

Epidemiology of dental caries in children in the United Arab Emirates

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Dental caries has a significant impact on the general health and development of children. Understanding caries epidemiology is an essential task for the United Arab Emirates (UAE) policymakers to evaluate preventive programmes and to improve oral health. The purpose of this review is to collect and summarise all data available in the published literature on the epidemiology of dental caries in the UAE in children aged under 13 years. This will provide dental health planners with a comprehensive data summary, which will help in the planning for and evaluation of dental caries prevention programmes. Data were collected from the various published studies in PubMed, Academic Search Complete, Google, and the reference lists in relevant articles. Four keywords were used in the search: 'dental caries,' 'epidemiology,' 'prevalence,' and 'UAE'. All studies conducted in the UAE in general or any single emirate that sheds light on the prevalence of dental caries of children under 13 years were included in this literature review. Studies on early childhood caries and factors associated with dental caries were also included. The review comprises 11 published surveys of childhood caries in UAE. The earliest study was published in 1991 and the most recent was published in 2011. The range of decayed, missing and filled primary teeth (dmft) in UAE children (age between 4 years and 6 years) was 5.1–8.4. For the 12-year-old group the decayed missing and filled permanent teeth (DMFT) ranged from 1.6 to 3.24. Baseline data on oral health and a good understanding of dental caries determinants are necessary for setting appropriate goals and planning for preventive oral health programmes. The current data available on the dmft and DMFT indicate that childhood dental caries is still a serious dental public health problem in the UAE that warrants immediate attention by the government and policy makers.

Key words: Dental caries, caries epidemiology, children, time trends, United Arab Emirates

INTRODUCTION

The importance of oral health

It is now well established that oral health is an essential component in defining overall health and quality of life¹. It is also well established that the most common oral disease is dental caries (cavities). Milk or primary teeth are as important to young children as the permanent teeth are to both children and adults. These teeth serve in chewing, speaking and reserving space for future permanent teeth in addition to their importance to the child's aesthetic and self-esteem¹. In addition to causing pain and discomfort, dental caries can affect children's ability to communicate and learn. Moreover, several studies have shown that children with caries in their primary teeth are more likely to have caries in their permanent teeth^{2,3}. A recent study estimates that more than 50 million school hours are lost annually because of oral health

problems in both developing and developed countries⁴.

Indices used for dental caries assessment

Dental caries is a multifactorial microbial disease. It affects both genders, all races, all ages and all socio-economic groups. It affects the hard tissue of the teeth by causing softening and cavity formation. There are two sets of main indices chosen by the World Health Organisation (WHO) as the most appropriate indices for the assessment of dental caries in public health surveys. The first is for permanent teeth, namely, DMFT (average number of decayed, missing, filled teeth per person) and DMFS (average number of decayed, missing, filled surfaces per person). The second is for primary teeth, and is written in lowercase letters, namely, dmft (average number of decayed, missing, filled teeth person) and dmfs (average number of decayed, missing, filled surfaces per

person). The DMFS/dmfs ratio is used in specialised studies but not for general public health dental survey purposes^{5,6}.

Children whose teeth show no evidence of dental caries, treated or untreated are known as 'caries-free'. Caries free is commonly recorded in the general evaluation of oral health of a population. It is recorded as a percentage. It is only used for children between 2 years and 17 years old⁷.

WHO and dental caries goals

In 1981, the WHO, which is a United Nations agency to coordinate international health activities and to help governments improve health services⁸, recognised the serious consequences of dental caries in children and outlined some goals to overcome this problem by the year 2000: 50% of 5- to 6-year-olds would be free of dental caries, and the DMFT in 12-year-olds would be 3 or less⁹.

In 2003, three large organisations issued 'Global Goals for Oral Health 2020':

- The World Dental Federation (FDI): FDI serves as the principal representative body for more than one million dentists worldwide¹⁰
- WHO
- International Association for Dental Research (IADR): which is a non-profit organisation with more than 11,500 members worldwide. It supports and represents the oral health research community¹¹. Oral health goals were not numerically specified, but each country was asked to specify targets according to its current disease prevalence and severity, local priorities and oral health systems¹².

Dental caries risk factors

About 100 years ago three main factors in dental caries were identified: diet, microflora and a susceptible tooth. Since that time a different number of local and general risk factors have been identified. Some of these factors are: total consumption of sugar, as well as the frequency of its intake, inadequate oral hygiene practices, deficient fluoride exposure, familial caries patterns, age, sex, race, geographic location and social class. In fact, the whole social-cultural environment of the community in which the individual lives may have an influence on the development of dental caries. The form and the arrangement of teeth, salivary flow and oral hygiene are considered as local factors^{13,14}.

Levels of dental caries in industrialised countries

Levels of dental caries in industrialised countries have decreased over the last few decades¹⁵. In Spain, the

mean DMFT in 12-year-old children is 1.33¹⁶. German 8- to 9-year-old children had a mean DMFT of 0.7 and in Hungary it is 0.4 for the same age group¹⁷. In Italy (Sardinia), the mean DMFT index decreased from 4.3 ± 3.1 in 1989 to 0.8 ± 1.5 in 2004¹⁸. A dmft value ranging from 0.94 to 2.55 has been reported in the UK¹⁹. Petersson and Bratthall²⁰ carried out a review to find out why dental caries had declined in industrialised countries during the past decade. They concluded that the use of fluoride in its various forms contributed most significantly to the decline in the prevalence of dental caries. Dental awareness, increased availability of dental resources, decreased sucrose consumption, introduction of dental health education programmes, improved preventive approaches in dental clinics also played a role in the reduction of dental caries prevalence²⁰.

Dental caries in the developing countries

However, the picture for dental caries varies in developing countries. For example, in Saudi Arabia a recent literature review in 2013 found that the mean dmft is 5.0 and the DMFT score is 3.5 for Saudi children²¹. In Nepal the prevalence of dental caries in 5- to 6-year-olds is 52% with a mean of dmft of 1.59²². A mean dmft of 4.6 is reported in 6-year-old Kuwaiti children in 2006²³. However, in the Islamic Republic of Iran, which is geographically very close to the UAE, and thus its population shares much culture, habits and employment with the UAE population, the DMFT index decreased from 1.67 in 1993–1994 to 0.77 in 2006 in 12-year-old children, which is very low by WHO standards^{24,25}.

United Arab Emirates

The UAE is a union of seven self-governing states: Abu Dhabi, Dubai, Sharjah, Umm al-Qaiwain, Fujairah, Ajman and Ra's al-Khaimah. Although small in size (83,600 km²), the UAE has become an important player in regional and international affairs²⁶. The population of the UAE is about 8 million (16.6% Emirati and 83.4% expatriates, coming from over 200 nationalities)²⁷. Children between 0 and 14 years comprise 33.9% of the population²⁸. This multicultural environment has imposed some challenges for researchers when interpreting results of studies and in the planning of preventive programmes.

The UAE and the dental caries preventive efforts

In the UAE, dental caries is still one of the most prevalent health problems²⁹. The UAE has made great efforts to reduce its caries level. The largest preventive oral health programme in the UAE was

in 1995–1996 and recommended by WHO consultants. The programme was established because of the alarming fact that dental caries in the UAE was increasing, that most carious lesions in children were untreated and little preventive activity had been carried out. The Emirate of Sharjah had the largest and most comprehensive programme, which contained many of the elements of a successful preventive programme.

The programme consisted of asking every school to do daily oral health education sessions and tooth brushing, television programmes on oral health, newspaper cartoons and booklets on dental health³⁰. This was followed by numerous programmes and projects, ranging in their scale and focus, within each emirate and by some dental schools, which mainly focused on tooth brushing and the importance of fluoride^{31,32}.

Dental caries studies in the UAE

Before 1996, few studies were conducted in the UAE to estimate the prevalence of dental caries. However, after this date, several studies were conducted, especially after the establishment of the first Dental Health Teaching Institution in the UAE in 1997–1998 at Ajman University of Science and Technology³³. There are now eight schools in the UAE that offer degree programmes for dental students.

There is an urgent need to collect all data available on the epidemiology of dental caries in the UAE to help public oral health planners to evaluate their preventive programmes and to plan future programmes.

This paper presents the first literature review of the published articles on the epidemiology of dental caries in the UAE for children aged under 13 years. Several unpublished reports on the prevalence of dental caries in the UAE (in 1981, 1992 and 1993) have been submitted to the Ministry of Health, Abu-Dhabi. These articles will not be reviewed because they are unpublished and it is difficult to get their full texts. In this study we look at the prevalence, distribution and change in disease severity over the years and the factors associated with dental caries.

The aims of this paper are to:

- Collect and summarise all data available in the published literature on the epidemiology of dental caries in the UAE in children under 13 years
- Provide dental health planners with a comprehensive data summary of the epidemiology of dental caries in the UAE for children aged under 13 years, which will help in the planning for and evaluation of dental caries prevention programmes.

This is a prerequisite step for planning for dental caries preventive programmes in the UAE.

METHODS

In order to meet these aims a search was performed for relevant literature. Studies considered in this literature review were all epidemiological studies conducted on the UAE in general or any single emirate to find the prevalence of dental caries in children under 13 years old. This review also included studies conducted in the UAE on early childhood caries (ECC), which is defined as the presence of one or more decayed (non-cavitated or cavitated lesions), missing (owing to caries) or filled tooth surfaces in any primary tooth in a preschool-age child between birth and 71 months of age³⁴. Studies that discussed the association between caries and factors such as the education level of parents, oral hygiene and other risk factors were also included because such studies often include data on the prevalence and distribution of the disease. Unpublished articles, reports and any other media were not included in this literature review.

Relevant papers were found through computerised literature searches of PubMed database and Academic Search Complete database. The search included all literature available until September 2013. In the PubMed database the MeSH term used was ‘dental caries’ and the subheadings were ‘prevalence’ and ‘statistics and numbers’. In Academic Search Complete the Boolean/Phrase used was ‘dental caries AND UAE’. Google was searched using the terms: ‘dental caries’, ‘prevalence’ and ‘UAE’. All languages were included in the search. In addition, articles were traced through the reference lists in different relevant studies. The literature search was performed in September 2013. The PubMed database was searched using the search strategy: UAE[All Fields] AND [‘Dental Caries/statistics and numerical data’(Mesh) AND ‘Dental Caries/epidemiology’(Mesh)].

The titles, authors and abstracts from all studies identified by the electronic search and reference lists were printed out and reviewed separately by the author. Those that met the inclusion criteria were marked to get their full text. In cases where there was uncertainty over the relevance of an article, a full copy was obtained and read to decide whether to include it in the literature review or not. If the study involved age ranges of samples extending beyond 6 years of age, data were extracted where caries in deciduous and permanent teeth were reported for children aged 12 years and less. If data could not be extracted the study was excluded.

The prevalence of dental caries was assessed as present or absent. The dmft/s and DMFT/S indices were used to assess the severity of dental caries.

The electronic search identified 10 papers. Six papers were retrieved from the PubMed database and four were retrieved from the Academic Search

Complete database. After review of the study title, keywords and abstracts, eight papers were identified meeting the inclusion criteria. Two papers were excluded because; the first was on Down syndrome children and the second was a duplicate study from PubMed database. Two articles were found through Google search and one was found from the article reference lists.

RESULTS

A total of 12 articles were gathered and full texts were obtained. One article was excluded after reading its full text because it did not meet the inclusion criteria. Therefore, a total of 11 articles remained, all of which were in the English language.

All of the studies were cross-sectional except for one populational study where all children attending public schools were examined. Five of these studies were conducted in the emirate of Ajman alone, four at Abu Dhabi and Al-Ain alone, and two included all seven emirates.

It is worth noting that six of the studies were conducted by professors from Ajman University, four of them by Hashim and coworkers.

The studies are discussed in chronological order.

A study was done to estimate the prevalence of dental caries in 5-year-old children in Abu Dhabi. All children attending public schools were included in the study. Three private schools were also included for comparison. A total of 1,210 children were sampled with 98% participation rate. The mean dmft was 5.1 and the prevalence was 80–95%. A mean correlation coefficient (Pearson's r) of 0.97 was recorded. Children attending public school had higher rates of dental caries than those attending private schools. Very good settings were used during the dental examinations, using a dental chair and a dental chair light, but the criteria used in the examination were not mentioned³⁵.

In a study conducted by Al-Hosani *et al.*³⁶ in 1996 and published in 1998, found that the prevalence of dental caries in 2-, 4- and 5-year-olds in Abu Dhabi was 36–47%, 71–86% and 82–94%, respectively. The mean dmft for 5-year-old children in Abu Dhabi was 8.4 and in Al Ain this was 8.6 and only 6% of them were caries free. The confidence interval (CI) was not given. A good stratified sample approach was used to select 640 children, but only children born in the UAE were included in the sample, which excluded many non-local children born outside the country. The dental examination was done by one examiner in good settings using the WHO criteria. Only high-income families and parents with low education levels were found to have a significant association with higher prevalence of dental caries³⁶.

In 1999 a population study on local children age 4 and 5 years old was conducted in Al-Ain by Naqvi *et al.*²⁹ to establish a baseline of the prevalence of dental caries for future comparative analysis. All 2,514 children attending public kindergartens were examined by four surgeons and four dental assistants using the FDI criteria. The prevalence of dental caries was 78.83% and the mean dmft was 5.82. An increase of 92.23% of dental caries was seen in 5-year-old children compared with 4-year-old children. No significant difference was seen between genders. There are several weak points in this study: (i) the validity and reliability between the surgeons were not checked, (ii) an ordinary chair was used in the dental examination and (iii) the materials and methods were not clear (no information was provided in the article about the consent and how they collected the basic information)²⁹.

The first comprehensive national survey of oral health on school children in the United Arab Emirates was done by El-Nadeef *et al.*¹⁹ in 2001–2002 which included all seven emirates (Abu Dhabi, Dubai, Sharjah, Umm al-Qaiwain, Fujairah, Ajman and Ra's al-Khaimah). This survey examined children 5, 12 and 15 years old and was published in two separate studies in 2009 and 2010, respectively. The prevalence of dental caries for 5 years old children was 83% and the average dmft score was 5.1. Only 14% of the sample were non-nationals, although in 80% of the UAE population are expatriates¹⁹. In the 12-year-old group, where all permanent teeth are new, the prevalence of dental caries was 54% and the dmft 1.6. The confidence interval was not calculated. The result of this study is trusted because it is a national survey, a good sampling method and appropriate settings were used, the reproducibility of the examiners was tested and the response rate was high (96.7%). However, because of the random selection of schools more girls were examined than boys (in the 12-year-old group) and the number of children examined in each medical district was only 150 children^{37,38}.

Hashim *et al.*³⁹ in a cross-sectional study done in 2002–2003 and published in 2009, used a cluster sample approach to randomly select 1,036 5- to 6-year-old children from all private and public kindergartens in Ajman (hence, local and non-local children were included in the study) to detect the prevalence of dental caries using the WHO criteria. The mean dmft was 4.5. A significant correlation was found between high snack consumption and high dental caries score³⁹.

In 2005–2006, 100 patients, aged 6–12 years, were selected in sequential sampling manner from the paediatric dental clinic at Ajman University to measure their caries experience. Ideal conditions were used in the examination (dental chair, dental chair light, air, radiograph). The study only mentioned the mean

DMF, which was 10.3 for all children, and the confidence interval was not calculated. No significant difference was seen between boys and girls. An interesting aspect of this study is that patients were asked about how they brush their teeth; the percentage of patients who used a wrong technique in tooth brushing was 45%⁴⁰.

Another cross sectional study was conducted by Hashim *et al.* in 2006²⁸, using the same sampling approach used in his previous studies and the same age group of children, to detect the prevalence of dental caries using the WHO criteria. The total number of children sample was 1,297. The prevalence of dental caries was 76.1%, dmft was 4.4 (SD 4.3, range 0–20) and the dmfs score was 10.2. Caries severity was greater among Emirati (local) children, males, low income families and mothers with less education. No other associations were found. The strengths of this study are the sampling approach and the use of one examiner (reduce problems related to the calibration between different examiners). However, the weakness is that the validity and reliability of the questionnaire were not examined and an ideal examination setting was not available²⁸.

A small study done on 242 students enrolled in two private schools in Abu Dhabi in 2008 showed that the prevalence of dental caries in seventh grade students (average age 12 years) was 66.24%. The mean DMFT was 3.27 and girls had significantly higher DMFT score than boys (90% CI, 2.95, 3.38). The FDI system was used with very good criteria in the detection of caries. The weakness in this study was that the sample was not representative of the UAE population. A significant correlation was found between children with lower family income and higher sugar and snack intake and higher DMFT score²⁴.

Another study was conducted by Hashim *et al.* in 2010⁴¹, using the same sampling approach used in his previous studies and the same age group of children, to detect the prevalence of dental caries using the WHO criteria. The total number of children sample was 1297. The prevalence of dental caries ranged from 72.9 to 80% and the mean dmft ranged from 4 to 4.5 in 5- to 6-year-old children. Males had higher dmft compared to females. It is worth noting that the criteria used for diagnosing dental caries in this study were conservative in nature, because incipient or uncavitated lesions were coded as sound. This means that the caries data reported in this study were underestimated⁴¹.

Hashim *et al.*⁴² conducted the first study in the UAE in 2011 to estimate the prevalence of severe early childhood caries (s-ECC). The study was carried out in the Emirate of Ajman only, using a random one-stage cluster sample. In this study, 1,038 children were examined. The prevalence of s-ECC on 5- and

or 6-year-old children was 31.1% (95% CI 23.6, 38.9). A positive correlation was found between s-ECC and low income families, those who had a high snack consumption level, low educated mothers and those who used dental services only when they had a problem. The validity and reliability of the questionnaire were not tested. They included 6-year-old children in his identification of cases of s-ECC but did not take into consideration the AAPD's strict criteria which specifically mentions children up to 5 years old. The way data was collected the on the dietary diary was with recall and this may have introduced some inaccuracies because parents were recording what their child had eaten retrospectively rather than prospectively. However, the study included a representative sample and a good participation rate⁴².

DISCUSSION

The purpose of this literature review was to collect and summarise all data available in the published literature on the epidemiology of dental caries in children under 13 years in the UAE. This will provide dental health planners with a comprehensive data summary that will help in the planning and evaluation of dental caries prevention programmes. The central question of this review is: What observations and recommendations can we take in from doing a literature review on the prevalence of dental caries in children under 13 years old in the UAE?

The epidemiology of dental caries in the UAE

In general, the prevalence of dental caries in the UAE is high with no evidence of decline. The WHO 2000 goals are still unmet for UAE children. The picture of the prevalence of dental caries in the UAE for children aged 5–6 years is more obvious than those for 12-year-old children. The prevalence of dental caries in children aged between 4 years and 6 years was between 78.85% and 95% in Abu Dhabi with a dmft range of 5.1–8.4. In Ajman the prevalence was between 72.9% and 76.1% with a dmft range 4.4–4.5. We can see that this is far from the WHO goal, which is that 50% of 5–6 year olds would be free of dental caries in 2000. The difference in the dmft range between Ajman and Abu Dhabi is observed because of one study done in Abu Dhabi in 1998 by Al-Hosani and Rugg-Gunn³⁶ which estimated the dmft to be 8.4. This dmft was high because only children born in the UAE were included in the sample, which excluded many children born outside the country. It is worth noting that all the studies used the WHO for diagnosing and recording dental caries except for two.

According to the WHO, 12 years is the most common age for oral health surveys⁴³. Only two studies

were conducted in the UAE to estimate the prevalence of dental caries in 12-year-old children. The first was a nationwide survey that found the prevalence to be 54% and the DMFT 1.6 and the other survey was conducted in two private schools in Abu Dhabi and the prevalence was 66.24% with a DMFT score of 3.24. More studies need to be conducted to estimate the prevalence of dental caries in this age group of children in the UAE.

There is no evidence on the status of oral health of children in emirates other than Abu Dhabi and Ajman. The only study to estimate the status was done in 2001–2002 in a nationwide survey of 150 children chosen randomly from each emirate. It is not clear whether the picture in other emirates is similar to that in Ajman and Abu Dhabi.

Six of the studies were conducted by professors from Ajman University because it had the first dental school in the UAE. The prevalence of dental caries in Ajman was estimated in five studies, four of which were done by Hashim and colleagues^{28,39,41,42}. It is worth noting that all the studies done by Hashim and colleagues had a participation rate of 79.9%.

Only one study used radiographs to detect dental caries. This may lead to underestimation of dental caries, because there are some caries that cannot be detected unless radiographs are used (e.g. root caries and interproximal caries). However, the WHO does not recommend using radiographs in public health surveys because of the impracticability of making them a standard requirement⁵.

Figure 1 shows the mean dmft score in 5-year-old children in Abu Dhabi/Al Ain and Ajman from 1991 to 2010. In Abu Dhabi/Al Ain data are only available from 1991 to 2001. In Ajman data are only available from 2001 to 2010. The results shows a high level of caries in Abu Dhabi and Al Ain with no decline.

Cross-sectional studies

Cross-sectional studies are the best type of study to determine the status of disease at a particular time. They are easy to conduct, can be conducted quickly, can study associations of a disease with a wide range of factors at one time and can be expanded into case control or cohort studies. However, they are based on prevalent rather than incident cases and are carried out at a point of time, so they give no indication of the sequence of events. By definition, a risk factor must clearly establish that the exposure occurs before the outcome, or before the conditions are established. This means that a cross-sectional study is not an ideal design to study risk factors or to investigate causal relationship⁴⁴. Other limitation of cross-sectional studies are that they are unsuitable for acute or rare diseases and rare exposures. However, one major advantage of cross-sectional studies over other forms of epidemiological studies is that the use of routinely collected data allows large cross-sectional studies to be made at little or no expense Table 1⁴⁵.

All studies conducted in the UAE to investigate the prevalence of dental caries were cross-sectional except for one census study done in Al Ain by Naqvi *et al*²⁹. Conducting an annual nationwide survey with standard criteria that includes the seven emirates will help in detecting the trend of dental caries in the different emirates and in evaluating dental caries preventive programmes. Recording dental fluorosis severity and prevalence in the annual survey seems a wise precaution because most of the UAE dental caries prevention programmes are fluoride based. It is also advisable to conduct longitudinal studies to provide stronger evidence on the temporal relationship between insecure factors and dental caries. Establishing an oral epidemiology training unit in the UAE will help considerably³⁷.

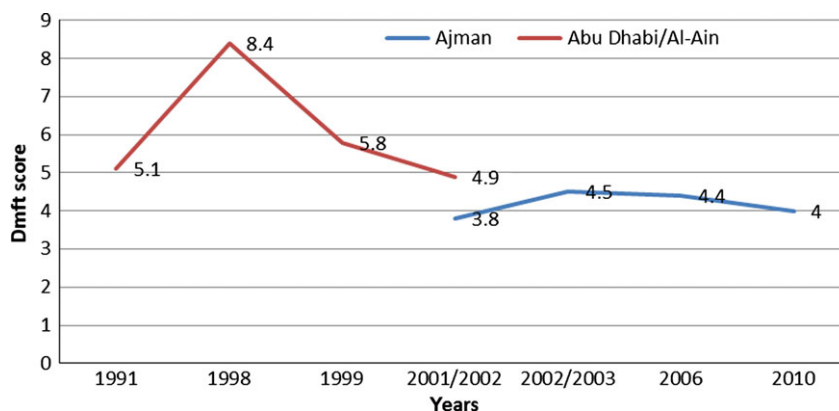


Figure 1. The mean dmft score in 5-year-old children in Abu Dhabi/Al Ain and Ajman from 1991 to 2010.

Table 1 Summary of the data of the 11 studies conducted in the United Arab Emirates (UAE) on the epidemiology of dental caries in children aged under 13 years

Article	Emirate	Sample size	Age group	Criteria	Prevalence	dmft	dmfs	DMFT	DMFS	Risk factors found
Al-Mughery <i>et al.</i> (1991) ³⁵	Abu Dhabi	1210	5 years	-	80–95%	5.1	-	-	-	Public schools
Al-Hosani <i>et al.</i> (1998) ³⁶	Abu Dhabi	640	2, 4 and 5 years	WHO	36–47%, 71–86% and 82–94%, respectively	8.5 (for 5-year-old)	-	-	-	High-income families and parents with low education
Naqvi (1999) ²⁹	Abu Dhabi	2514	4 and 5 years	FDI	78.83%	5.82	-	-	-	-
National survey (2009) Done in 2001 ³⁷	Seven emirates	150 from each emirate	5 years	WHO	83%	5.1	-	-	-	-
National survey (2010) Done in 2002 ³⁸	Seven emirates	150 from each emirate	12 years	WHO	54%	-	-	1.6	-	-
Hashim <i>et al.</i> (2009) ³⁹	Ajman	1036	5–6 years	WHO	-	4.5	-	-	-	High snack consumption
Done in 2002/2003	Ajman	100	6–12 years	WHO	-	-	-	-	10.3	-
Ansari <i>et al.</i> (2010) ⁴⁰	Ajman	1297	5–6 years	WHO	76.1%	4.4	10.2	-	-	Emirati (local) children, males, low-income families and low-education mothers
Hashim <i>et al.</i> (2006) ²⁸	Abu Dhabi	242	Average 12 years	FDI	66.24%	-	-	3.27	-	Females, lower family income and higher sugar and snack intake
ur Rehman <i>et al.</i> (2008) ²⁴	Ajman	1297	5 and 6 years	WHO	(5 years) 72.9% (6 years) 80%	(5 years) 4 (6 years) 4.5	-	-	-	Males
Hashim <i>et al.</i> (2010) ⁴¹	Ajman	1038	5 and/or 6 years old	-	31.1% (of s-ECC)	-	-	-	-	Low-income families, high snack consumption level, low-education mothers and utilising dental services only when they have a problem

dmft, average number of decayed, missing, filled primary teeth; dmfs, average number of decayed, missing, filled surfaces primary teeth; DMFT, average number of decayed, missing, filled permanent teeth per person; DMFS, average number of decayed, missing, filled surfaces permanent teeth; WHO, World Health Organisation; FDI, World Dental Federation; s-ECC, severe early childhood caries.

Risk indicators in the UAE

Factors shown to have a significant relationship with higher dental caries score were: attending public schools, being a male in primary teeth age group, being a female in permanent age group, less educated mothers, high income families, low income families, high snack consumption level and utilising dental services only when there is pain. The combination of high income and low mother education is a new risk factor that needs further investigation³⁶.

The inverse relationship between socioeconomic status and DMFT in children has been recognised as far back as 1842. Parents of higher socioeconomic status have a higher level of oral health awareness and take their children at an earlier age to the dentist, while middle- and lower-class mothers cannot afford complex dental treatment, so they wait until pain develops²⁴. Previous research also found that adolescent females had more decayed and filled teeth compared with males. This was explained by the earlier eruption of females' teeth compared with those of males. As a result, females visit the dentist more frequently and have more treated teeth⁴⁶. Hashim *et al.*²⁸ explained the higher males' dmft score compared with that of females by the traditional practice of overindulging sons in Arabic culture. Al-Hosani and Rugg-Gunn³⁶ were the only ones to find that children with higher income families have higher caries scores. They explained this by high sugar foods and drinks being readily available in shops in UAE and being purchased and given to children more easily by parents with largest income. However, this sample only contained children born in the UAE, so they were mainly Emirati children. This factor may therefore be related only to Emirati children and more investigation needs to be done³⁶.

Preventive programs in the UAE

Despite the various efforts and preventive strategies to reduce dental caries in the UAE, the dmft score of UAE children is still high and far from the WHO Goal⁹. The large preventive programme in 1995–1996 did not work because it only concentrated on oral hygiene practice (for example, fluoride tablets, distributing toothbrushes and toothpaste, posters, television programmes, etc.). Dental caries is a multifactorial disease and oral hygiene is only one factor that contributes to this disease. Diet practice, type of snacks, frequency of eating and unfavourable infant feeding practice are as important as tooth brushing and these are influenced mostly by cultural background and mother's education. Thus, the challenge is to address this in a country with a multicultural background. Another point is that access to dental services and fluoridated toothpaste may have been confounded by

greater access to high sugared food and drinks. In the future, programmes should focus on the mother during pregnancy and after birth to promote a more positive attitude towards oral health and diet habits and when conducting surveys on dietary habits reliance should not be by recalled behaviour.

Importance of water fluoridation

In Australia, a dental health survey conducted in 2002 reported that children living in areas with negligible fluoride in the water had poorer dental health than those living in optimally fluoridated areas, regardless of socioeconomic status⁴⁷. The UAE public health planners should think seriously about water fluoridation. During the closing ceremony of the FDI Annual Dental Congress 2007, Dr Tareq Khoury, Chairman of Scientific Committee stated that inclusion of fluoride in tap water could reduce dental problems among the population in the UAE by 50–70%. He also said that people from the hotter regions such as the Gulf Cooperation Council (GCC) required a smaller amount of fluoride (0.75 ppm) because ingestion of water was greater compared with the people from colder regions (1.2 ppm)⁴⁸. The UAE population currently depends mostly on two sources of drinking water: water from municipality (tap water) and bottled drinking water. Tap water in the UAE is not fluoridated at present, unlike bottled water, which contains different fluoride concentrations not usually mentioned on their labels⁴⁹.

RECOMMENDATIONS

Based on the results found from this study, which is summarised in *Box 1*. The following recommendations are made:

- Carry out annual nationwide cross-sectional studies to estimate the prevalence of dental caries are needed
- Establish an oral epidemiology training unit in the UAE
- UAE public health planners should think seriously about water fluoridation
- Maternity health centres should be encouraged to play a role in the dental caries preventive programmes
- Providing healthy food and drinks for purchase in schools and restricting sales of cariogenic food (sweet drinks and foods) is paramount.

CONCLUSION

Dental caries remains a considerable public health problem in young children in the UAE. The prevalence of dental caries in the UAE is high with no

Box 1

Summary of observations

- Dental caries remain a considerable public health problem in young children in the United Arab Emirates (UAE)
 - The range of dmft in UAE children (age between 4 and 6 years) is 5.1–8.4. In Ajman the prevalence was between 72.9% and 76.1% with dmft range 4.5–4.5. In Abu Dhabi the prevalence was between 78.85% and 95% with dmft range 5.1–8.4
 - Only two studies conducted in the UAE to estimate the prevalence of dental caries in children aged 12 years. One found the DMFT to be 1.6 and the other study found it to be 3.24
 - The World Health Organisation 2000 goals are still unmet for UAE children
 - Lack of longitudinal studies to study the risk factors associated with dental caries in young children in the UAE
 - Only one nationwide survey available to estimate the prevalence of dental caries in the seven emirates
- Being a male in primary teeth age group, being a female in permanent age group, less educated mothers, high-income families, low-income families, high snack consumption level and utilising dental services only when there is pain are risk indicators found to have an association with dental caries in young children living in the UAE.

Note: dmft, average number of decayed, missing, filled primary teeth; dmfs, average number of decayed, missing, filled surfaces primary teeth; DMFT, average number of decayed, missing, filled permanent teeth per person; DMFS, average number of decayed, missing, filled surfaces permanent teeth.

evidence of decline. The WHO 2000 goals are still unmet for UAE children. This literature review forms a prerequisite step for the planning of dental caries preventive programmes in the UAE.

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Conflicts of interest

None declared.

REFERENCES

1. World Health Organization. The objectives of the WHO Global Oral Health Programme (ORH). [Online]. Available from: www.who.int/oral_health/objectives/en/index.html. Accessed 13 November 2013.
2. Kaste LM, Marianos D, Chang R *et al*. The assessment of nursing caries and its relationship to high caries in the permanent dentition. *J Public Health Dent* 1992 52: 64–68.
3. Thomson WM, Poulton R, Miline BJ *et al*. Socio-economic inequalities in oral health in childhood and adulthood in a birth cohort. *Community Dent Oral Epidemiol* 2004 32: 345–353.
4. Abu Dhabi: Health Authority (HAAD). Oral health [online]. Available from: <http://www.haad.ae/haad/tabid/1218/Default.aspx>. Accessed 10 November 2013.
5. World health organization. Standardization of reporting of dental diseases and conditions. Report number: 242, 1962.
6. Wesal A. Indices used for dental caries assessment [online]. Available from <http://www.codental.uobaghdad.edu.iq/uploads/lectures/3rd%20class%20community%20dentistry/2%20DC%20Indices.pdf>. Accessed 10 November 2013.
7. Lewit EM, Kerrebrock N. Child Indicators: dental health. *The Future of Children* 1998 8: 133–142.
8. World Health Organization. About WHO [Online]. Available from: <http://www.who.int/about/en/>. Accessed 28 November 2013.
9. Federation Dentaire Internationale/World Health Organization. Global goals for oral health in the year 2000. *Int Dent J* 1982 23: 74–77.
10. World Dental Federation. FDI in brief [Online]. Available from: <http://www.fdiworldental.org/about-fdi/fdi-in-brief/fdi-in-brief.aspx>. Accessed 28 November 2013.
11. The International Association for Dental Research (IADR). Frequently asked (FAQ) [Online]. Available from <http://www.iadr.com/i4a/pages/index.cfm?pageid=3288#1>. Accessed 1 of July 2014.
12. Hobdell M, Petersen PE, Clarkson J *et al*. Global goals for oral health 2020. *Int Dent J* 2003 53: 285–288.
13. Tinanoff N. Dental caries risk assessment and prevention. *Dent Clin North Am* 1995 39: 709–719.
14. Hunter PB. Risk factors in dental caries. *Int Dent J* 1988 38: 211–217.
15. Attrill DC, Ashley PF. Comparison of DIAGNOdent with conventional methods. *Br Dent J* 2001 190: 440–443. <http://www.nature.com/bdj/journal/v190/n8/abs/4800998a.html> [accessed 20 September 2013].
16. Bravo M, Casals E, Cortés FJ, Llodra JC. Encuesta de salud oral en España 2005. *RCOE* 2006 11: 409–456.
17. Borutta A, Brauner K, Hufnagl S *et al*. Oral health in 8-9 year-old children in Saxony-Anhalt (Germany) and in two Hungarian cities (Budapest and Debrecen). *Community Dent Health* 2006 23: 26–30.
18. Dukić W, Delija B, Lulić Dukić O. Caries prevalence among schoolchildren in Zagreb, Croatia. *Croat Med J* 2011 52: 665–671.
19. Pitts NB, Evans DJ, Nugnet ZJ. The dental caries experience of 12. 5-year-old children in Great Britain. Surveys coordinated by the British Association for the study of community dentistry in 1999/2000. *Community Dent Health* 2001 18: 49–55.
20. Petersson GH, Bratthall D. The caries decline: a review of reviews. *Eur J Oral Sci* 1996 104: 436–443.
21. Dania EA. A systematic review of population-based dental caries studies among children in Saudi Arabia. *Saudi Dent J* 2013 25: 3–11.
22. Prasai Dixit L, Shakya A, Shrestha M *et al*. Dental caries prevalence, oral health knowledge and practice among indigenous

- Chepang school children of Nepal. *BMC Oral Health*. 2013 13: 20.
23. Al-Mutawa SA, Shyama M, Al-Duwairi Y, Soparker P. Dental caries experience in Kuwaiti schoolchildren. *Community Dent Health* 2006 23: 31–36.
 24. ur Rehman MM, Mahmood N, ur Rehman B. The relationship of caries with oral hygiene status and extra-oral risk factor. *J Ayub Med Coll Abbottabad*. 2008 20: 103–108.
 25. Momeni A, Mardi M, Pieper K. Caries prevalence and treatment needs of 12-year-old children in the Islamic Republic of Iran. *Med Princ Pract* 2006 15: 24–28.
 26. Emirates. United Arab Emirates [online]. Available from: <http://www.emirates.org/>. Accessed 13 November 2013.
 27. National Bureau of Statistics, UAE. Methodology of estimating the population in UAE [Online]. Available from <http://www.uaestatistics.gov.ae/EnglishHome/ReportDetailsEnglish/tabid/121/Default.aspx?ItemId=1914&PTID=104&MenuId=1>. Accessed 1 July 2014.
 28. Hashim R, Thomson WM, Ayers KM *et al*. Dental caries experience and use of dental services among preschool children in Ajman, UAE. *Int J Paediatr Dent* 2006 16: 257–262.
 29. Naqvi A, Othman SA, Thabit MG. Baseline oral conditions in preschool children in Al-Ain Medical District. *Dental News* 1999 4: 17–20.
 30. Tala H Assignment report on oral health in the United Arab Emirates, 29 December 1995–12 January 1996. WHO Regional Office for the Eastern Mediterranean. Report number: 17.1,1996.
 31. Press release distribution. ‘Abu Dhabi Smiles’: Oral Health Promotion Program launched in Abu Dhabi: Global Citynews. *PRL.OG*. December 19 2011. <http://www.prlog.org/11753716-abu-dhabi-smiles-oral-health-promotion-program-launched-in-abu-dhabi-global-citynews.html> (accessed 1st December 2013).
 32. AlBayan. Oral health program for Ras Al Khaima students. AlBayan. 23 February 2009. <http://www.albayan.ae/across-the-uae/1233756456644-2009-02-23-1.408484> (accessed 1st December 2013).
 33. Ajman University of Science & Technology. College of Dentistry DDS Study Plan. [dentistry.ajman.ac.ae/upload/.../dds_study_plan_\(199_ch2011-2012\).pdf](http://dentistry.ajman.ac.ae/upload/.../dds_study_plan_(199_ch2011-2012).pdf) (accessed 28 September 2013).
 34. American Dental Association. Statement on Early Childhood Caries [online]. Available from <http://www.ada.org/2057.aspx>. Accessed 2 July 2014.
 35. Al-Mughery AS, Attwood d, Blinkhorn A. Dental health of 5 year-old children in Ab Dhabi, United Arab Emirates. *Community Dent Oral Epidemiol* 1991 19: 308–309.
 36. Al-Hosani E, Rugg-Gunn A. combination of low parental education attainment and high parental income related to high caries experience in pre-school children in Abu Dhabi. *Community Dent Oral Epidemiol* 1998 26: 31–36.
 37. El-Nadeef MA, Al Hussani E, Hassab H *et al*. National survey of the oral health of 12- and 15-year-old schoolchildren in the United Arab Emirates. *East Mediterr Health J* 2009; 15: 993–1004.
 38. El-Nadeef MA, Hassab H, Al-Hosani E. National survey of the oral health of 5-year-old children in the United Arab Emirates. *East Mediterr Health J* 2010 16: 51–55.
 39. Hashim R, Williams SM, Murray Thomson W. Diet and caries experience among preschool children in Ajman, United Arab Emirates. *Eur J Oral Sci* 2009 117: 734–740.
 40. Ansari G, Mansouri Y, Golpayegani MV. Caries Experience Among 6-12 Years Old Children Attended to Ajman University Dental Clinic During 2005-2006. *Res J Biol Sci* 2010 5: 285–288.
 41. Hashim R, Williams SM, Thomson WM *et al*. Caries prevalence and intra-oral pattern among young children in Ajman. *Community Dent Health* 2010 27: 109–113.
 42. Hashim R, Williams S, Thomson WM. Severe early childhood caries and behavioural risk indicators among young children in Ajman, United Arab Emirates. *Eur Arch Paediatr Dent* 2011 12: 205–210.
 43. *Oral Health Surveys – Basic Methods*, 4th ed. Geneva: World Health, Organization; 1979.
 44. Harris R, Nicoll AD, Adair PM *et al*. Risk factors for dental caries in young children: a systematic review of the literature. *Community Dent Health* 2004 21(1 Suppl): 71–85.
 45. Hejar AR. Descriptive and cross sectional study design. Presented at UPM university Malaysia. 27 February 2013.
 46. Okeigbemen SA. The prevalence of dental caries among 12 to 15-year-old school children in Nigeria. *Oral Health Prev Dent* 2004 2: 27–31.
 47. Lee JG, Brearley Messer LJ. Contemporary fluid intake and dental caries in Australian children. *Aust Dent J* 2011 56: 122–131.
 48. Asma AZ. FDI calls for adding fluoride to tap water. *Khaleej Times*. October 28 2007. http://www.khaleejtimes.com/DisplayArticleNew.asp?section=theuae&xfile=data/theuae/2007/October/theuae_october726.xml (accessed 2 December 2013).
 49. Nimr HIS. Fluoride supplement and sources of drinking water in Dubai. *Dental News* 1997 4: 37–39.

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