydrates in the Coloured population which may lead to a higher prevalence of dental caries amongst the Coloured population. In a study by Toi et al[114], pearson correlations showed low yet statistically significant correlations between plaque mutans streptococci counts and the number of decayed surfaces (ds) and decayed, missing and filled surfaces (dmfs) of primary teeth in Coloureds. Salivary streptococci counts correlated with decayed surfaces (ds) and decayed, missing and filled surfaces (dmfs) in Coloureds. Significant associations were evident between plaque mutans

streptococci and *Actinomyces* and *Lactobacillus* and *Veillonella* in Coloured children with caries. The authors also concluded that oral microbes are in constant flux but have interrelationships with caries[114].

South Africa is a land of contrasts, even with regard to caries rates between groups[3,41,88]. The results of the current study show that dental caries was more prevalent (Table 5.2: Prevalence of dental caries; Figure 3) and severe (Table 5.3: Severity of dental caries; Figure 5) amongst the Coloured and Black population groups in South Africa. However, dental caries prevalence and severity rates recorded amongst the Coloured population were more severe than amongst the Black population; although they are of nearly similar socio-economic status[33].

This finding can be explained by the fact that in contrast to Black Africans, most Coloured South Africans live in the coastal Western Cape province, where drinking water fluoride levels are very low[42,115]. Du Plessis et al[116] also found that it is most likely that the use of fluoridated toothpaste and other fluoride supplements, which are almost universal in the White population and almost non existent in the Black population, are providing enough fluorides to the White children in the low fluoride (coastal) areas to provide significant protection against dental caries, whereas these forms of fluoridating the mouth are not available to the Black (or Coloured) children. Steyn et al[91] also suggested that due to intake of sugars, people of the Coloured population group substantially have more caries than people of the Black population group, with people of the Asian population group somewhere between.

However, subsequent to the repeal of apartheid laws that previously restricted where different population groups could reside in South Africa, the situation may change as the Black Africans begin to move to urban areas, and those in the rural communities begin to receive water reticulation, thus changing their water source from the traditionally high fluoride-containing ground water supplies (e.g. boreholes)[117] to reticulated public water supplies with lower levels of fluoride. These changes, together with indications of changes in terms of cariogenic food-consumption habits in Black African children following a rural-to-urban shift[87], certainly suggest that an increase in dental caries in the Black population may be expected in future[115].

In South Africa, the socio-economic status of the Whites is still considerably higher when compared to that of the Black, Coloured, and Asian populations[33]. Therefore, by implication, members of the White population have better access to fluoridated toothpaste, health promotional aids and dental services[115].

The literature shows that low socio-economic status/poverty[118,119] as well as an inability to afford toothpaste[120] can be associated with an increase in dental caries. It is therefore not surprising that the prevalence (Table 5.2; Figure 3) and severity (Table 5.3; Figure 5) of dental caries was relatively lower in the White population group compared with the Black and the Coloured population groups. This argument is supported by a UK-based study that showed that free provision of toothpaste to disadvantaged individuals achieved a significant reduction in the occurance of dental caries[120].

6.1.3 Prevalence and severity of dental caries, across geographical locations

Differences in the severity (dmft/DMFT) of dental caries recorded between the coastal regions (Metro Cape, Port Elizabeth and Durban) and an interior region (Bloemfontein) (Table 5.8: Severity (dmft/DMFT) of dental caries, across geographical locations) might be due to the following:

1. The National Food Consumption Survey (NFCS) undertaken in 1999, shows large differences in sugar intake according to geographical area and dietary assessment method used[91,92].

   The lowest mean sugar consumption in the National Food Consumption Survey (NFCS), determined with the 24-hour recall dietary method, was 22g in the Eastern Cape Province and the highest was 57g in the Western Cape Province[92]. When the food frequency method was used, the lowest mean intake was 22g in the Free State Province and the highest was 91g in the Western Cape Province[92].

   As a dose-response relationship has previously been shown between the level of dental caries and the intake of sugars[92]; and scientific proof exists that many diseases like dental caries could have been prevented if the proper diet was followed[91,92,93,102]; it is therefore not surprising that higher dental caries severity levels were recorded in Metro Cape in the current study (Table 5.8).

2. A Nutrition Education Intervention Programme (NEIP) was developed in the Free State between 1992 and 1995, based on the principles of the previous Administration: House of Representatives[121].

The programme used nutrition advisors as community health workers. Nutrition advisors were local persons, respected members of the community, trained to improve the community's knowledge of balanced, economic nutrition using the three food group approach, where energy foods include starches and fats, protective foods include vegetables and fruits, and building foods include proteins and milk[121].

The Nutrition Education Intervention Programme (NEIP) included both nutrition education and education on the relationship between diet and oral diseases like dental caries[121].

This Nutrition Education Intervention Programme (NEIP), developed in the Free State between 1992 and 1995[121]; together with the National Food Consumption Survey (NFCS) undertaken in South Africa that shows lower mean sugar consumption in children in Bloemfontein[92]; might have contributed to the decrease in the DMFT amongst 12-year-old children, as observed in Bloemfontein, from 1988 (1.01) to 2002 (0.73) (Table 5.8: Severity (dmft/DMFT) of dental caries, across geographical locations).

3. It has been previously reported that in coastal provinces or regions such as: Metro Cape in the Western Cape; Port Elizabeth in the Eastern Cape and Durban in Kwa-Zulu Natal; the fluoride levels are lower than in the interior provinces/regions such as: Bloemfontein in the Free State Province[42,88,122].

   Du Plessis et al[116] also found that differences in the prevalence and experience of dental caries occurred between geographical areas according to fluoride levels in the domestic water supply that varied from <0.05 ppm in the coastal areas (Cape Peninsula, Port Elizabeth and Durban) to 0.35 ppm in the Bloemfontein area. The percentage children with caries free primary dentitions at age 6 varied from 36 percent in Cape Town area to 47 percent in the Bloemfontein area. The DMFT for 12-year-old children ranged from 2.45 in Cape Town to 1.68 for Bloemfontein; and for 15-year-old children the DMFT values recorded were 5.45 in Cape Town to 3.21 for Bloemfontein. The authors concluded that an increased level of fluoride in the water supply has an inverse relationship to the experience of dental caries in 6-, 12-, and 15-year-old children[116].

   It might therefore be concluded that the relative low caries risk in Bloemfontein and the strong protection of children in Bloemfontein against dental caries (Table 5.8), may be related to the higher levels of fluoride in the drinking water in this largely urban area/ region[42,116,122].

6.2 COMPONENTS OF THE dmft/DMFT

6.2.1 Decayed teeth (dt/DT)

Analysis of the different components of the dmft/DMFT, in this study, show high levels of untreated caries (decayed component) in all age groups (Table 5.5). This is consistent with other studies done in South Africa and on the African continent[3,41,88]. This may be due to the inadequacy of resources such as oral health personnel and dental facilities, as well as a lack of awareness about oral health and dental services amongst the majority of the population[41].

6.2.1.1 Decayed teeth (dt/DT), per age and population group

A decrease was observed, in the current study, in the mean number of decayed teeth (dt/DT) amongst 6-year-old and 15-year-old children, from 1988 to 2002 (Table 5.5); and amongst 12-year-old children, from 1982 to 2002 (Table 5.5; Figure 8).

However, it is also shown that the number of decayed teeth (dt/DT) contributes the most to the caries experience (dmft/DMFT) amongst 6-year-old Asian, Black, Coloured, and White children; and amongst 12-year- and 15-year-old Asian, Black, and Coloured children (Table 5.5; Table 5.6; Table 5.7). From 1982 to 2002, trends in the number of decayed teeth (DT) for all 12-year-olds, by population group (Figure 9), indicate that the number of decayed teeth (DT) is highest amongst 12-year-old Coloured children; followed in descending order by 12-year-old Black; 12-year-old Asian; and 12-year-old White children.

This finding can be explained by the fact that in contrast to the Black population, most Coloured South Africans live in the coastal Western Cape province, where drinking water fluoride levels are very low[42,71,115]; and where there is more access to a sugary diet[91,92].

Potentially harmful infant feeding practices[63] may also explain why dental caries (number of decayed teeth (dt/DT)) was relatively higher amongst the non-whites (Table 5.5; Figure 9). Previously, in a study in the northern parts of South Africa, the majority of those in the lowest socio-economic class had indeed been reported to practice prolonged breast and/or bottle feeding. Furthermore, in the latter study the severity of dental caries was also shown to be the lowest amongst the Whites[89,123].

During the 1990's, tobacco smoking increased by one percent per year[124]. A survey on smoking, conducted in 1995, found that the prevalence was particularly highest amongst the Coloured population, almost reaching sixty percent who smoke[125].

As previously stated, studies have consistently shown smoking prevalence as the highest amongst the Coloured population in South Africa[111,112,125]; and the literature also suggests a significant increase in permanent teeth caries amongst teenagers who smoke and have irregular eating habits[109]. Therefore it is not surprising that these factors may well be contributory risk factors to the higher caries risk observed amongst the Coloured population in the current study (Table 5.5; Figure 9).

The literature[126] also suggests that compared to Asian, Coloured and White children, the permanent teeth of many Black (African) people erupt at an earlier age (average of one year earlier), hence a longer exposure of these teeth to the cariogenic oral environment. It may therefore be concluded that this could have contributed to the high number of decayed teeth(DT) observed amongst 6-year-; 12-year-; and 15-year-old Black children, in the current study (Table 5.5).

6.2.1.2 Decayed teeth (dt/DT), across geographical locations

Health and by implication oral health, is a product of environmental, social and economic determinants, not just genetics, individual behaviour and a well functioning health service[127].

Ayo-Yusuf et al[37] reported that the relatively strong protection of children of the unemployed from caries in the North West Province may be related to the relatively high levels of natural fluoride in drinking water in many parts of this largely rural province[128] especially in areas of socio-economic deprivation. This contrast the situation in the coastal provinces (Eastern Cape, Kwa-Zulu Natal, Western Cape and Northern Cape) where fluoride levels have been reported to be mostly lower than in the interior provinces/regions[42,88,116,122].

The view that the differences in the natural fluoride levels may be contributory to the differential caries risk observed in the current study (Table 5.9: Number of decayed teeth (dt/DT), across geographical locations) is further supported by a recent literature review, which provided evidence that fluoridation reduces socio-economic based

disparities in dental caries[129]. Furthermore, the observation of greater socio-economic based disparities in dental caries, in the relatively affluent provinces (Kwa-Zulu Natal and Western Cape) is consistent with findings from other similar studies[33,130,131].

Social capital or cohesion, an important feature of social organization of a community, have indeed been reported to be negatively affected by the growing gap between the rich and the poor with resultant negative impact on public's general health[132]. Patussi, Marcenes and Croucher[133] previously reported a direct correlation between dental caries experience among Brazilian school children and measures of social inequality and social cohesion in their respective communities.

It is conceivable that with decreasing social capital, there would be lower capacity for caregivers within a community to cope with environmental stress to the extent that it may consequently result in neglect of children's oral hygiene and/or dietary habits[37]. This neglect in dietary habits can include an increase in the use of sugar and the frequency of this habit, which in turn leads to an increase in dental caries[91,92,102].

It is therefore not surprising that the number of decayed teeth (DT) was relatively higher in Metro Cape as compared to Port Elizabeth, Durban and Bloemfontein (Table 5.9: Number of decayed teeth (dt/DT), across geographical locations) as it has been previously indicated that there is a higher mean sugar consumption, of 57kg per person per year, in the Western Cape Province as compared to the Eastern Cape, Kwa-Zulu Natal and Free State Provinces[92].

Furthermore, as social barriers to population movement have disappeared in the new South Africa[95], urbanization has increased at an exceptionally high rate[71]. The South African data show that most of the population migration from South Africa's rural areas and small towns has taken place to the big metropolitan centres[71].

It is also known that rapid urbanization leads to lifestyle changes which normally result in an increase in sugar consumption, especially amongst children, which leads to an increase in dental caries[134].

This, perhaps again explain the higher number of decayed teeth (dt/DT) observed in the big metropolitan centre of Metro Cape in the Western Cape, in the current study (Table 5.9: Number of decayed teeth (dt/DT), across geographical locations).

6.2.2 **Filled teeth (ft/FT)**

6.2.2.1 Filled teeth (ft/FT), per age and population group

It was observed in the current study that the number of filled teeth (FT) contributes the most to the caries experience (DMFT) amongst 12-year- and 15-year-old White children in South Africa. Amongst 12-year-old White children, expressed as a percentage of the DMFT, the number of filled teeth (FT) contributes 62.34 percent of the severity (DMFT) of dental caries in 1982; 66.67 percent in 1988; and 55.79 percent in 2002; and amongst 15-year-old White children, expressed as a percentage of the DMFT, the number of filled teeth (FT) contributes 72.50 percent of the severity (DMFT) of dental caries in 1988; and 60.39 percent in 2002 (Table

5.3: Severity profile (dmft/DMFT) of dental caries per NOHS; Table 5.7: Mean number of filled teeth (ft/FT) per NOHS).

In South Africa the socio-economic status of Whites is still considerably higher when compared to that of the Black, Coloured, and Asian populations[33]. The 1998 Poverty and Inequality report[33], identified 61 percent of Black Africans, 38 percent of the Coloured, 5 percent of the Asian, and only 1 percent of the White population categorised as being poor; assessed against consumption-based income poverty lines. Therefore, by implication, it might seem that members of the White population have better access to dental services.

This argument is supported by a study done by Cleaton-Jones et al[52] amongst young South African children. The authors concluded that the high values of filled teeth (ft/FT), found amongst 6-, 12- and 15-year-old White children in South Africa, may be related to the fact that the higher the socio-economic status, the lower the caries experience; or on the other hand the filled component shows a trend that the higher the socio-economic group, the higher the filled value, and the lower the socio-economic group, the lower the filled value[52].

6.2.2.2 Filled teeth (ft/FT), across geographical locations

The highest mean number of filled teeth (FT) in the most recent survey (1999/2002) were recorded amongst 12-year-old children in Port Elizabeth (0.22); followed by 12-year-old children in Metro Cape (0.10); Durban (0.10); and Bloemfontein (0.04) (Table 5.10: Number of filled teeth (ft/FT), across geographical locations). It is also observed that the mean number

of filled teeth (FT) increased from 1988 (0.17) to 2002 (0.22) amongst 12-year-olds in Port Elizabeth (Table 5.10). According to du Plessis[135] this may indicate that dental personnel in Port Elizabeth are still using the diagnostic and treatment criteria which were valid before the introduction of the various fluoride regimes in the prevention of dental caries.

The 1998 Poverty and Inequality report[33], listed the nine provinces in South Africa in descending order according to poverty rates : Eastern Cape (71% of the residents are poor), Free State (63%), North West (62%), Limpopo (formerly Northern) province (59%), Mpumalanga (57%), Northern Cape (55%), Kwa-Zulu Natal (52%), Western Cape (28%) and Gauteng (17%). It has also been previously reported that the higher the socio-economic status/group the higher the filled value[52]; therefore, by implication, explaining the high filled values recorded amongst 12-year- and 15-year-old Metro Cape children; and amongst 15-year-old Durban children (Table 5.10: Number of filled teeth (ft/FT), across geographical locations).

6.3 TRENDS IN UNTREATED CARIES (1982 TO 2002)

The following table is a summary of the mean dmft/DMFT, and the mean dt/DT, extracted from the data found in Table 5.3 and Table 5.5.

Table 6.2 Summary of the dmft/DMFT of dental caries and the number of decayed teeth (dt/DT), per age group, per National Oral Health Survey

6-year-old		**1988**	**2002**
dmft		3.16	3.13
d (untreated)		2.66 (84.18)	2.51 (80.19)
12-year-old	**1982**	**1988**	**2002**
DMFT	2.54	1.73	1.17
D (untreated)	1.79 (70.47)	1.25 (72.25)	0.88 (75.21)
15-year-old		**1988**	**2002**
DMFT		3.23	2.35
D (untreated)		2.08 (64.39)	1.82 (77.45)
Values in parentheses are the number of decayed teeth (untreated caries) expressed as a percentage of the dmft/DMFT of dental caries			

A very positive observation, in terms of dental caries in this study, is the huge reduction in the severity of dental caries in children during the past twenty years. Caries severity in the general population of 12-year-olds (Table 6.2) is well below the WHO's target of 3 for this age group; and the severity of dental caries for 12-year- and 15-year-old children (Table 6.2) is regarded as low in terms of the WHO classification for dental caries for these age groups[101].

Although caries levels could be regarded as low in terms of the WHO classification, both the 12-year and 15-year-old children show an increase in the percentage untreated caries. In the 12-year-old children the percentage untreated caries increased from 70,47 percent in 1982 to

75.21 percent in 2002; while untreated caries in the 15-year-old children increased from 64,39 percent in 1988 to 77.45 percent in 2002. This increase in untreated caries took place despite a decrease in the prevalence and severity of dental caries. Prior to 1975, dental services to school children in the then 4 provinces of South Africa were either organised or rendered by the provincial department of education[136]. After 1975[137] these services were expanded to include Indian, Coloured and Black school children. School dental services continued to be rendered throughout the three-chamber parliament but were gradually replaced by clinic-based dental services. The new South African Oral Health Strategy[138] does not make provision for any organised school dental services. In the case of the 6-year-old children the percentage of untreated dental caries decreased, and this decrease could be attributed to the provision of free health services to children under the age of 6 years since 1994[139].

Available data[140] show that the mean DMFT at age 12-years of low-income countries is 1.9 compared with 3.3 DMFT for middle-income countries and 2.1 DMFT for high-income countries; however in most countries more than 90 percent of caries is untreated.

In order to obtain an objective view of the quantity of services provided for the treatment of dental caries, the Unmet Treatment Need Index (UTN)[141] is calculated. The UTN as expressed as a percentage is calculated by dividing the percentage untreated caries by the percentage caries. Van Wyk et al[88] found that based on the weighted national mean the UTN ranged from 82.1 percent for 12-year-old children

through 82.7 percent for 15-year-old children and 91.4 percent for 6-year-old children, which meant that for all children in South Africa more than 80 percent of all caries go untreated.

Moynihan and Petersen[142] found that in low-income countries, the cost of traditional restorative treatment of dental caries is disproportionally expensive in light of the low public health priority and it would exceed the available resources for health care. Sheiham[108] found that dental diseases are a costly burden to health care services; illustrating that the treatment of dental caries is expensive for governments of both developed and developing countries and cost between 5 and 10 percent of total health care expenditures in industrialized countries exceeding the cost of treating cardiovascular disease, cancer and osteoporosis.

South Africa is classified as a middle income emerging market with an abundant supply of natural resources and well developed financial, legal, communications, energy and transport sectors[70]; and therefore, by implication, members of the different population groups should have better access to health promotional aids and dental services.

However, as the literature suggests, the treatment of dental caries is expensive for governments of both developed and developing countries[108,142]. The approach to disease eradication remains largely curative, delivered at an individual level[143]. As most oral health care service delivery is dependent on sophisticated and expensive technology, many South Africans are thus denied access to oral health services[143]. It is

therefore not surprising that high levels of untreated caries were recorded in the current study (Table 6.2).

The inadequacy of resources such as oral health personnel and dental facilities, as well as a lack of awareness about oral health and dental services amongst the majority of the population[88], may also be contributory factors to the high levels of untreated caries found in the current study (Table 6.2).

Van Wyk et al[88] found that if the current backlog of dental caries for children under the age of 15 in South Africa is to be treated it would imply that unrealistically high numbers of personnel and a substantial amount of person treatment hours would be required to do the conservative work. The authors concluded that a massive and unrealistic allocation of resources would be required if such a public oral health programme was to be implemented, a cost that South Africa can certainly not afford.

The South African Health Review of 1997[144] determined that a relatively high patient to health worker ratio exists in the urban clinics compared to peri-urban facilities. This may be a reflection of the influx of people into urban areas where service provision has not been designed to cope with such a demand[144]. It may also be a result of the perception of higher quality care in urban areas[144].

It seems that the current dental caries levels are likely to worsen as a result of rapid urbanization in South Africa[145]; thus resulting in lifestyle changes. These changes normally result in an increase in sugar consumption,

especially amongst children, which lead to an increase in dental caries[106,107,108,142].

The large financial benefits of preventing dental diseases should be emphasised to countries where current disease levels are low. This argument is supported by the section on oral health in the White Paper for the Transformation of the Health System in South Africa[146], which is based on the findings of the Oral Health Committee, appointed by the Minister of Health 1994, which gives a national unified vision for the transformation of oral health services based on the primary health care approach.

This vision sees oral health services focusing on equitable, preventive services integrated with the primary care services. It suggests that there should be a minimum package of services which could be delivered by oral hygienists or dental therapists[146]. This is supported by the National Human Resources Audit[147] that has identified oral hygienists and dental therapists as important members of the oral health team, and an urgent need for additional training of this category of health worker has been expressed.

Other means of achieving oral health need to be explored, including selective community water fluoridation and/or the use of fluoridated toothpaste in combination with fissure sealants[88].

The treatment of caries can include the atraumatic restorative treatment, which has been shown to be effective in managing dental caries, especially amongst children[148]. The provision of mobile dental units could

be alternative means for providing dental services in remote areas of South Africa where facilities are not available[88]. The present high untreated caries rates (Table 6.2) would justify the implementation of such a measure.

Every effort should be made to encourage and promote the positive dietary habits of the population. It is important to limit the frequency of cariogenic snacks and drinks through aggressive health education and anti-sugar policies.

CHAPTER 7

CONCLUSIONS

Dental caries is the most common oral disease in the world[7], and it is predominantly a disease of children and adolescents[23].

The population under 15 years of age in South Africa numbers about 14 million[71]; and with an increasing number of children in the population, South Africa will have an increasing number of people at risk for this disease.

However, the results of the current study show a decrease in dental caries prevalence and severity in the permanent teeth of children during the past 20 years. This reduction can mainly be attributed to the widespread use of fluoridated toothpaste in South Africa. However, it might also be due to the use of varying diagnostic thresholds, where lower levels in caries prevalence and severity were recorded, which otherwise might not be the case.

It was observed that dental caries is more severe in the primary than permanent dentition, and the literature suggests that dental caries in the primary dentition could be associated with early protein-energy malnutrition; exposure to environmental tobacco smoke; enamel hypoplasia; salivary glandular hypofunction and saliva compositional changes.

This observation is of particular importance in South Africa. The prevention of early childhood caries should therefore be an important priority in South Africa. A reduction in sugar consumption may reduce the aggregated caries prevalence,

however a greater reduction would only be achieved through an integrated Primary Oral Health Care approach that includes oral health promotional interventions and the economic empowerment of the poor.

It was recorded that the prevalence and severity (DMFT) of dental caries increased dramatically from 12-year-old to 15-year-old children. This increase could mainly be attributed to caries on the second permanent molar. As children get older there is an increased exposure to cariogenic agents, this fact combined with the position of the second permanent molar in the mouth make it more vulnerable to caries attack. Also, the increase in dental caries prevalence is mainly due to the eruption of sixteen permanent teeth between 11- and 13-years of age, thus increasing the number of susceptible teeth from twelve to twenty-eight.

Dental caries was found to be more prevalent and severe amongst the Black and Coloured population groups; and more prevalent and severe amongst the Coloured population than amongst the Black population. This finding can be explained by the fact that in contrast to Black Africans, most Coloured South Africans live in the coastal Western Cape Province, where drinking water fluoride levels are very low. However, the situation may change and may in the case of the Blacks be further compounded by a rapid rate of urbanization.

Higher dental caries prevalence and severity rates were recorded in the coastal regions (Metro Cape, Port Elizabeth and Durban) as compared to an interior region (Bloemfontein). This is mainly due to the low fluoride levels in the drinking water in the coastal regions compared to the interior region.

Although the severity (dmft/DMFT) of dental caries decreased during the past 20 years; the percentage of untreated caries in 12-year- and 15-year-old children increased, indicating a decrease in the dental services rendered to school children. At the same time the percentage of untreated caries in 6-year-old children decreased, implicating an increase in the dental services rendered to children 6-year-old and younger.

The mean number of decayed teeth constituted the major component of the mean dmft/DMFT in 6-year-, 12-year- and 15-year-old children, showing that the majority (more than 70 percent) of caries go untreated. This may be due to the inadequacy of resources such as oral health personnel and dental facilities as well as a lack of awareness about oral health and dental services amongst the majority of the population.

The number of filled teeth (FT) contributes the most to the caries experience (DMFT) amongst 12-year- and 15-year-old White children. In South Africa, the socio-economic status of Whites is still considerably higher when compared to that of the Asian, Black and Coloured populations[33]. Therefore, by implication, members of the White population have better access to dental services, which were not controlled for during this study.

REFERENCES

1. World Health Organization. Educational imperatives for oral health personnel: change or decay? 1990; Geneva, WHO.
2. Williams WN. Dental Caries in 12-year-old South African school children. Journal of Dental Research 1983; 64(4):597.
3. Department of Health. National Oral Health Survey: South Africa 1988/89. Pretoria: Government Printer; 1994.
4. Department of Health. National Oral Health Survey : South Africa 1999/2002. Pretoria : Government Printer; 2003.
5. Van Rensburg HCH. Profile of health and disease in South Africa. Academia 1982; 1-22.
6. Lalloo R, Myburgh NG and Hobdell MH. Dental Caries, socio-economic development and national oral health policies. International Dental Journal 1999; 49:196-202.
7. Hobdell MH and Sheiham A. Barriers to the promotion of dental health in Developing Countries. Society of Science and Medicine 1981; 15: 817-823.
8. Downer MC. Changing trends in dental caries experience in Great Britain. Advances in Dental Research 1993; 7(1):19-24.
9. National Institutes of Health Consensus Development Conference statement. Diagnosis and Management of Dental Caries throughout Life 2001, March: 26-28.
10. Burt BA. Trends in Caries prevalence in North American children. International Dental Journal 1994; 44:403-413.
11. Niendorff WJ and Jones CM. Prevalence and severity of dental caries among American Indians and Alaska Natives. Journal of Public Health Dentistry 2000; 60(1): 243-249.

12. Burt BA. The future of the Caries Decline. Journal of Public Health Dentistry 1985; 45:261-269.

13. Pakhomov GN. Future trends in oral health and disease. International Dental Journal 1999; 49:27-32.

14. Lo GL and Bagramian RA. Declining prevalence of dental caries in school children in Singapore. Oral Diseases 1997; 3(2):121-125.

15. Renson CE. Global changes in caries Prevalence and Dental Manpower Requirements: 2. The reasons underlying the changes in prevalence. Dental Update 1989, 345-350.

16. Morinushi T, Ueda Y and Tanaka C. Autistic children: experience and severity of dental caries between 1989 and 1995 in Kagoshima City. Japan. Journal of Clinical Pediatric Dentistry 2001; 25(4):323-328.

17. Frencken JE, Kalsbeck H and Verrips GH. Has the decline in dental caries been halted? Changes in caries prevalence among 6- and 12-year-old children in Friesland, 1973-1988. International Dental Journal 1990; 40:225-230.

18. Truin GJ, König KG and Bronkhorst EM. Caries Prevalence in Belgium and The Netherlands. International Dental Journal 1994; 44:379-385.

19. Truin GJ, König KG, Bronkhorst EM and Mulder J. Caries Prevalence amongst school children in The Hague between 1969 and 1993. Caries Research 1994; 28:176-180.

20. Warren JJ, Hand JS and Yao J. First-molar caries experience among Taiwanese first-grade children. Journal of Dentistry for Children 1997; 425-428.

21. Slade GD, Spencer AJ, Davies MJ and Burrow D. Intra-oral distribution and impact of caries experience among South Australian school children. Australian Dental Journal 1996; 41:343-350.

22. Van Nieuwenhuysen JP, Carvalho JC and D'Hoore W. Caries reduction in Belgian 12-year-old children related to socio-economic status. Acta odontol Scand 2002; 60:123-128.

23. Silverstone L, Johnson NW, Hardie JM and Wiliams RAD. Dental caries, aetiology, pathology and prevention 1981, London; Macmillan, p3-18.

24. Cleaton-Jones PC, Richardson BD, Setzer S and Williams S. Primary dentition caries trends, 1976-1981, in four South African populations. Community Dentistry and Oral Epidemiology 1983; 11:312-316.

25. Walker ARP, Dison E, Walker BF and Segal AF. Contrasting patterns of caries profile and dental treatment in pupils of 16-18 years in South African ethnic groups. Community Dentistry and Oral Epidemiology 1982; 10:69-73.

26. Rudolph MJ and Gilbert L. Oral health status, attitude and behaviour of Riverlea primary school children. Journal of the Dental Association of South Africa 1986; 41:737-740.

27. Brindle R, Wilkinson D, Harrison A, Connolly C and Cleaton-Jones P. Oral health in Hlabisa, KwaZulu/Natal – a rural school and community based survey. International Dental Journal 2000; 50(1):13-20.

28. Du Plessis JB, Carstens IL, Rossouw LM and Olivier I. The dental caries status of the urban population in the major metropolitan areas of the Republic of South Africa. In: National Oral Health Survey of South Africa 1988/89, ed PJ van Wyk, 1994; 24-32, Pretoria : Department of Health.

29. Khan MN and Cleaton-Jones PE. Dental caries in African preschool children: social factors as disease markers. Journal of Public Health Dentistry 1998; 58(1):7-11.

30. Bonecker M and Cleaton-Jones P. Trends in dental caries in Latin American and Caribbean 5-6 and 11-13-year-old children: a systemic review. Community Dentistry and Oral Epidemiology 2003; 3(2):152-157.

31. Beltrán-Aguilar ED, Estupinan-Day S and Báez R. Analysis of prevalence and trends of dental caries in the Americas between the 1970's and 1990's. International Dental Journal 1999; 49:322-329.

32. Irigoyen ME and Sánchez-Hinojosa G. Changes in Dental Caries Prevalence in 12-year-old students in the State of Mexico after 9 years of salt fluoridation. Caries Research 2000; 34:303-307.

33. May J. (ed). Poverty and Inequality in South Africa. Report prepared for the office of the executive deputy president and inter-ministerial committee for poverty and inequality. Durban: Praxis Publishing. 1998.

34. Awadia AK, Birkeland JM, Haugejorden O and Bjorvatn K. Caries experience and caries predictors – a study of Tanzanian children consuming drinking water with different fluoride concentrations. Clinical Oral Investigations 2002; 6(2):98-103.

35. Yee R and Sheiham A. The burden of restorative dental treatment for children in Third World countries. International Dental Journal 2002; 52:1-9.

36. Ng'ang'a PM and Valderhaug J. Dental caries in primary school children in Nairobi, Kenya. Acta Odontol Scand 1992; 50:269-272.

37. Ayo-Yusuf OA, Ayo-Yusuf IJ and van Wyk PJ. Socio-economic Inequities in Dental Caries Experience of 12-year-old South Africans: Policy Implications for Prevention. South African Dental Journal 2007; 62(1):6-11.

38. Cleaton-Jones P. Dental caries trends in 5 to 6 year-old and 11 to 13-year-old children in two UNICEF designated regions: Sub-Saharan Africa, and Middle-East and North Africa, 1970-2000. Refuat Hapeh Vehashinayim 2001; 18(1):11-22.

39. Cleaton-Jones PC and Fatti P. Dental caries trends in Africa. Community Dentistry and Oral Epidemiology 1999; 27(5):316-320.

40. Cleaton-Jones PC, Williams S and Fatti P. Surveillance of primary dentition caries in Germiston, South Africa, 1981-1997. Community Dentistry and Oral Epidemiology 2000; 28(4):267-273.

41. Van Wyk PJ and van Wyk C. Oral Health in South Africa. International Dental Journal 2004; 54:373-377.

42. Grobler SR and Dreyer AG. Variations in the fluoride levels of drinking water in South Africa. Implications for fluoride supplementation. South African Medical Journal 1988; 73:217-219.

43. Lehohla P, Statsonline News Archive. Studies reveal the circular nature of urban migration. Originally Published in the Business Report of 4 May 2006.

44. Urbanization and industrialization: What future for Sub-Saharan Africa? David Simon. 1992. Available from:
URL: http://www.unu.edu/unupress/unupbooks/80918e/80918E0d.htm.

45. McNulty JA and Fos PJ. The study of caries prevalence in children in a developing country. Journal of Dentistry for Children 1989; 56(2):129-136.

46. Mascarenhas AK. Determinants of caries prevalence and severity in higher SES Indian Children. Community Dental Health 1999; 16(2):107-113.

47. Varenne B, Petersen PE and Quattara S. Oral health status of children and adults in urban and rural areas of Burkina Faso, Africa. International Dental Journal 2004; 54(2):83-89.

48. Jamieson LM, Thomson WM and McGee R. Caries prevalence and severity in urban Fijian school children. International Journal of Pediatric Dentistry 2004; 14(1):34-40.

49. Irigoyen ME, Luengos IF, Yashine A, Mejia AM and Maupome G. Dental caries experience in Mexican school children from rural and urban communities. International Dental Journal 2000; 50(1):41-45.

50. Jalili VP, Sidhu SS and Kharbanda OP. Status of dental caries and treatment needs in tribal children of Mandu (Central India). Journal of Pieree Fauchard Academy 1993; 7(1):7-15.

51. El-Nadeef MA, Adegbembo AO and Honkala E. The association of urbanisation with the prevalence of dental caries among school children in Nigeria new capital territory. International Dental Journal 1998; 48(1):44-49.

52. Cleaton-Jones PE, Hargreaves JA, Roberts G, Williams S and Leidal TI. The dmfs and dmft of young South African children. Community Dentistry and Oral Epidemiology 1989; 17(1):38-40.

53. Cleaton-Jones P, Chosack A, Hargreaves JA and Fatti LP. Dental caries and social factors in 12-year-old South African children. Community Dentistry and Oral Epidemiology 1994; 22(1):25-29.

54. Dini EL and Silva SR. Prevalence of caries and dental care status of school children from urban and rural areas in Araraquara, Brazil. International Dental Journal 1994; 44(6):613-616.

55. Donahue GJ, Waddell N, Plough AL, bel Aguila MA and Garland TE. The ABCD's of treating the most prevalent childhood disease. American Journal of Public Health 2005; 95(8):1322-1324.

56. Jackson RJ, Newman HN, Smart GJ, Sokes E, Hogan JI, Brown C and Seres J. The effects of a supervised toothbrushing programme on the caries increment of primary school children, initially aged 5-6 years. Caries Research 2005; 39(2):108-115.

57. Davies GM, Worthington HV, Ellwood RP, Bentley EM, Blinkhorn AS, Taylor GO and Davies RM. A randomized controlled trial of the effectiveness of providing free fluoride toothpaste from the age of 12 months on reducing caries in 5-6 years old children. Community Dental Health 2002; 19(3):131-136.

58. Pakhomov GN, Moller IJ, Atanassov NP, Kabackchieva RI and Sharkov NI. Effect of amine fluoride dentifrice on dental caries used in a community-based and health education program. Journal of Public Health Dentistry 1997; 57(3):181-183.

59. Peng B, Petersen PE, Bian Z, Tai B and Jiang H. Can school-based oral health education and a sugar-free chewing gum program improve oral health? Results from a two-year study in PR China. Acta Odontologica Scandinavia 2004; 62(6):328-332.

60. Freeman R, Oliver M, Bunting G, Kirk J and Saunderson W. Addressing children's oral health inequalities in Northern Ireland: a research – practice – community partnership initiative. Public Health Reports 2001; 116(6):617-625.

61. Milgram P and Reisine S. Oral Health in the United States: the post-fluoride generation. Annual Review of Public Health 2000; 21:403-436.

62. Schwarz E and Lo EC. Oral Health and dental care in Hong Kong. International Dental Journal 1995; 45(3):169-176.

63. Ismail AI. Prevention of early childhood caries. Community Dentistry and Oral Epidemiology 1998; 26 (1 Suppl): 49-61.

64. Soderholm KJ. The impact of recent changes in the epidemiology of dental caries on guidelines for the use of dental sealants: clinical perspectives. Journal of Public Health Dentistry 1995; 55 (5 Spec no): 302-311.

65. Horowitz AM. Effective oral health education and promotion programs to prevent dental caries. International Dental Journal 1983; 33(2):171-181.

66. Petersen PE, Hadi R, Al-Zaabi FS, Hussein JM, Behbehani JM, Skougaard MR and Vigild M. Dental knowledge, attitudes and behavior among Kuwait mothers and school teachers. Journal of Pedodontics 1990; 14(3):158-164.

67. Teng O, Narksawat K, Podang J and Pacheon O. Oral health status among 12-year-old children in primary schools participating in an oral health preventive school program in Phnom Penh City, Cambodia, 2002. Southeast Asian Journal of Tropical Medicine and Public Health 2004; 35(2):458-462.

68. Lalloo R and Solanki GS. An evaluation of a school-based comprehensive public oral health care programme. Community Dental Health 1994; 11(3):152-155.

69. Josie-Perez A, Chikte UM, Rudulph MJ, Bellingan A and Brand AA. The impact of a mobile dental system on a school community. Part I: Oral Health Status of schoolchildren. Journal of the Dental Association of South Africa 1994; 49(10):491-494.

70. The World Fact book. South Africa (Cited 2003 August 1). Available from: URL: www.odci.gov/cia/publications/factbook/geos/sf.html.

71. Statistics South Africa. Census 2001: Census in brief. Report no:03-02-03 (2001) Pretoria: Statistics South Africa; 2003, p10.

72. Department of National Health and Population Development. Health Trends in South Africa 1992. Pretoria: Department of National Health and Population Development; 1992.

73. World Health Organization. Oral Health Surveys, Basic Methods. 1979. Geneva, WHO.

74. World Health Organization. Oral Health Surveys, Basic Methods. 1987. Geneva, WHO.

75. World Health Organization. Oral Health Surveys, Basic Methods. 1997. Fourth Edition, Geneva.

76. Pitts NB and Fyffe HE. The effect of varying diagnostic thresholds upon Clinical Caries Data for a Low prevalence group. Journal of Dental Research 1988; 67(3):592-596.

77. Klein H, Palmer CE and Knutson JW. Studies on dental caries. 1. Dental status and Dental Needs of Elementary Schoolchildren. Public Health Report 1938; 53:751-756.

78. Todd JE, Walker AM and Dodd P. Adult dental health, Volume 2, United Kingdom 1978. London: HMSO.

79. Downer MC and Teagle FA. SPEED – System for Planning and Epidemiological Evaluation of Dental Services, 1979.

80. Federation Dentaire Internationale. Global goals for Oral Health by the year 2000. International Dental Journal 1982; 32:74-77.

81. Palmer JD, Anderson RJ and Downer MC. Guidelines for Prevalence studies of Dental Caries. Community Dental Health 1984; 1:55-66.

82. World Health Organization. A Guide to Oral Health. Epidemiological Investigations. 1979. Geneva: WHO.

83. Marthaler TM. Experimental Design in Epidemiologic Research. Journal of Dental Research 1963; 42:192-201.

84. Cleaton-Jones P, Hargreaves JA, Fatti LP, Chandler HD and Grossman ES. Dental caries diagnosis for clinical field surveys. Caries Research 1989; 23(3):195-199.

85. Bratthall D. Introducing the significant caries index together with a proposal for a new global oral health goal for 12-year-olds. International Dental Journal 2000; 50:378-384.

86. Batchelor P and Sheiham A. The limitations of a "high-risk" approach for the prevention of dental caries. Community Dentistry and Oral Epidemiology 2002; 30:302-312.

87. Rose G. The strategy of preventive medicine. 2nd ed. Oxford: Oxford University Press; 1993.

88. Van Wyk PJ, Louw AJ and du Plessis JB. Caries status and treatment needs in South Africa: Report of the 1999-2002 national children's oral health survey. South African Dental Journal 2004; 59:238-242.

89. MacKeown M and Faber M. Urbanization and cariogenic food habits among 4-24-month-old black South African children in rural and urban areas. Public Health Nutrition 2002; 5(6):719-726.

90. North K, Emmett P and Noble S, the ALSPAC Study Team. Types of drinks consumed by infants 4 and 8 months of age: sociodemographic variations. Journal of Human Nutrition and Diet 2000; 13:71-82.

91. Steyn NP, Myburgh NG and Nel JH. Evidence to support a food-based dietary guideline on sugar consumption in South Africa. Bulletin of the World Health Organization 2003;81(8):599-608.

92. Labadarios D, Steyn NP, Maunder E, McIntyre U, Swart R and Gericke G. The National Food Consumption Survey (NFCS): Children aged 7-9 years, South Africa, 1999. Pretoria: Department of Health, Directorate: Nutrition; 2000.

93. Psoter WJ, Reid BC and Katz RV. Malnutrition and dental caries: A review of the literature. Caries Research 2005; 39(6): 441-447.

94. Stephens C. The urban environment, poverty and health in developing countries. Health Policy Plan 1995; 10:109-121.

95. Roberts GJ, Cleaton-Jones PE, Richardson BD, Sinwel RE and Lucas VS. Breast and bottle feeding in rural and urban South African children. Journal of Human Nutrition and Diet 1995; 8:255-263.

96. Dannhauser A, Bester CJ, Joubert G, Badenhorst PN, Slabber M and Badenhorst AM. Nutritional status of preschool children in informal settlement areas near Bloemfontein, South Africa. Public Health Nutrition 2000; 3:303-312.

97. Harpham T and Stephens C. Urbanization and Health in developing countries. World Health Statistics Quarterly Rapport 1991; 44:62-69.

98. Solomons NW and Gross R. Urban nutrition in developing countries. Nutrition Review 1995; 53(4Pt 1): 90-95.

99. Yach D, Matthews C and Buch E. Urbanization and health: methodological difficulties in undertaking epidemiological research in developing countries. Society of Scientific Medicine 1990; 31:507-514.

100. Shenkin JD, Broffitt B and Levy SM. The association between environmental tobacco smoke and primary tooth caries. Journal of Public Health 2004;64:184-186.

101. Barmes D. Epidemiology of Dental Diseases. Journal of Clinical Periodontology 1977; 4:80-93.

102. Nel JH and Steyn NP. Report on South African food consumption studies undertaken amongst different population groups, 1983-2000; average intake of foods most commonly consumed. Pretoria: Department of Heath; 2002. Available from URL: http://www.doh.gov.za/department/dir.foodcontr-fhtl.

103. Joint WHO.FAO Expert Consultation on Diet. Nutrition and the prevention of chronic disease. Geneva: World Health Organization; 2003 (WHO Technical Report Series No.916).

104. Takeuchi M. Epidemiological study on the relationship between dental caries incidence and sugar consumption. Bulletin of the Tokyo Dental College 1960; 2:57-58.

105. Takahashi K. Statistical study on caries incidence in the first molar in relationship to the amount of sugar consumption. Bulletin of the Tokyo Dental College 1961; 2:44-57.

106. Sheiham A. Sucrose and dental caries. Nutrition and Health 1987; 5:25-29.

107. Sheiham A. Why sugar consumption should be below 15kg per person per year in industrialised countries; the dental evidence. British Dental Journal 1991;171:63-65.

108. Sheiham A. Dietary effects on dental diseases. Public Health Nutrition 2001; 4:569-591.

109. Bruno-Ambrosius K, Swanholm G and Twetman S. Eating habits, smoking and tooth brushing in relation to dental caries: a 3-year study in Swedish female teenagers. International Journal of Pediatric Dentistry 2005; 15:190-196.

110. Hargreaves JA, Cleaton-Jones PE, Roberts GJ and Williams SD. Hypocalcification and Hypoplasia in primary teeth of pre-school children from different ethnic groups in South Africa. Advances in Dental Research 1989; 3(2): 110-113.

111. Steyn K, Bradshaw D and Norman R. Tobacco use in South Africans during 1998: the first demographic and health survey. Journal of Cardiovascular Risk 2002; 9:161-170.

112. Swart D, Reddy P and Panday S. The 2002 Global Youth Tobacco Survey (GYTS): The 2nd GYTS in South Africa – A comparison between GYTS (SA) 1999 and GYTS (SA) 2002. Cape Town: South African Medical Research Council, 2004.

113. Pollard MA, Cleaton-Jones P, Smith A and Sam C. The plaque acidogenic response to carbohydrates of children from three ethnic groups in South Africa. International Dental Journal 1997; 47(1): 39-44.

114. Toi CS, Cleaton-Jones PE and Daya NP. Mutans streptococci and other caries-associated acidogenic bacteria in five-year-old children in South Africa. Oral Microbiology and Immunology 1999; 14(4):238-243.

115. Postma TC, Ayo-Yusuf OA and van Wyk PJ. Association of early childhood caries with socio-demographic factors, and area-based sugar consumption and water fluoride levels, in developing countries. Under Review.

116. du Plessis JB, van Rooyen JJC, Naude DA and van der Merwe CA. Water fluoridation in South Africa: will it be effective? Journal of the Dental Association of South Africa 1995; 50:545-549.

117. Chikte UME, Grobler SR and Louw AJ. Drinking water fluoride concentrations in different municipal sources (boreholes, dams, mixtures, rivers, springs) in South Africa. South African Dental Journal 2006; 61:448.

118. Psoter WJ, Pendrys DG, Morse DE et al. Associations of ethnicity/race and socio-economic status with early childhood caries patterns. Journal of Public Health Dentistry 2006; 66:23-29.

119. Albert DA, Park K, Findley S et al. Dental caries among disadvantaged 3- to 4-year-old children in Northern Manhattan. Pediatric Dentistry 2002; 24:229-223.

120. Ellwood RP, Davies GM, Blinkhorn AS et al. Relationship between area deprivation and the anticaries benefit of an oral health programme providing free toothpaste to children. Community Dentistry and Oral Epidemiology 2004; 32:159-165.

121. Walsh CM, Dannhauser A and Joubert G. Impact of a nutrition education programme on nutrition knowledge and dietary practices of lower socio-economic communities in the Free State and Northern Cape. SAJCN 2003; 16(3):89-95.

122. Ockerse T. Dental Caries: Clinical and experimental investigation [DSc Thesis]. Pretoria: University of Pretoria; 1947; 53-54.

123. Roberts GJ, Cleaton-Jones PE, Fatti LP et al. Patterns of breast and bottle feeding and their association with dental caries in 1- to 4-year-old South African children. Community Dental Health 1993; 10:405-413.

124. Martin G, Steyn K and Yach D. Beliefs about smoking and health and attitudes towards tobacco control measures. South African Medical Journal 1992; 82:241-245.

125. Reddy P, Meyer-Weitz A and Yach D. Smoking status, knowledge of health effects and attitudes towards tobacco control in South Africa. South African Medical Journal 1996; 86:1389-1393.

126. Legler DW and Menaker L. Definition, Etiology, Epidemiology and Clinical implications of Dental caries. In Menaker L (ed). The Biological Basis of Dental caries. 1980. Harper and Row, p217.

127. Daly B, Watt R, Batchelor P and Treasure E. Essential Dental Public Health. Oxford : Oxford University Press; 2002.

128. Mothusi B. Letter to the Department of Health. Fluoride levels of drinking water in North West Province, May 1999.

129. Burt BA. Fluoridation and social equity. Journal of Public Health Dentistry 2000; 62:195-200.

130. Nishi M, Stjernsward J, Carlsson P and Bratthall D. Caries experience of some countries and area expressed by the significant caries index. Community Dentistry and Oral Epidemiology 2002; 30:296-301.

131. Antunes JLF, Narvai PC and Nugent ZJ. Measuring inequalities in the distribution of dental caries. Community Dentistry and Oral Epidemiology 2004; 32:41-48.

132. Kawachi I, Kennedy BP and Lochner K. et al. Social capital, income inequality and mortality. American Journal of Public Health 1997; 87:1491-1498.

133. Pattussi MP, Marcenes W, Croucher R et al. Social deprivation, income inequality, social cohesion and dental caries in Brazilian school children. Soc Science and Medicine 2001; 53:915-925.

134. Oral Health Committee. Summary Report to the Minister of Health Dr N Zuma. 1995.

135. Du Plessis JB. The effect of socio-economic status on dental caries experience in 6, 12 and 15-year-old school children in Port Elizabeth and Despatch. South African Dental Journal 1997; 52:483-486.

136. Republic of South Africa. Commission of Enquiry into Dental Services and the Training of Non-White Dental Surgeons Report. Pretoria Government Printer 1967; 183-187.

137. Department van Gesondheid. Nasionale Tandheelkundige Gesondheids-beleid : Verslag en Aanbevelings. Deel 3, Pretoria Staatsdrukker 1975.

138. Department of Health. South African National Oral Health Strategy. Available from URL: http://www.doh.gov.za/docs/index.html.

139. Department of National Health and Population Development. Rendering of free health services. Government Gazette. No 15817. 1 July 1994.

140. World Health Organization. Global Oral Health Data Bank. Geneva: World Health Organization, 2001.

141. Jong A. Dental Public Health and Community Dentistry. St Louis : CV Mosby Company. 1981; p79.

142. Moynihan P and Petersen PE. Diet, nutrition and the prevention of dental diseases. Public Health Nutrition 2004; 7(1A):201-206.

143. Lowe RE, Barron P, Steyn SD, Malekela LL, Steynberg MH and Reid G. Occupational health services in Johannesburg and Randburg. South African Medical Journal 1990; 77:581-584.

144. South African Health Review 1997, Published by the Health Systems Trust. 1997.

145. Central Statistical Service. 1996 Census, CSS Pretoria, 1997.

146. Department of Health White Paper for the Transformation of the Health System in South Africa. Government Gazette Vol 382 No 17910, Notice 667 of 1997, Pretoria 16 April 1997.

147. Directorate of Human Resources Development. The Human Resource Audit for Health Care Personnel in South Africa. Department of Health, Pretoria, 1996.

148. Motsei SM, Kroon J, Holtshousen WSJ. Evaluation of Atraumatic restorative treatment restorations and sealants under field conditions. South African Dental Journal 2001; 56(7):309-315.

Annexure A1

Percentage change, per annum, in the prevalence of dental caries per NOHS

Population	Age		Change (Slope) per year								
			Between 1983+1989			Between 1989+2002			Between 1983+2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	Primary	-	-	-	-	-	-	-	-	-
		Permanent	-	-	-	-0.40	-0.28	-0.33	-	-	-
	12		6.15	-3.97	-5.06	0.23	-0.54	-0.17	-1.90	-1.68	-1.80
	15		-	-	-	-2.49	-1.33	-1.83	-	-	-
Black	6	Primary	-	-	-	-0.57	-0.25	-0.38	-	-	-
		Permanent	-	-	-	-0.47	-0.29	-0.39	-	-	-
	12		0.60	-0.68	-0.64	-0.90	-1.65	-1.28	-0.80	-1.33	-1.06
	15		-	-	-	-0.70	-1.30	-1.05	-	-	-
Coloured	6	Primary	-	-	-	1.22	0.67	0.98	-	-	-
		Permanent	-	-	-	-0.01	0.32	0.15	-	-	-
	12		4.08	-2.83	-3.63	0.79	-0.17	0.39	-0.83	-1.06	-0.95
	15		-	-	-	0.31	-0.21	0.03	-	-	-
White	6	Primary	-	-	-	-0.20	0.02	-0.10	-	-	-
		Permanent	-	-	-	-0.54	-0.29	-0.43	-	-	-
	12		4.67	-5.07	-4.90	-1.71	-1.30	-1.46	-2.69	-2.56	-2.61
	15		-	-	-	-1.63	-1.55	-1.54	-	-	-
Total Weighted mean	6	Primary	-	-	-	0.50	0.68	0.61	-	-	-
	12	Permanent	-1.60	-1.52	-1.57	-0.80	-1.43	-1.10	-0.73	-1.32	-1.01
	15	Permanent	-	-	-	-0.77	-1.22	-1.02	-	-	-

Annexure A2

% Prevalence of dental caries, per NOHS, in all 6-year-olds (total), primary dentition

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Asian	-	-	114	66.90
	Diff (%) 1988-2002 =		**SE=**	**p=**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Black	970	66.20	1006	61.60
	Diff (%) 1988-2002 = -4.60		**SE= 0.02**	**p=0.04**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Coloured	966	76.10	461	88.80
	Diff (%) 1988-2002 = +12.70		**SE= 0.02**	**p=0.00**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
White	1068	58.50	184	57.30
	Diff (%) 1988-2002 = -1.20		**SE= 0.04**	**p=0.77**

Annexure A3

% Prevalence of dental caries, per NOHS, in all 12-year-olds (total)

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
Asian	930	80.85	397	50.50	106	48.50
	Diff 1982-1989= -30.35 SE=0.03 p=0.00					
			Diff 1988-2002=-2.00 SE=0.05 p=0.76			
	Diff 1982-2002= -32.35 SE=0.04 p=0.00					

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
Black	363	57.85	1049	54.00	977	38.70
	Diff 1982-1989= -3.85 SE=0.03 p=0.25					
			Diff 1988-2002=-15.30 SE=0.02 p=0.00			
	Diff 1982-2002= -19.15 SE=0.03 p=0.00					

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
Coloured	983	82.25	1208	60.50	452	65.20
	Diff 1982-1989= -21.75 SE=0.02 p=0.00					
			Diff 1988-2002= +4.70 SE=0.03 p=0.09			
	Diff 1982-2002= -17.05 SE=0.02 p=0.00					

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
White	368	86.20	1005	56.80	201	39.30
	Diff 1982-1989= -29.40 SE=0.03 p=0.00					
			Diff 1988-2002= -17.50 SE=0.04 p=0.00			
	Diff 1982-2002= -46.90 SE=0.04 p=0.00					

Annexure A4

% Prevalence of dental caries, per NOHS, in all 15-year-olds (total)

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Asian	505	69.00	116	47.10
	Diff (%) 1988-2002 = -21.90		**SE= 0.05**	**p=0.00**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Black	952	70.70	1009	58.10
	Diff (%) 1988-2002 = -12.60		**SE= 0.02**	**p=0.00**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Coloured	1284	78.20	429	78.60
	Diff (%) 1988-2002 = +0.40		**SE= 0.02**	**p=0.92**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
White	921	80.10	248	61.60
	Diff (%) 1988-2002 = -18.50		**SE= 0.03**	**p=0.00**

Annexure A5

% Prevalence of dental caries, per NOHS, in 6-year-old males, primary dentition

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Asian	-	-	51	70.40
	Diff (%) 1988-2002 =		**SE=**	**p=**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Black	477	68.00	511	61.20
	Diff (%) 1988-2002 = -6.80		**SE= 0.03**	**p=0.03**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Coloured	487	77.00	230	92.80
	Diff (%) 1988-2002 = +15.80		**SE= 0.03**	**p=0.00**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
White	499	59.00	102	56.60
	Diff (%) 1988-2002 = -2.40		**SE= 0.05**	**p=0.78**

Annexure A6

% Prevalence of dental caries, per NOHS, in 12-year-old males

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
Asian	460	79.70	202	42.80	52	45.50
	Diff 1982-1989= -36.90 SE=0.04 p=0.00					
			Fishers Exact=0.75			
			Diff 1988-2002= +2.7 SE=0.07 p=0.76			
	Diff 1982-2002= -34.20 SE=0.06 p=0.00					

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
Black	180	53.60	481	50.00	489	39.20
	Diff 1982-1989= -3.60 SE=0.04 p=0.51					
			Diff 1988-2002= -10.80 SE=0.03 p=0.00			
	Diff 1982-2002= -14.40 SE=0.04 p=0.00					

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
Coloured	491	81.50	579	57.00	218	66.50
	Diff 1982-1989= -24.50 SE=0.03 p=0.00					
			Diff 1988-2002= +9.5 SE=0.04 p=0.02			
	Diff 1982-2002= -15.00 SE=0.03 p=0.00					

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
White	185	85.00	502	57.00	86	36.50
	Diff 1982-1989= -28.00 SE=0.04 p=0.00					
			Diff 1988-2002= -20.50 SE=0.06 p=0.00			
	Fishers Exact=0.00					
	Diff 1982-2002= -48.50 SE=0.06 p=0.00					

Annexure A7

% Prevalence of dental caries, per NOHS, in 15-year-old males

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Asian	248	65.00	46	35.10
	Diff (%) 1988-2002 = -29.90		**SE= 0.08**	**Fishers Exact=0.00 p=0.00**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Black	342	70.00	493	61.60
	Diff (%) 1988-2002 = -8.40		**SE= 0.03**	**p=0.02**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Coloured	591	76.00	200	79.70
	Diff (%) 1988-2002 = +3.70		**SE= 0.03**	**p=0.35**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
White	414	80.00	110	60.40
	Diff (%) 1988-2002 = -19.60		**SE= 0.05**	**p=0.00**

Annexure A8

% Prevalence of dental caries, per NOHS, in 6-year-old females, primary dentition

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Asian	-	-	63	63.90
	Diff (%) 1988-2002 =		**SE=**	**p=**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Black	493	65.00	495	62.00
	Diff (%) 1988-2002 = -3.00		**SE= 0.03**	**p=0.38**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Coloured	479	76.00	231	84.70
	Diff (%) 1988-2002 = +8.70		**SE= 0.03**	**p=0.00**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
White	569	58.00	82	58.20
	Diff (%) 1988-2002 = +0.20		**SE= 0.06**	**p=0.98**

Annexure A9

% Prevalence of dental caries, per NOHS, in 12-year-old females

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
Asian	470	82.00	195	58.20.80	52	51.70
	Diff 1982-1989= -23.80		**SE=0.04**	**p=0.00**		
			Diff 1988-2002= -6.50	**SE=0.08**	**Fishers Exact=0.44 p=0.52**	
	Diff 1982-2002= -30.30		**SE=0.06**		**p=0.00**	

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
Black	183	62.10	568	58.00	488	38.20
	Diff 1982-1989= -4.10		**SE=0.04**	**p=0.34**		
			Diff 1988-2002= -19.80	**SE=0.03**	**p=0.00**	
	Diff 1982-2002= -23.90		**SE=0.04**		**p=0.00**	

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
Coloured	492	83.00	629	66.00	234	64.00
	Diff 1982-1989= -17.00		**SE=0.03**	**p=0.00**		
			Diff 1988-2002= -2.00	**SE=0.04**	**p=0.58**	
	Diff 1982-2002= -19.00		**SE=0.03**		**p=0.00**	

Population Group	1982/83		1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %	n	Prevalence %
White	183	87.40	503	57.00	115	41.40
	Diff 1982-1989= -30.40		**SE=0.04**	**p=0.00**		
			Diff 1988-2002=-15.60	**SE=0.05**	**p=0.00**	
	Diff 1982-2002= -46.00		**SE=0.05**		**Fishers Exact=0.00 p=0.00**	

Annexure A10

% Prevalence of dental caries, per NOHS, in 15-year-old females

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Asian	257	72.50	70	56.50
	Diff (%) 1988-2002 = -16.00		**SE= 0.06**	**Fishers Exact=0.01 p=0.01**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Black	610	71.00	570	55.40
	Diff (%) 1988-2002 = -15.60		**SE= 0.03**	**p=0.00**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
Coloured	693	80.00	229	77.50
	Diff (%) 1988-2002 = -2.50		**SE= 0.03**	**p=0.45**

Population Group	1988/89		1999/2002	
	n	Prevalence %	n	Prevalence %
White	570	81.00	138	62.40
	Diff (%) 1988-2002 = -18.60		**SE= 0.04**	**p=0.00**

Annexure A11

Severity (dmft) of dental caries, per NOHS, in all 6-year-olds (total), primary dentition

Population Group	1988/89		1999/2002	
	n	dmft	n	dmft
Asian	516	4.10	114	3.49
	Diff 1988-2002	**chi-sq = 1.89**		**p=0.17**

Population Group	1988/89		1999/2002	
	n	dmft	n	dmft
Black	970	3.10	1006	2.88
	Diff 1988-2002	**chi-sq = 2.01**		**p=0.16**

Population Group	1988/89		1999/2002	
	n	dmft	n	dmft
Coloured	966	4.10	461	5.79
	Diff 1988-2002	**chi-sq = 31.23**		**p=0.00**

Population Group	1988/89		1999/2002	
	n	dmft	n	dmft
White	1068	58.50	184	57.30
	Diff 1988-2002	**chi-sq = 0.47**		**p=0.49**

Annexure A12

Severity (DMFT) of dental caries, per NOHS, in all 12-year-olds (total)

Population Group	1982/83		1988/89		1999/2002	
	n	DMFT	n	DMFT	n	DMFT
Asian	930	2.95	397	1.30	106	1.06
	Diff 1982-1989		**chi-sq = 117.43**		**p=0.00**	
			Diff 1988-2002		**chi-sq = 1.88**	**p=0.17**
	Diff 1982-2002		**chi-sq = 57.25**		**p=0.00**	

Population Group	1982/83		1988/89		1999/2002	
	n	DMFT	n	DMFT	n	DMFT
Black	363	2.15	1049	1.70	977	1.08
	Diff 1982-1989		**chi-sq = 9.92**		**p=0.00**	
			Diff 1988-2002		**chi-sq = 59.33**	**p=0.00**
	Diff 1982-2002		**chi-sq = 79.90**		**p=0.00**	

Population Group	1982/83		1988/89		1999/2002	
	n	DMFT	n	DMFT	n	DMFT
Coloured	983	3.75	1208	2.00	452	2.07
	Diff 1982-1989		**chi-sq = 158.26**		**p=0.00**	
			Diff 1988-2002		**chi-sq =0.27**	**p=0.61**
	Diff 1982-2002		**chi-sq = 78.42**		**p=0.00**	

Population Group	1982/83		1988/89		1999/2002	
	n	DMFT	n	DMFT	n	DMFT
White	368	31.14	1005	22.22	201	36.84
	Diff 1982-1989		**chi-sq = 118.89**		**p=0.00**	
			Diff 1988-2002		**chi-sq =35.50**	**p=0.00**
	Diff 1982-2002		**chi-sq=156.50**		**p=0.00**	

Annexure A13

Severity (DMFT) of dental caries, per NOHS, in all 15-year-olds (total)

Population Group	1988/89		1999/2002	
	n	DMFT	n	DMFT
Asian	505	2.50	116	1.36
	Diff 1988-2002	**chi-sq = 21.26**		**p=0.00**

Population Group	1988/89		1999/2002	
	n	DMFT	n	DMFT
Black	952	3.00	1009	2.25
	Diff 1988-2002	**chi-sq = 29.32**		**p=0.00**

Population Group	1988/89		1999/2002	
	n	DMFT	n	DMFT
Coloured	1284	4.20	429	3.69
	Diff 1988-2002	**chi-sq = 4.27**		**p=0.04**

Population Group	1988/89		1999/2002	
	n	DMFT	n	DMFT
White	921	4.00	248	2.07
	Diff 1988-2002	**chi-sq = 60.76**		**p=0.00**

Annexure A14

Mean number change, per annum, in the severity profile (dmft/DMFT score) of dental caries per NOHS

Population	Age		Change (Slope) per year								
			Between 1983+1989			Between 1989+2002			Between 1983+2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	dmft	-	-	-	-0.10	0.00	-0.05	-	-	-
		DMFT	-	-	-	-0.01	-0.01	-0.01	-	-	-
	12	DMFT	0.28	-0.25	-0.28	-0.01	-0.04	-0.02	-0.10	-0.11	-0.11
	15	DMFT	-	-	-	-0.12	-0.09	-0.10	-	-	-
Black	6	dmft	-	-	-	-0.02	-0.02	-0.02	-	-	-
		DMFT	-	-	-	-0.01	-0.01	-0.01	-	-	-
	12	DMFT	0.07	-0.08	-0.08	-0.03	-0.07	-0.05	-0.04	-0.08	-0.06
	15	DMFT	-	-	-	-0.03	-0.09	-0.06	-	-	-
Coloured	6	dmft	-	-	-	0.16	0.12	0.14	-	-	-
		DMFT	-	-	-	-0.01	0.00	0.00	-	-	-
	12	DMFT	0.25	-0.33	-0.29	0.01	0.00	0.01	-0.08	-0.11	-0.09
	15	DMFT	-	-	-	-0.02	-0.06	-0.04	-	-	-
White	6	dmft	-	-	-	-0.03	0.01	-0.01	-	-	-
		DMFT	-	-	-	-0.01	0.00	0.00	-	-	-
	12	DMFT	0.32	-0.37	-0.34	-0.08	-0.06	-0.07	-0.16	-0.16	-0.16
	15	DMFT	-	-	-	-0.17	-0.16	-0.16	-	-	-
Total Weighted mean	6	DMFT	-	-	-	-0.01	0.00	0.00	-	-	-
	12	DMFT	-	-	-	-0.03	-0.05	-0.05	-	-	-
	15	DMFT	-	-	-	-0.05	-0.09	-0.07	-	-	-

Annexure A15

The percentage change, per annum, in the percentage of individuals with active caries (decayed component of the dmft/DMFT) per NOHS

Population	Age		Change (Slope) per year								
			Between 1983+1989			Between 1989+2002			Between 1983+2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	dt	-	-	-	-0.34	0.27	0.07	-	-	-
		DT	-	-	-	-8.33	8.33	0.00	-	-	-
	12	DT	0.70	-1.41	-0.03	-1.70	1.04	-0.74	-1.37	0.22	-0.50
	15	DT	-	-	-	2.03	1.37	1.30	-	-	-
Black	6	dt	-	-	-	-0.31	-0.14	-0.23	-	-	-
		DT	-	-	-	-0.93	-1.92	-1.52	-	-	-
	12	DT	1.81	0.15	-0.24	1.32	-0.51	0.08	0.28	-0.29	-0.02
	15	DT	-	-	-	0.98	1.18	0.91	-	-	-
Coloured	6	dt	-	-	-	-2.67	-2.23	-2.46	-	-	-
		DT	-	-	-	0.85	0.25	0.50	-	-	-
	12	DT	0.00	-0.83	-0.42	0.56	1.15	0.88	0.37	0.49	0.45
	15	DT	-	-	-	0.55	0.59	0.58	-	-	-
White	6	dt	-	-	-	2.87	1.05	2.17	-	-	-
		DT	-	-	-	0.00	-3.03	-3.47	-	-	-
	12	DT	1.17	-1.78	-1.49	0.90	1.39	1.22	0.21	0.33	0.32
	15	DT	-	-	-	2.17	1.01	1.43	-	-	-
Total Weighted mean	6	dt	-	-	-	-0.17	-0.19	-0.15	-	-	-
	12	DT	-1.52	-0.23	-0.39	1.10	-0.07	0.27	0.23	-0.12	0.05
	15	DT	-	-	-	1.11	1.10	0.95	-	-	-

Annexure A16

% Active caries, per NOHS, in all 12-year-olds (total)

Population Group	1982/83		1988/89		1999/2002	
	n	Active Caries %	n	Active Caries %	n	Active Caries %
Asian	930	69.42	397	69.23	106	60.38
	Diff 1982-1989= -0.19		**SE=0.03**	**p=0.99**		
			Diff 1988-2002= -8.85		**SE=0.05**	**p=0.11**
	Diff 1982-2002= -9.04		**SE=0.05**		**p=0.07**	

Population Group	1982/83		1988/89		1999/2002	
	n	Active Caries %	n	Active Caries %	n	Active Caries %
Black	363	83.77	1049	82.35	977	83.33
	Diff 1982-1989= -1.42		**SE=0.02**	**p=0.60**		
			Diff 1988-2002=+0.98		**SE=0.02**	**p=0.61**
	Diff 1982-2002= -0.44		**SE=0.02**		**p=0.92**	

Population Group	1982/83		1988/89		1999/2002	
	n	Active Caries %	n	Active Caries %	n	Active Caries %
Coloured	983	62.50	1208	60.00	452	70.53
	Diff 1982-1989= -2.50		**SE=0.02**	**p=0.26**		
			Diff 1988-2002=+10.53		**SE=0.03**	**p=0.00**
	Diff 1982-2002= +8.03		**SE=0.03**		**p=0.00**	

Population Group	1982/83		1988/89		1999/2002	
	n	Active Caries %	n	Active Caries %	n	Active Caries %
White	368	31.14	1005	22.22	201	36.84
	Diff 1982-1989= -8.92		**SE=0.03**	**p=0.00**		
			Diff 1988-2002=+14.62		**SE=0.03**	**p=0.00**
	Diff 1982-2002= +5.70		**SE=0.04**		**p=0.21**	

Annexure A17

% Active caries, per NOHS, in all 15-year-olds (total)

Population Group	1988/89		1999/2002	
	n	Active Caries %	n	Active Caries %
Asian	505	52.00	116	67.65
	Diff (%) 1988-2002 = +15.65		**SE= 0.05**	**p=0.00**

Population Group	1988/89		1999/2002	
	n	Active Caries %	n	Active Caries %
Black	952	76.69	1009	87.56
	Diff (%) 1988-2002 = +10.89		**SE= 0.02**	**p=0.00**

Population Group	1988/89		1999/2002	
	n	Active Caries %	n	Active Caries %
Coloured	1284	52.38	429	59.35
	Diff (%) 1988-2002 = +6.97		**SE= 0.03**	**p=0.01**

Population Group	1988/89		1999/2002	
	n	Active Caries %	n	Active Caries %
White	921	20.00	248	37.19
	Diff (%) 1988-2002 = +17.19		**SE= 0.03**	**p=0.00**

Annexure A18

The mean number change, per annum, in the mean number of decayed teeth (dt/DT) per NOHS

Population	Age		Change (Slope) per year								
			Between 1983+1989			Between 1989+2002			Between 1983+2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	dt	-	-	-	-0.09	0.01	-0.04	-	-	-
		DT	-	-	-	-0.01	0.00	-0.01	-	-	-
	12	DT	0.20	-0.20	-0.19	-0.02	-0.01	-0.02	-0.08	-0.07	-0.08
	15	DT	-	-	-	-0.05	-0.02	-0.03	-	-	-
Black	6	dt	-	-	-	-0.03	-0.02	-0.02	-	-	-
		DT	-	-	-	-0.01	-0.01	-0.01	-	-	-
	12	DT	0.08	-0.07	-0.07	-0.01	-0.07	-0.04	-0.03	-0.07	-0.05
	15	DT	-	-	-	0.00	-0.04	-0.03	-	-	-
Coloured	6	dt	-	-	-	0.00	0.00	0.00	-	-	-
		DT	-	-	-	0.00	0.00	0.00	-	-	-
	12	DT	0.15	-0.23	-0.19	0.02	0.02	0.02	-0.04	-0.06	-0.05
	15	DT	-	-	-	0.01	-0.01	0.00	-	-	-
White	6	dt	-	-	-	0.05	0.03	0.05	-	-	-
		DT	-	-	-	-0.01	-0.01	-0.01	-	-	-
	12	DT	0.12	-0.15	-0.13	-0.01	0.00	0.00	-0.05	-0.05	-0.05
	15	DT	-	-	-	0.00	-0.01	0.00	-	-	-
Total Weighted mean	6	dt	-	-	-	-0.02	-0.01	-0.01	-	-	-
	12	DT	-0.09	-0.09	-0.09	-0.01	-0.05	-0.03	0.00	-0.03	-0.02
	15	DT	-	-	-	0.00	-0.03	-0.02	-	-	-

Annexure A19

The mean number change, per annum, in the mean number of missing teeth (mt/MT) per NOHS

Population	Age		Change (Slope) per year								
			Between 1983+1989			Between 1989+2002			Between 1983+2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	mt	-	-	-	0.00	0.00	0.00	-	-	-
		MT	-	-	-	0.00	0.00	0.00	-	-	-
	12	MT	0.10	-0.08	-0.09	0.02	0.01	0.01	-0.02	-0.02	-0.02
	15	MT	-	-	-	-0.03	-0.01	-0.02	-	-	-
Black	6	mt	-	-	-	0.01	0.00	0.00	-	-	-
		MT	-	-	-	0.00	0.00	0.00	-	-	-
	12	MT	0.00	-0.03	-0.01	-0.02	0.00	-0.01	-0.01	-0.01	-0.01
	15	MT	-	-	-	-0.03	-0.04	-0.03	-	-	-
Coloured	6	mt	-	-	-	0.16	0.11	0.13	-	-	-
		MT	-	-	-	-0.01	0.00	0.01	-	-	-
	12	MT	0.12	-0.12	-0.12	0.00	-0.01	-0.01	-0.04	-0.05	-0.04
	15	MT	-	-	-	-0.02	-0.02	-0.02	-	-	-
White	6	mt	-	-	-	-0.03	0.00	-0.01	-	-	-
		MT	-	-	-	0.00	0.00	0.00	-	-	-
	12	MT	0.00	-0.03	-0.03	-0.01	0.00	0.00	-0.01	-0.01	-0.01
	15	MT	-	-	-	-0.01	-0.02	-0.01	-	-	-
Total Weighted mean	6	mt	-	-	-	0.02	0.01	0.01	-	-	-
	12	MT	-0.02	-0.04	-0.02	-0.01	0.00	-0.01	-0.01	-0.02	-0.01
	15	MT	-	-	-	-0.03	-0.03	-0.03	-	-	-

Annexure A20

The mean number change, per annum, in the mean number of filled teeth (ft/FT) per NOHS

Population	Age		Change (Slope) per year								
			Between 1983+1989			Between 1989+2002			Between 1983+2002		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Asian	6	ft	-	-	-	0.00	-0.01	-0.01	-	-	-
		FT	-	-	-	0.00	0.00	0.00	-	-	-
	12	FT	0.00	0.02	0.01	0.00	-0.02	-0.01	0.00	-0.01	-0.01
	15	FT	-	-	-	-0.05	-0.06	-0.05	-	-	-
Black	6	ft	-	-	-	0.00	0.00	0.00	-	-	-
		FT	-	-	-	0.00	0.00	0.00	-	-	-
	12	FT	-0.02	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	0.00
	15	FT	-	-	-	0.00	0.00	0.00	-	-	-
Coloured	6	ft	-	-	-	0.01	0.01	0.01	-	-	-
		FT	-	-	-	0.01	0.00	0.00	-	-	-
	12	FT	-0.02	0.02	0.02	-0.01	-0.01	-0.01	0.00	0.00	0.00
	15	FT	-	-	-	-0.02	-0.03	-0.02	-	-	-
White	6	ft	-	-	-	-0.05	-0.03	-0.05	-	-	-
		FT	-	-	-	0.00	0.01	0.00	-	-	-
	12	FT	-0.18	-0.20	-0.20	-0.07	-0.05	-0.06	-0.11	-0.10	-0.10
	15	FT	-	-	-	-0.16	-0.13	-0.14	-	-	-
Total Weighted mean	6	ft	-	-	-	0.00	0.00	0.00	-	-	-
	12	FT	-0.01	-0.02	-0.02	-0.02	0.00	-0.01	-0.01	-0.01	-0.01
	15	FT	-	-	-	-0.02	-0.02	-0.02	-	-	-