DENTAL CARIES, ORAL HEALTH AND LIFE STYLE VARIABLES AMONG SCHOOL CHILDREN IN QATAR

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ABSTRACT

Background: Effective delivery of dental services must be based on reliable information regarding the prevalence and severity of disease in the target population. Evaluation of the various factors known to influence the severity and progression of disease is essential for health policy makers to promote oral health resources and address oral health needs.

Objective: The overall aim of this research is to describe the situation of dental caries and investigate the associations of level of oral health knowledge, teeth irregularity, BMI and other life style variables (TV viewing, internet use, passive smoking and dietary habits) with dental caries, including the impact of socio-demographic factors amongst school children in Qatar.

Materials and methods: A cross-sectional study was conducted in Qatar from October 2011 to March 2012. A total of 2,113 children aged 12-14 years were randomly selected from 16 schools from different areas. Clinical examination was conducted by three calibrated examiners using World Health Organization criteria for diagnosing dental caries. Teeth irregularity was determined clinically according to a method described by Björk *et al* (1964). A pre-tested and structured questionnaire was used to assess oral health knowledge and life style data. Data analyses were performed.

Results: The mean decayed, missing and filled teeth index values was 4.62 (±3.2), 4.79 (±3.5), and 5.5 (±3.7), respectively, for the 12, 13 and 14 year old children. The caries prevalence was 85%. The mandibular incisors and canines were least likely to be affected by dental caries, while maxillary and mandibular molars were the most frequently attacked by dental caries. Of the total sample, only one quarter reported a high level of oral health knowledge. There were more incidences of teeth crowding

(44.1%) than teeth spacing (9.5%). The overall prevalence of underweight, overweight, and obesity was 5%, 10%, and 5% respectively. Almost half of the children spent > two hours watching television and 46% spent > two hours using internet. Approximately 35.8% of children had exposure to passive smoking. Concerning dietary habits, 99.4% of children consumed sugar containing snacks in between meals. Approximately 65% consumed sugar containing snacks within one hour of bed time. Almost 49.1% skipped eating breakfast regularly and 22.7% skipped eating lunch regularly. Around 83.8% consumed diary snacks in between meals. Overall, 74.2% drank tea in-between meals and 80.1% chewed gum in-between meals. All variables were affected by socio-demographic factors, but significant differences were found in female children in that they were more at risk to dental caries than male children. Also, children who resided in semi-urban areas were more at risk to dental caries than children who resided in urban areas. The occurrence of dental caries is significantly associated with the level of oral health knowledge, teeth irregularity, and other life style variables.

Conclusion: The need to reduce sedentary behaviors and to promote a more active and healthy lifestyle is becoming increasingly essential in Qatar. Implementation of a community-based preventive oral health programs on a healthy diet and practices of adequate oral hygiene should be promoted in schools through integration into the school curriculum and services to combat the growing problem of dental caries.

AUTHOR'S DECLARATION

I declaration that the work in this thesis was carried out in accordance with the regulations of the University of Gloucestershire and is original except where indicated by specific reference in the text. No part of the thesis has been submitted as part of any other academic award. The thesis has not been presented to any other education institution in the United Kingdom or overseas.

Any views expressed in the thesis are those of the author and in no way represent those of the University.

Signed: Date: 21 October, 2013.

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LIST OF ABBREVIATIONS

DC	Dental Caries
OH	Oral Health
WHO	World Health Organization
DMFT	Decayed, Missing, and Filled Teeth
FDI	International Dental Federation
BMI	Body Mass Index
TV	Television
DT	Decayed Teeth
SPSS	Statistical Package for the Social Sciences
ANOVA	Analysis of Variance

1. INTRODUCTION

This study aims to document the oral health (OH) status in school children in the State of Qatar. It begins with the geographic, socio-demographic, and climate background about the State of Qatar; analyses the situation of the oral healthcare infra-structure, disease prevalence, socio-demographic variations; discusses a number of factors that may be associated with dental caries (DC); compares the findings of the study in Qatar with similar findings in the Eastern Mediterranean region; continues with a discussion of possible solutions; and concludes with some recommendations.

1.1 Geographic, socio-demographic, and climate background

The State of Qatar declared its independence on September 3, 1971; after the United Kingdom announced its withdrawal from the Arabian Peninsula region. The State of Qatar is a small country, which lies halfway along the West Coast of the Arabian Gulf, east of the Arabian Peninsula. The country is a peninsula from south to its extreme north, which is approximately 160 Kilometers in length, varying in width between fifty-five and ninety kilometers. The total area, including its islands, is approximately 11,493 square kilometers (Figure 1). The capital, Doha, is located on the central east coast on a sweeping shallow harbor. Approximately 74% of the country's population lives in the capital. The land of Qatar is mainly flat (the highest point is 103 meters) and rocky (WHO, 2006; Permanent Population Committee, 2012).

Figure 1: Map of Qatar.

Qatar had the world's fastest growing population over the last decade (United Nations, 2011). Qatar's total population, including expatriates, has grown quickly, from 70,000 in the late 1960s to 1,920,798 as of March 2013. Expatriates comprise eighty six per cent (86%) of the total population. Ninety per cent (90%) of the population lives in an urban setting, and the urban population is increasing at an average rate of 2% per year. Rapid urbanization, explosive population growth (due to a combination of immigration of foreign workers and natural increase through a high fertility rate among the local population), increases in wealth, availability of most modern amenities, and a rapidly growing economy due to the booming petroleum industry has transformed Qatar in a short period of time into a wealthy modern society (Qatar Statistics Authority, 2013; Permanent Population Committee, 2012). Qatar ranks highest in the Gross Domestic Product (GDP) per capita in the world (The World Bank, 2013).

The climate in Qatar has a long summer (May through September) that is characterized by intense heat and alternating dryness and humidity, with temperatures exceeding 55 °C. In winter temperatures may fall to 17 °C, rainfall is negligible, averaging 100 millimeters per year. Sudden violent dust storms occasionally descend on the peninsula, blotting out the sun, causing wind damage, and momentarily disrupting transport and other services. The scarcity of rainfall and the limited underground water lead the country to support the desalination of seawater (WHO, 2006).

1.2 Current oral healthcare infrastructure

Establishing baseline data on children DC and other OH issues through regular national surveys is crucial for planning and development of intervention programs (WHO, 2012). In Qatar, the oral healthcare system is in a transitional development stage, and systematic data collection is needed to evaluate and plan oral healthcare for the public. The total number of dentists in the country is about 935, whereas 296 dentists work in the government sectors, while 639 dentists work in private sectors (Qatar Statistics Authority, 2012). The average dentist-population ratio in Qatar is 5.8 dentists for every 10,000 population (1:1.724) and most of them are based in Doha (the capital) (WHO, 2012). The WHO Global Oral Data Bank has information on the prevalence of DC in many countries, unfortunately, to date; the DC status among school children in the state of Qatar has never been documented (WHO, 2013). Furthermore, unfortunately, to date; there is no dental school in Qatar. Moreover, Qatar has not yet developed a system in which routinely regular dental visits are the accepted norm. In addition, an OH education program has not been launched either.

In Qatar, the Supreme Council of Health is the statutory health authority and oral healthcare like all other health services is mainly provided by both the governmental

sector (Hamad Medical Corporation, Primary Health Care Corporation, Ministry of Defense, Ministry of Interior, Qatar Petroleum, Aspetar, RasGas, Qatargas) and the private sector (Annual Health Report, 2011). However, the current status of communication between sectors providing health services is inadequate. There is a lack of clarity between different stakeholders in carrying out health policy analysis, strategic health planning, priority setting and formulation of national health targets and standards. This absence of communication between health sectors results in duplicated efforts, waste of time and resources. Also, there is little co-ordination among different stakeholders in delivering health systems and most systems are treatment - rather than preventive in orientation (WHO, 2006).

One of the main problems in Qatar is the reliance on expatriate workers in the health sector, although a specific policy to encourage the local population is in place with various incentives. Moreover, in regard to human resources planning, it seems that there are no clear plans to match needs with number and categories of health personnel. Also, there is poor linkage between continuing medical education (CME) programs and career development, and inadequate training in health management (WHO, 2006).

In regard to oral healthcare financing in Qatar, for a long time there were three main sources: The state, health insurance companies, and direct payment by the patient. However, OH treatments have rarely been included in the package of health insurance and the patient pays the private dental practitioner directly.

Currently, the demand for dental services in the governmental sector results in long waiting queues and long waiting lists for an appointment. Consequently, the population experiences difficulty in obtaining dental services when they need them.

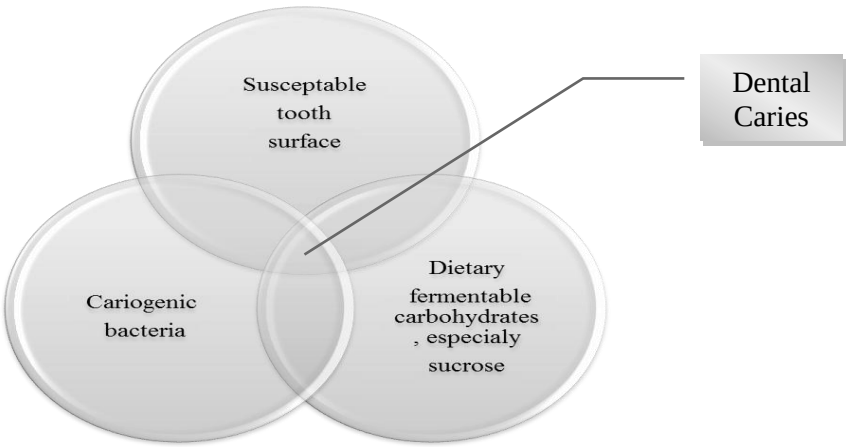
1.3 Dental caries

Dental caries currently represents the most common chronic disease among children; it is five times more common than asthma and seven times more common than hay fever (U.S.Department of Health and Human Services, 2014).

In some countries, oral diseases are the fourth most expensive disease to treat. Treating DC, estimated at US $3513 (UK £2240) per 1000 children, would exceed the total health budget for children of most low-income countries (Yee *et al*., 2002). However, the explanation as to why some young children develop DC is a complex one. There is no single country that claims to have caries free children, and almost all adults and more than 90% of children have experienced caries at some point in their lives (WHO, 2003).

Dental caries is defined as a multi-factorial infectious disease caused by plaque bacteria, as a by-product of their metabolism of fermentable carbohydrates, which then diffuse into dental hard tissues and dissolve their mineral contents (Featherstone, 2008). The three essential factors for caries development are dental plaque (which can contain harmful bacteria), fermentable carbohydrate from the diet and susceptible tooth (Figure 2).

Figure 2: Etiology of dental caries.



1.4 Oral health (OH) and overall health

Oral health is defined as the standard of health of the oral and related tissues, which enables an individual to eat, speak and socialize without active disease, discomfort or embarrassment and which contributes to general well-being (An Oral Health Strategy for England, 1994).

Several previous studies have confirmed that OH is integral to overall health. Recent research pointed out the associations between chronic oral infections and low birth weight, and premature births in women (Lopez et al., 2002; Alves and Ribeiro 2006). Furthermore, oral disease is capable of predisposing individuals to cardiovascular disease through direct and indirect effects of oral bacteria (Li *et al*., 2000). An association between inflammatory oral disease and diabetes has long been noted and strongly suggests that the prevalence of gum inflammation is greater in children with diabetes than children without diabetes and considers that diabetes is a risk factor of developing an oral inflammatory disease (Siudikiene *et al*., 2005; Mealey, 2006).

Good OH is not only essential to good overall health and freedom from pain and suffering associated with OH problems; it also affects social interaction (McGrath and Bedi, 2004; Chavers *et al*., 2004), self-esteem (Kallestal *et al*., 2006; Agou *et al*., 2008), quality of life (Cunnion *et al*., 2010), and performance of children at school (Blumenshine *et al*., 2008). An estimated 51 million school hours per year are lost as a result of visits to a dentist or dental related illness (Gift *et al*., 1992).

Blumenshine *et al*., (2008) investigated the relationship between school children's performance and OH status and reported that children with poor OH are more likely to have poor school performance. McGrath and Bedi's, (2004) studied the importance of OH to social interaction and addressed the importance of OH and its value in a

wide context. Enhancement of functions like eating, appearance, and general health was perceived as a positive aspect of OH.

Oral health, although generally not life threatening, can affect the way one eats, speaks, and socializes (McGrath and Bedi, 2004). The relationship between OH and social interaction also was studied by Chavers *et al*., (2004) and Jokovic *et al*., (2006). An important finding was that a large proportion of participants avoided certain activities such as smiling, laughing, and talking because of poor OH. Because of pain, they were unable to sleep and perform normal activities. They also avoided chewing hard things, eating certain foods, and eating with others.

1.5 Dental caries indicators

Dental caries is commonly measured by a value, which is the sum of the number of decayed, missing and filled teeth (DMFT Index) (WHO, 2000). This value has been widely used for assessing the OH status of populations for public health planning and policy-making purposes (Jakobsen and Hunt, 1990). The DMFT Index first introduced by Klien in 1930 (Klien *et al*., 1938), it is a measure of cumulative caries attacks that shows the occurrence of caries including past and present DC. Although the DMFT Index has been in use for more than 80 years, it remains the most commonly used epidemiological index for assessing DC (Broadbent and Thomson, 2005).

The World Health Organization (WHO) and International Dental Federation (FDI) established the first global OH goal of an average not more than three decayed, missing, and filled permanent teeth (DMFT) at the age of 12 years to be achieved by the year 2000 (Aggeryd, 1983). During the following decades most high-income countries reached or even exceeded these goals, but for many low-income countries this remains a remote aspiration (World Health Organization, 2000).

In 2003, the FDI, the WHO and the International Association for Dental Research (IADR) issued "Global Goals for Oral Health 2020" (Hobdell *et al*., 2003). These goals provided guidance for local, regional, and national planners and policy makers to improve the OH status of their populations. The new OH goals were not numerically specific. Instead, each country may specify targets according to its current disease prevalence and severity, local priorities, and OH systems. Based on the DMFT value, the WHO provided a scale for categorizing the severity of caries: DMFT between 0.0-1.1 is considered to be very low, 1.2-2.6 is low, 2.7-4.4 is moderate, 4.5-6.5 is high, and 6.6 or more is considered to be very high (WHO, 2000). (APPENDIX A).

Various epidemiologic studies from different parts of the world reported that DMFT value and caries prevalence is high among school children (12-14 years old) in some countries and higher than the figure recommended by the WHO goal, such as Saudi Arabia (mean DMFT 5.94, caries prevalence 93.7%) (Al-Sadhan, 2006), Puerto Rico (mean DMFT 3.8, caries prevalence 81%) (Elias-Boneta *et al*., 2003), Peru (mean DMFT 3.9, caries prevalence 83.3%) (Delgado-Angulo *et al*., 2009), Albania (mean DMFT 3.8, caries prevalence 85.5%) (Hysi *et al*., 2010), and Lithuania (mean DMFT 3.7, caries prevalence 85.5%) (Milciuviene *et al*., 2009).

1.6 Factors potentially associated with DC

Dental caries is considered a multifactorial disease, resulting from interplay between environment, behavior, and genetic factors (Cameron and Widmer, 2008). In the current study a number of factors have been put forward to explain the expected variation in prevalence and severity of DC that can be found in Qatar.

1.6.1 Level and source of OH knowledge

In order to create such OH education, the assessment of knowledge and attitude is essential (Al-Omiri *et al*., 2006). Knowledge means that the individual has all data necessary to understand what oral disease is and how it arises, as well as to understand the protective measures that need to be adopted. This knowledge will, in theory, lead to a change in attitude, which will in turn lead the individual to make changes in their daily life (Smyth *et al*., 2007).

Thus in the case of DC, the individual knows (for example) that incorrect brushing may cause caries, and this information generates a positive attitude towards daily brushing, and thus changes in brushing behavior.

Evidence has showed that an increase in knowledge about risk factors for oral disease and strong knowledge of OH demonstrates better oral care practices that aim to promote healthy habits (Smyth *et al*., 2007; Attaullah *et al*., 2010). Children with inadequate OH knowledge are twice as likely to have caries as children with adequate knowledge (Oliveira *et al*., 2000).

Several researchers clearly identified different sources of information, such as parents, school teachers, dentist, media or relatives, which have a direct influence on the OH knowledge of children (Abdellatif, 2004; Bondarik and Leous, 2004; Schroth *et al*., 2007; Miller *et al*., 2010), which in turn influences their caries prevalence.

The assessment of level of OH knowledge among school children and investigation the possible association between OH knowledge and DC has never been documented in Qatar. Furthermore, inquiry into children's sources of OH information is needed to detect the primary and secondary sources of early education on children with regard to good OH.

1.6.2 Teeth irregularity

The association between teeth irregularity and DC is still controversial. The most common forms of teeth irregularity are crowding and spacing (Puri *et al*., 2007). Crowding is defined as the condition in which the teeth are too close together and have positions such as overlapping, and displacement in various directions (Mosby Medical Dictionary, 2009). Logically it may be postulated that irregular teeth create areas difficult to clean, which facilitate the accumulation and maturation of dental plaque, and, therefore, predispose caries process. However, a review of the literature does not fully support this hypothesis. While some authors reported a positive association between teeth irregularity and DC (Gabris *et al*., 2006; Nobile *et al*, 2007; Mtaya *et al*., 2009), others could not establish any significant relationship (Helm and Petersen, 1989; Stahl and Grabowski, 2004).

Knowledge concerning the distribution of teeth irregularities in the child population and identification the possible association between teeth irregularity and DC has not yet been investigated in Qatar. Such information is worthy of consideration for correct orthodontic diagnosis, treatment planning and might help in assist orthodontists and public health policy makers improve interventions.

1.6.3 Body Mass Index (BMI)

The current global changes within the last decade towards consumption of soft drinks and fast food have led to serious dietary changes of the population. The changes in diet, together with spending too much time watching television (TV) or using the internet, have a widespread impact on children, facilitating the recent increases in the prevalence of overweight and obesity among them worldwide (Crespo *et al*., 2001).

It is unclear if there is a correlation between DC and obesity. One could expect that as the result of diet habits, obese children will have a higher prevalence of caries when compared to children who are of a normal or lower than normal weight. On the other hand, it may be possible that children with severe DC have difficulty eating and, therefore, are underweight.

In fact, the literature does not indicate consistent findings. One such study (Moreira *et al*., 2006) found that no association between obesity and DC among 12-15 year old Brazilian children. Another study (Tramini *et al*., 2009) among 12 year old children in France also found no association between BMI and DC. On the other hand, Narksawat *et al*., (2009) showed a higher prevalence of DC in normal and thin rather than overweight and obese 12-14 year old children in Thailand. Another investigation (Gokhale *et al*., 2010) found that there was a higher prevalence of DC in overweight and obese 3-14 year old children in India. Differences in the age ranges of populations studied, ethnicity, and the number of children examined could explain some of the variations.

In Qatar, the most recent epidemiological study in 12-17 year old school children revealed that among 3,923 school children (1,968 boys and 1,955 girls), the prevalence of underweight, overweight, and obesity was 8.6%, 28.6%, and 7.9%, respectively, among boys and 5.8%, 18.9%, 4.7% among girls (Bener, 2006). To date, no studies on the association between Body Mass Index (BMI) and DC in Qatar have been published. The current study will represent the first to examine the association between BMI and DC in a representative sample of Qatar children. Knowledge of these possible associations could lead to preventive health measures designed to decrease the incidence of both obesity and DC.

1.6.4 Life style variables

1.6.4.1 Dietary habits

Some studies link diet containing sugars and the development of DC (Yabao *et al*., 2005). While others, link dairy products (cheese, yoghurt and milk), drinking tea, chewing gum and inhibition action on DC (Bowen *et al*., 1991; Gedalia *et al*., 1994; Moynihan *et al*., 1999, 2002).

Although the type of food consumed is an important factor in the development or inhibition of DC, the frequency of food consumption is believed to be of greater significance (Aimutis, 2004). The national report on diet and dental health in the United States concluded, "There was a direct, strong, and statistically significant relationship between DMFT and the frequency of intake of sugary snacks between meals" (U.S. Department of Health and Human Services, Page 45, 1982). However, this report was released three decades ago.

Furthermore, in an attempt to explain the relationship between dietary habits and DC, some studies include an association between the main meal and snacks. Studies reported main meals such as breakfast, are usually high in protein and fat, often skipped altogether, school children who miss breakfast are more likely to snack during the day and snacks have relatively higher sugar content when compared to a main meal (that is, breakfast, lunch, and dinner), skipping main meals could lead to an increase in sugar consumption, which in turn may influence caries prevalence (Summerbell *et al*., 1995; Dye *et al*., 2004). It is also advisable to avoid sugars-containing food and drinks within one hour of bedtime (Levine, 2001). Thus, more studies are required to confirm the association between dietary habits and DC.

1.6.4.2 Television viewing and internet use

The American Academy of pediatrics has recognized excessive television (TV) viewing and internet use as major contributors to children's physical and mental health problems in the 21st century (American Academy of Pediatrics, 2001).

A multitude of studies have documented associations between prolonged TV viewing and internet usage and children's low vision (Bener *et al*., 2010), aggressive behavior (Robinson *et al*., 2001), obesity (Crespo *et al*., 2001) and poor school performance (Taras and Potts-Datema, 2005). Lears, (1992) reported an association between children's TV viewing and poor eating habits. These children are, therefore, more likely to be at increased risk for DC. Thus, it is important to clarify the possible association between excessive TV viewing, internet use and DC.

1.6.4.3 Passive smoking

Researchers pointed out, that the inhalation of tobacco smoke by non-smokers has been referred to as "passive smoking" (U.S.Department of Health and Human Services, 2007). Several studies have reported an association between passive smoking and ear problems, acute respiratory infections, asthma, wheeze, cough, and bronchitis on the health of children (Kum-Nji *et al*., 2006). Furthermore, passive smoking has been shown in a number of studies to adversely affect physical growth in young children (Eskenazi and Bergmann., 1995).

In contrast, the evidence to infer a causal association between passive smoking and DC in children is limited and not sufficient. A literature search revealed only four cross-sectional studies specifically investigating the link between passive smoking and DC (Aligne *et al*.,2003; Ayo-Yusuf *et al*., 2007; Tanaka *et al*., 2006 and 2010). Thus, from the view point of preventing DC in children, it is important to clarify the possible effect of passive smoking on the development of DC.

1.6.5 Socio-demographic factors (gender, ethnicity, age, area and type of school)

Recent research has shown that genetic, hormonal, cultural, social and metabolic differences all create variations in male and female experiences of health and illness (Doyal and Naidoo, 2010). During the past 15 years, immigration to Qatar has increased considerably. The growing numbers of immigrants are most prominent in children. This migration process might change living conditions as a result of settlement in a new country and adoption of new lifestyles (Cunnion *et al*., 2010). From the literature, it is evident that, from a socio-economic and socio-cultural point of view, OH is unevenly distributed (Christensen *et al*., 2010). An important first step in bridging these gaps is to thoroughly investigate and describe the occurrence of disease in children with different cultural and socio-economic backgrounds. Hence it is necessary to explore the association of socio-demographic factors as well as interaction between them.

1.7 OH in Qatar and importance of the study

In Qatar, the OH system is in a transitional development stage, and systematic data collection is needed to evaluate and plan OH care for the public. The WHO Global Oral Data Bank (WHO, OH Country/Area Profile, 2013) has information on the prevalence of caries in many countries. Unfortunately, to date, the DC status among school children in the state of Qatar has never been documented.

Since no study is available for DC prevalence in Qatar, and in order to organize community-oriented OH promotion program, systematic analysis of the OH situation would be needed.

Based on this background, the current study is pioneering and is valuable in several ways. First, it provides a baseline record on the prevalence, severity and distribution of DC, level of OH knowledge, teeth irregularity, BMI, and other life style variables

(e.g. TV viewing, internet use, passive smoking and dietary habits) in school children in Qatar in order to determine future trends of OH. Second, it signposts dental practitioners in Qatar to a number of factors among school children that can predispose the DC. Third, it provides comparisons between DC, level of OH knowledge, teeth irregularity, BMI, and other life style variables by socio-demographic factors (gender, ethnicity, age, area, and type of school) in school children in Qatar. Fourth, the findings of the study will contribute to the world database of OH and diseases, maintained by the WHO (WHO, OH Country/Area Profile 2013), which makes the comparison between the findings of the study in Qatar with similar findings in the Eastern Mediterranean region and other regions in the world possible.

Hence, the results of the current research are a novel finding, which has not been undertaken in any previous research among school children in Qatar. The general aim of the study is to document the DC and oral health status in school children in the state of Qatar.

2. RESEARCH QUESTIONS AND OBJECTIVES

The study seeks to answer the following questions:

1- What is the prevalence of DC, level of OH knowledge, teeth irregularity, BMI and life style variables (e.g. TV viewing, internet use, passive smoking and dietary habits) among 12-14 year old school children in Qatar?

2- What are the differences between prevalence of DC, OH knowledge, teeth irregularity, BMI and life style variables (e.g. TV viewing, internet use, passive smoking, and dietary habits) by socio-demographic factors (gender, ethnicity, age, area, and type of school) among 12-14 year old school children in Qatar?

3- Is OH knowledge, teeth irregularity, BMI and life style variables (e.g. TV viewing, internet use, passive smoking and dietary habits) associated with DC among 12-14 year old school children in Qatar?

4- How do the findings of the study in Qatar compare to similar findings in the Eastern Mediterranean region and other regions in the world?

5- What recommendations can be given to health policy makers in Qatar as regards to DC and other associated factors for 12-14 year old school children?

In order to mobilize the research questions, the following five research objectives were developed:

1) To measure the prevalence of DC, level of OH knowledge, teeth irregularity, BMI and life style variables (e.g. TV viewing, internet use, passive smoking and dietary habits) among 12-14 year old school children in Qatar;

2) To compare DC, OH knowledge, teeth irregularity, BMI and life style variables (e.g. TV viewing, internet use, passive smoking and dietary habits) by socio-demographic factors (gender, ethnicity, age, area, and type of school) among 12-14 year old school children in Qatar;

3) To investigate the associations of OH knowledge, teeth irregularity, BMI and life style variables (e.g. TV viewing, internet use, passive smoking and dietary habits) with DC among 12-14 year old school children in Qatar;

4) To compare the findings of the study in Qatar with similar findings in the Eastern Mediterranean region and other regions in the world;

5) To provide health policy makers with data regarding the severity and distribution of DC and other associated factors in the12-14 year old school children in Qatar.

3. MATERIALS AND METHODS

This is a community based cross-sectional study carried out in the state of Qatar, where the dental examination (APPENDIX F) and survey questionnaire (APPENDIX D, E) were conducted from October 2011 to March 2012 to assess the prevalence and associated factors of DC among a randomly selected sample of school children 12-14 years old. Data were collected through clinical examination and a structured questionnaire. The questionnaire as a whole, including the clinical examination, took approximately 20 minutes for each child.

3.1 Selection, training and calibration of the examiners

Three dentists with previous experience in epidemiological surveys of DC were invited to participate in this study. Each dentist was helped by a trained data entry dental assistant, to assist in recording the data measured by the dentist during the study. Staff training and calibration, as well as methodological adjustments, were performed in a pilot study that involved thirty children who were not included in the final sample.

A benchmaker examiner “Gold Standard” (the researcher) conducted the training processes with both theoretical and practical activities, which lasted 8 hours. During the theoretical discussions, the benchmaker examiner showed the examiners some photographic slides with clinical examples of each criterion that would be used in the study, in order to instruct the examiners on the criteria and examination method to be used, and finally, to achieve an initial standardization and improve reproducibility among them.

Thirty children were selected for calibration purposes. During this practical phase, each dentist examined the thirty children, discussed clinical diagnosis, study codes and criteria, recording and other errors in order to reach an acceptable level of

agreement (Kappa > 0.80). The calibration exercises, were carried out in 2 periods of 4 hours each, with a one week interval.

In this study, in line with others, the reliability of caries measurements was determined by the test-retest method described by Guilford, (1965) and explained with more detail by Rugg-Gunn and Holloway, (1974). Intra-examiner reliability (same examiner in two or more occasions) assessed by repetition of clinical examination for 30 of children, after a 7 day-interval (Intra-examiner agreement was evaluated by comparing data from the first and second session respectively). The inter-examiner reliability (variation in disease diagnosis between two or more examiners) was achieved by double-blind duplicated examination of the same 30 children (Inter-examiner agreement was computed from the data of the three examiners, pooled from the two sessions). Inter and intra-examiner reliability was measured through Kappa statistics (Table 1 and 2). Kappa value of above 0.80 was considered as highly reliable which has been achieved in the study and recommended by the WHO (1997).

Table 1: Inter-observer agreement (three examiners) (N=30).

	Examiner 2	**Examiner 3**
Examiner 1	0.89*	0.92*
Examiner 2	-	0.87*

* Kappa coefficient ($p < 0.001$)

Table 2: Intra-observer agreement (three examiners) (N=30).

	Agreement between 1st and 2nd observation
Examiner 1	0.94*
Examiner 2	0.92*
Examiner 3	0.90*

* Kappa coefficient ($p < 0.001$)

3.2 Sample size

3.2.1 School selection

The total number of 12-14 year old school children (Intermediate school children) in Qatar in the 2011-2012 academic year was 40,440 (20,141 males and 20,299 females). The total number of all government and private Intermediate schools in the same academic year was 135 (APPENDIX B and C) (Supreme Education Council, 2011; Qatar Statistics Authority, 2013).

This is a descriptive cross-sectional study. A list of all intermediate schools (12-14 year school children) were provided by the Supreme Education Council, although the WHO mentioned that between 10 to 15 sampling sites are usually sufficient for this kind of study (WHO, 1997), in the current study 16 schools (8 boys and 8 Girls schools; 12 government and 4 private schools) were randomly selected from different areas (Urban and Semi Urban) within the state of Qatar. This was to ensure an appropriate representation from all segments of the society, keeping in mind the socio-demographic factors (gender, ethnicity, age, area, government or private school) (Figure 3, 4).

Because most children are not able to disclose their parent's income reliably, the type of school (government or private) will be used as a proxy indicator of the child's economic background.

Figure 3: Sampling and inclusion procedure of schools.

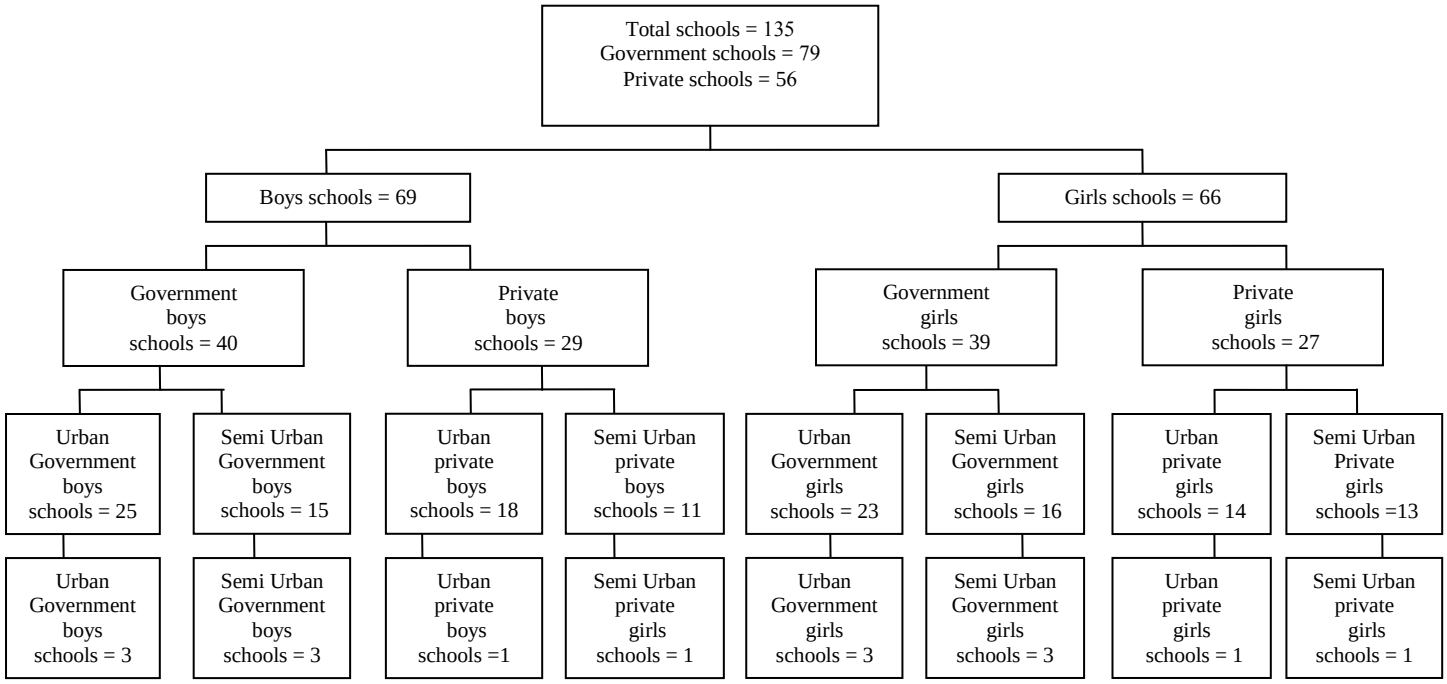
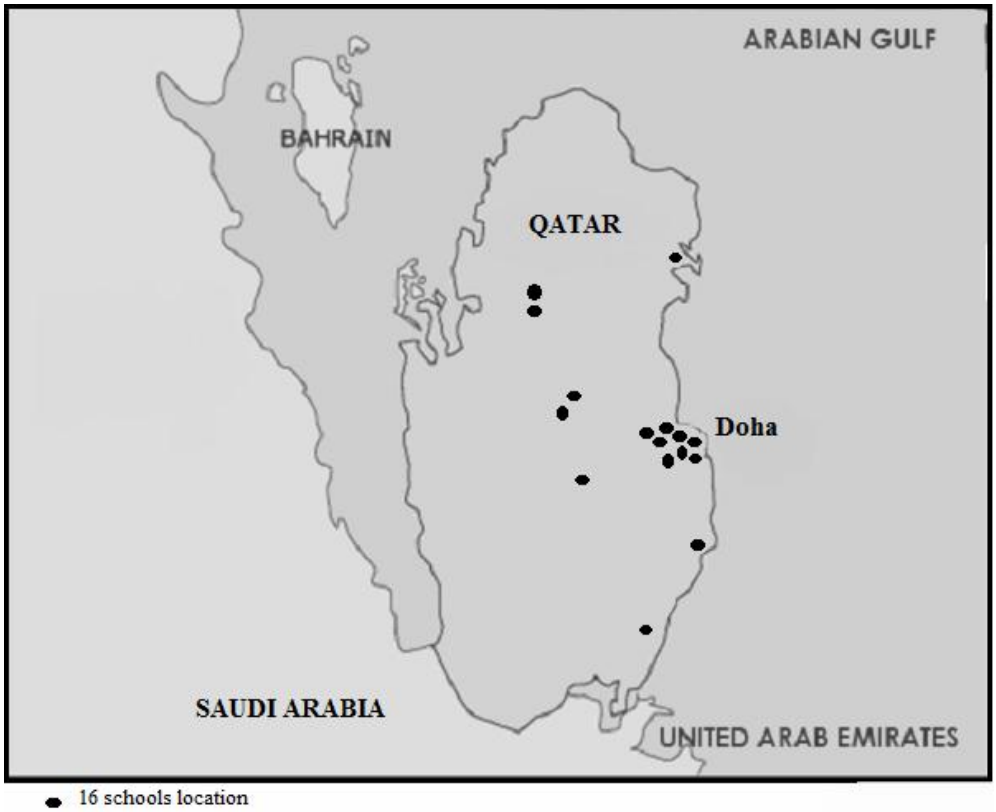


Figure 4: Map of Qatar including 16 schools location.



3.2.2 Children selection within the school

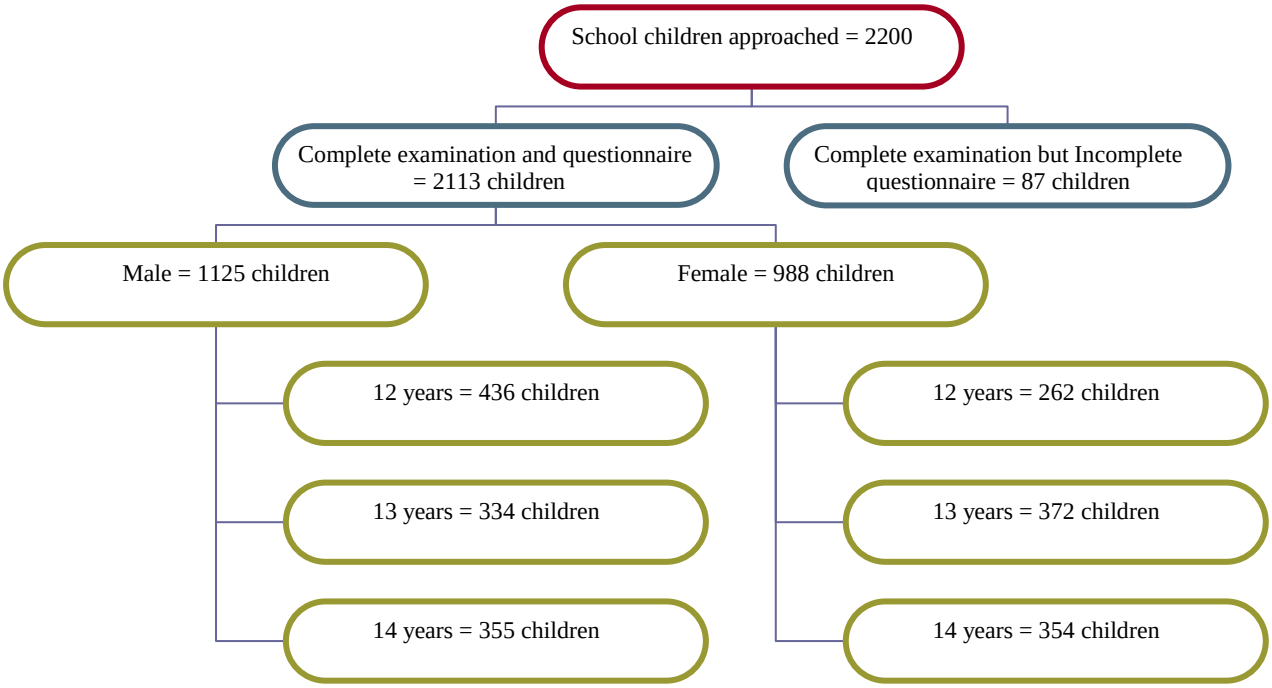
A multistage random sample using the stratified random sample technique with proportion allocation was used to select the sample (Levy and Lemeshow, 1980). The number of the children in each age group (12, 13, 14 years) to be examined ranges from a minimum of 25 to 50 for each sampling site (WHO, 1997). In this study 40 children for each age in each sampling site should be selected, then, the sample size of the survey for each age group calculated as the following:

Urban: 6 sites in the capital city	6 x 40 = 240
1 sites in 2 large towns	1 x 2 x 40 = 80
Semi Urban: 1 site in 8 semi urban locations	1 x 8 x 40 = 320
Total:	16 sites x 40 child = 640

This distribution applied to 3 age groups (12, 13, 14 years), hence, the total sample that should be selected for the study is 3 x 640 = 1,920 children. In order to cover the expected attrition during the study period, an additional 280 children were added to the 1,920 children. Thus, 2,200 school children were selected, which is sufficient to address the objectives of the study and exceed the recommended sample size by the WHO guidelines for a national basic OH survey (WHO, 1997) (Figure 5).

The number of students selected from each school was determined according to the total number of students at each school. Finally, the classrooms were chosen on a random basis, and all children from the randomly selected classes were invited to participate in the study.

Figure 5: Sampling and inclusion procedure of school children.



It should be noted, however, that in some areas, the desired number of children was not always found complete in the randomly selected schools; this resulted in an imbalance of males and females. The reasons of the variation were willingness to participate or not, and number of children in school in some areas was below the required number of each site (Table 3). Extra children were therefore chosen from other school sites.

Visit permissions and coordination to visit the schools was obtained from the Supreme Education Council and principals of each selected school. The principal of each school asked to inform the students and their parents about the study, and a day be set for each school to collect the data.

Table 3: Distribution of socio-demographic characteristics by gender.

Variables	Total N=2113(%)	Male n=1125(53.2%)	Female n=988(46.8%)
Age (in years):			
12	698(33)	436(38.8)	262(26.5)
13	706(33.4)	334(29.7)	372(37.7)
14	709(33.6)	355(31.6)	354(35.8)
Nationality:			
Qatari	1293(61.2)	756(67.2)	537(54.4)
Non-Qatari	820(38.8)	369(32.8)	451(45.6)
Type of school:			
Public	1509(71.4)	774(68.8)	735(74.4)
Private	604(28.6)	351(31.2)	253(25.6)
Area (16 schools):			
Urban:			
Al Saad	152(7.2)	152(13.5)	0
Al Gharafa	175(8.3)	118(10.5)	57(5.8)
South Madinat Khalifa	138(6.5)	0	138(14.0)
West Bay	230(10.9)	230(20.4)	0
Al Thamama	161(7.6)	161(14.3)	0
Al Muntaza	150(7.1)	150(13.3)	0
Al Waab	237(11.2)	0	237(24.0)
Total	1243(58.8)	811(72)	432(43.8)
Semi Urban:			
North:			
Al Khor	59(2.8)	0	59(6.0)
South:			
Al Wakra	154(7.3)	0	154(15.6)
Umm Said	141(6.7)	0	141(14.3)
West:			
Al Jumailliah	73(3.5)	36(3.2)	37(3.7)
Al Shahaniyah	313(14.8)	148(13.2)	165(16.7)
Rawdat Rashid	130(6.2)	130(11.6)	0
Total	870(41.3)	314(28)	556(56.3)

The child's age was confirmed from the school registries. School children who are below 12 years or over 14 years were not invited to participate in the study. A total of 87 children completed the examination but because they did not provide complete responses in their questionnaires, they were exempted from the study, while 2,113 completed the study (Table 3). The 2,113 children represented 5.3% of the total

number of 12-14 year old school children in Qatar in the 2011-2012 academic year, which was 40,440 school children.

3.3 Questionnaire

The approach taken in this research was quantitative, utilizing close-ended questions format in a structured paper and pencil self-administrated survey questionnaire. The questionnaire included thirty-seven items designed to evaluate five different aspects which include: OH knowledge, sources of OH information, passive smoking, TV viewing, internet use, and dietary habits. (APPENDIX D, E).

Children received a full explanation of how to score their responses and were made aware that for some items, the children were free to choose more than one answer for the same item. Furthermore, the researcher was always available during the completion of the questionnaire, and the children were encouraged to approach him whenever they needed clarification of any point. Care was taken that children did not duplicate each other's answers by asked each child to keep an empty seat between themselves and other child. Also, care was taken that each child completed only one questionnaire, and children answered all the items in the questionnaire. Once the children completed the questionnaire, they were asked to remain in the classroom until all have completed the survey. When everyone had completed the survey, children were able to hand the completed questionnaires to the examiners.

Oral health knowledge (Items 1-21)

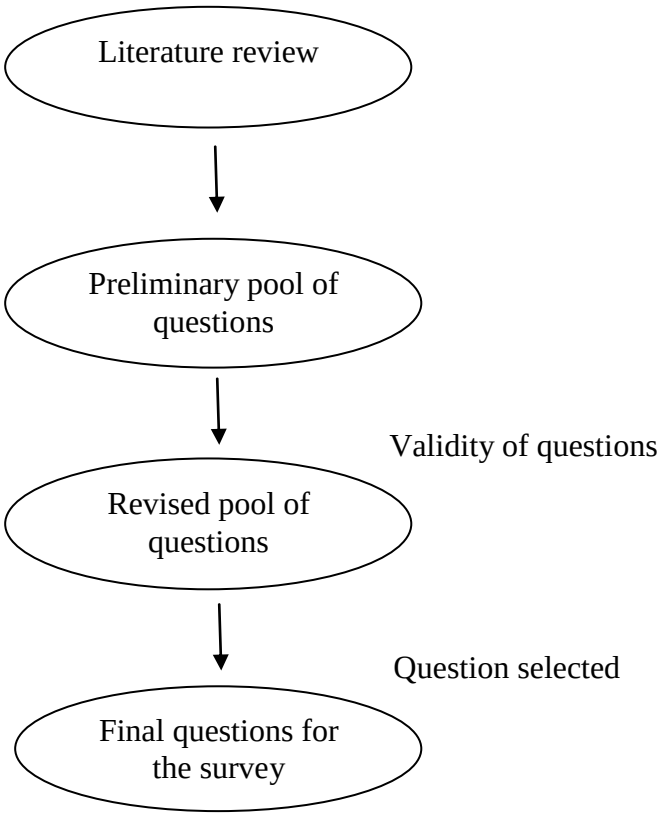
In dentistry many survey questionnaires have appeared in the literature claiming to assess the OH knowledge (Woolfolk *et al*., 1989; Oliveira *et al*., 2000; Abdellatif *et al*., 2004; Wyne *et al*., 2004; Al-Omiri *et al*., 2006; Smyth *et al*., 2007; Attaullah *et al*., 2010; Cheah *et al*., 2010). These survey questionnaires vary considerably in

content (ranging from 9 to 46 items) and aspects of OH which they assess (ranging from only knowledge to assessing habits, attitudes, behaviors, and practices).

In line with others, in this study the information about OH knowledge and its sources of information was collected through a survey questionnaire, which was derived from previously developed and tested questionnaires that are used in pediatric OH research (Woolfolk *et al*., 1989; Wyne *et al*., 2004 and 2005; Al-Omiri *et al*., 2006; Smyth *et al*., 2007; Cheah *et al*., 2010) with some modifications.

The questionnaire was constructed using a systematic multistage process: literature review, validity testing, and consideration to nominate questions for inclusion, revision or elimination from the questionnaire (Figure 6). These processes in questionnaire development were grounded based on the methodological framework for assessing health indices proposed by Guyatt and others (Guyatt *et al*., *1989* and 1996).

Figure 6: Development of OH questionnaire.



The original version of the questionnaire was written in English and had been translated into Arabic (APPENDIX D, E). The translation was performed by two independent and expert translators. Finally, another independent translator returned back translations, which were further compared with the originals, and inconsistencies were analyzed and corrected (Sartorius and Kuyken, 1994).

The questionnaire was designed to be comprehensible for the intermediate school children and was pre-tested among a group of children (Thirty children). The pre-test focused on the children's ability to understand the vocabulary used in the questionnaire, and that the questions were clear and unambiguous. Consent for participation was obtained prior to enrolment from the parents of all children. Only children with signed parental consent had been enrolled in the study (APPENDIX G, H, I). The questionnaire was distributed in the classrooms and collected after completion. Assessment of children's OH knowledge included items on the importance of dental health to general health, functions of teeth, frequency of brushing teeth, best brushing aids, attitudes toward regular dental visits, the effects of using fluoride on teeth, signs of tooth decay, symptoms of gum diseases, the ways of keeping gums healthy, and the meaning of plaque and its effects on teeth (APPENDIX D, E).

The total estimate of OH knowledge was calculated from responses to the 21 items of the OH knowledge questionnaire by giving each correct answer 1 mark and each wrong answer given 0 marks, with 21 as the maximum possible score. The score of OH knowledge scale was constructed based upon the numbers of correct responses. Respondents were stratified in to groups by level of knowledge: low (less than 8 answers correct), medium (8 to 14 correct), high (15 or more answers correct) the higher the score, the better OH knowledge (Woolfolk *et al*., 1989).

Sources of OH information (Item 22)

Item number 22 in the questionnaire was used to determine the primary and secondary sources of OH information.

Passive smoking (Item 23)

Item number 23 in the questionnaire asked if someone in the household was reported smoking cigarettes at the time of the survey, then smoking in the household was defined as positive.

TV viewing and internet use (Items 24-25)

Items number 24 and 25 in the questionnaire, the TV viewing and excessive internet use was measured by asking the children about the number of hours that they spent viewing TV and using internet (Koposova *et al*., 2010).

Dietary habits (Items 26-37)

Data concerning dietary habits were collected with the aid of a self-reported 12 items in the questionnaire (Item 26 to 37). The questions were derived from questionnaires used in previous studies among 12-14 year school children with some modifications (Roberts and Roberts, 1979; Zhu *et al*., 2003).

3.4 Examination

Clinical examination of DC status

All children were examined with a disposable mouth mirror, calibrated periodontal probe, tweezers, tray, gloves, mask, and consistent light source in their school. The collected data registered in a diagnostic chart for each child. Information about each child's details, age, gender, residential area, name of school, class, and name of both the examiner and recorder were included in the diagnostic chart. The diagnostic chart used in the study shown in APPENDIX F.

The examination procedures, instruments and diagnostic criteria used in this study are based on the publication recommended by the WHO (1997), in which a tooth is considered as decayed when a cavitation is present. When both carious lesion and restoration are present, the tooth is listed as decayed. All teeth were examined in a systematic order using FDI tooth numbering system.

The examinations were carried out in classrooms and performed under florescent lighting with the child sitting on a normal chair. Based on visual-tactile criteria, caries diagnosis documented using the DMFT Index (WHO, 2000), were (D) decayed, (M) missing, (F) filled, and (T) teeth. The DMFT Index had been used to measure the prevalence of caries activity since 1930 (Klein *et al*., 1938), and is considered as the simplest and most reliable index.

The DMFT Index scores for each child were computed for permanent teeth. Teeth that had been extracted for orthodontic purposes, or those that were missing due to trauma or congenitally absent, were excluded from the data processing and therefore did not contribute to the final missing score. Missing teeth were counted only if there was no doubt that tooth loss was due to caries.

As most previous published research using WHO criteria for diagnosis of DC, radiographic examinations not taken and no fiber-optic trans-illumination performed (Al-Sadhan, 2006; Campus *et al*., 2008; Tramini *et al*., 2009; Mtaya *et al*., 2009).

In the current study, the dental examination was performed by three trained dentists with previous experience in epidemiological surveys of DC and recorded by three adequately trained data entry dental assistances.

Teeth irregularity

In this research crowding and spacing (Figure 3) of the dentition determined clinically according to the criteria described by Björk *et al*., (1964). In accordance

with WHO (1997) guide lines, crowding and spacing between two adjacent teeth had been measured in millimeters using a periodontal probe with a scale as measuring device in both the maxilla (upper) and mandible (lower) incisors teeth region, and were coded in three categories as: 0 = No crowding or spacing, 1 = one segment crowded or spaced, 2 = two segments crowded or spaced (APPENDEX F). Total spacing or crowding of at least 2 mm in a segment was considered to be as the presence of spacing or crowding. Any space resulting from tooth extraction was excluded.

Body Mass Index (BMI)

The measurements of body height and weight were carried out by two trained dental assistants in the morning at the time the OH examination was performed. Body weight was measured using a portable balanced beam scale and height was measured using a stadiometer attached to the scale (SECA 769; Vogel and Hakle, Hamburg, Germany). The Children were dressed in light clothing and wore no shoes throughout the measurements.

BMI was calculated using the formula weight in kilogram (Kg) divided by height in meter square (m^2) (Speiser *et al.*, 2005). The portable scale and stadiometer were calibrated daily. BMI was categorized using an internationally recognized classification system (Centers for Disease Control and Prevention, 2011): children if they were between the 5^{th}-85^{th} percentile range were suggested as having normal weight for their age and sex, if they were < 5^{th} percentile were considered underweight, if they were between 85^{th}-95^{th} percentile range were considered overweight, and if > 95^{th} percentile were suggested as obese.

The children were given oral hygiene instructions following the examination and rewarded with a toothbrush, toothpaste tube and an appreciation certificate

(APPENDEX K). Children who needed treatment were provided with a letter to their parents indicating that they should visit a dental care facility (APPENDIX J).

3.5 Data management

Once the questionnaire and examination diagnostic chart were completed, they were stored securely in a locked file cabinet. Both the questionnaire and examination diagnostic chart were reviewed for completeness and clarity before starting data entry into a computer. All data were double entered to assure accuracy. Both entry and double entry of the data were completed by the main researcher. Electronic copies of the data were stored on a password protected computer and only the researchers involved in this study had access to the computer. Regarding the possibility of loss of subject confidentiality, the researchers involved in this study made all possible effort to ensure that the data collected kept confidential.

3.6 Ethical approval

Ethical approvals for the study were obtained from three organizations. First, the Research Ethics Sub-Committee, University of Gloucestershire, United Kingdom. Second, the Medical Ethics Committee (Reference number: RC/11660/2011), Hamad Medical Corporation, State of Qatar. Third, the Policy Analysis and Research Office, Supreme Education Council, State of Qatar. Schools that were selected through the sampling procedure were officially informed and assured about the confidentiality of the research findings and of the report. Written consent was taken both from the schools participating in the study and the children with their guardians after explaining the objectives of the study (APPENDIX G, H, I).

Maintaining survey data in a form that permits including the name and the identification number of children who participated in the study increases the risk that confidentiality will be breached. However, the researcher needed to be able to identify

each child in order to link the questionnaire form (APPENDIX D, E) to the examination form (APPENDIX F). Once these links were no longer needed, all children identifiers were removed.

4. STATISTICAL ANALYSIS

Data analysis had been conducted using Statistical Package for the Social Sciences (SPSS) version 20. Following data collection, descriptive statistics, including means and standard deviations were calculated for quantitative (continuous) variables such as DT, MT, FT, and DMFT, and frequency distribution with percentages for categorical variables such as gender, types of school, residential area, ethnicity, BMI percentile group, level of OH knowledge, frequency of tooth brushing and others that included in closed ended questions. The DMFT Index scores were computed for each child.

Correlation between DMFT and exposure variables such as level of OH knowledge, teeth irregularly and life style variables (e.g. TV viewing, internet use, passive smoking and dietary habits) were calculated using Kendall's tau-b for ordinal scale variables and Cramer's V for nominal scale variables.

Differences in continuous variables between two groups were measured through student's *t*-test and among more than two groups were measured through one way analysis of variance (ANOVA). On the other hand, associations between two or more than two categorical variables were measured through chi-square test. Furthermore, because all expected frequencies presented in this research were more than 5%, therefore, chi-square statistic was used to test the association. If the percentage of the expected frequency in any cell was less than 5% then Fisher's exact test would have been the alternative solution. Since in this study all the assumptions for chi-square test were fulfilled, hence chi-square test was used to investigate the associations between two or more than two categorical variables. The DMFT Index score was categorized binary into children with and without caries.

Assumptions for logistic regression were assessed by identifying the multicollinearity between all exposure variables. Univariable logistic regression was employed to identify association between different exposure variables and DC. Variables significant at 10% level of significance at the univariable level were carried forward into multivariable logistic regression analysis through the best subset method. Variables that demonstrated P-values < 5% levels of significance in the multivariable logistic regression model were considered significant, while variables that demonstrated P-value ≥ 5% level of significance in the multivariable logistic regression model were considered not significant. Adjusted odds ratios with 95% confidence intervals were calculated for all the significant variables in the final model. Model adequacy was assessed through Hosmer & Lemeshow goodness of fit test.

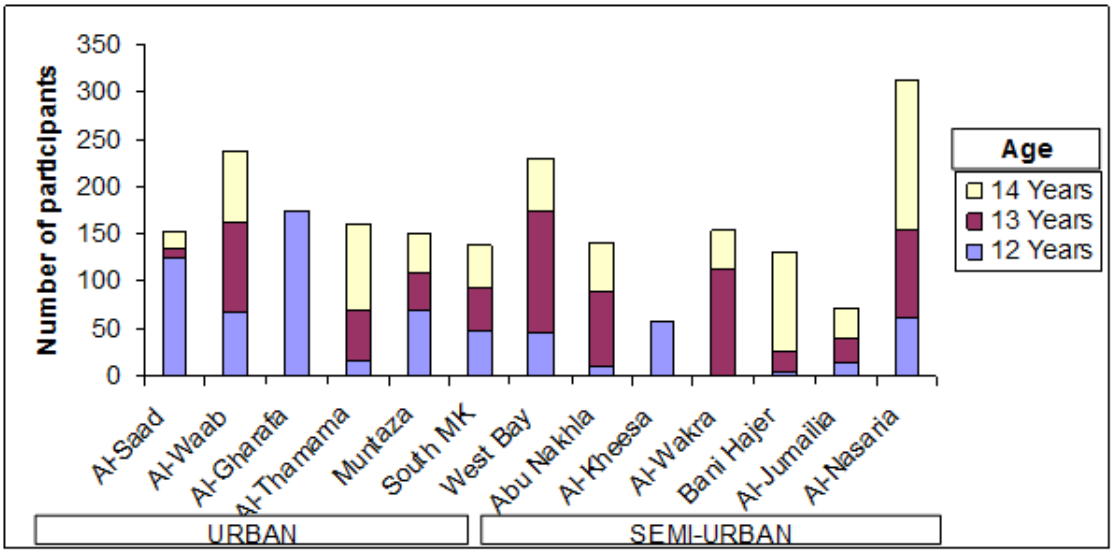
Inter and intra-examiner reliability was measured through Kappa statistics. Kappa value of above 0.80 was considered as highly reliable which has been recommended by the WHO (1997).

5. RESULTS

5.1 Socio-demographic status

A total of 2113 school children out of 2,200 originally sampled completed the study. Of which, 1,125 (53%) were males and 988 (46.8%) were females. Out of the study population 698 (33%) were aged 12 years, 706 (33.4%) aged 13 years and 709 (33.6%) aged 14 years. About 1,293 (61.2%) were Qatari and 820 (38.8%) were non-Qatari. Nearly 1,509 (71.4%) were from public schools and 604 (28.6%) from private schools. About 1,243 (58.8%) were from urban areas and 870 (41.3%) from semi urban areas. Table 3 summarizes the socio-demographic characteristics by gender of the sample. Sixteen schools (8 boys and 8 Girls schools; 12 government and 4 private schools) were randomly selected from different areas (Urban and Semi Urban) within the state of Qatar. Figure 7 shows the distribution of school children by age and area. In some areas two schools were selected, that's why only thirteen schools appear in Figure 7.

Figure 7: Distribution of school children by age and area.



5.2 Prevalence of teeth irregularities

Data on crowding and spacing are presented in Table 4 and 5. As shown, crowding and spacing were observed in different proportions 932 (44.1%) and 201 (9.5%) respectively. Dentitions with one segment crowding were found in 443 (21%) of the children, 489 (23.1%) with two segment crowding, and 1181 (55.9%) without crowding.

For each socio-demographic variable of crowding, the differences between its categories were not significant except ethnicity (only between Qatari and non-Qatari children for no crowding), and age (only for no crowding and for two segments crowding). Overall, there were no significant differences between the no crowding, one segment crowding, and two segment crowding by all socio-demographic variables except age.

Table 4: Distribution of socio-demographic characteristics by crowding.

Variable	Crowding						Overall P-Value**
	No Crowding n=1181(55.9) n(%)	P-value**	One Segment n=443(21.0) n(%)	P-Value**	Two Segment n=489(23.1) n(%)	P-Value**	
Ethnicity							
Qatari	697(59.0)	0.021	283(63.9)	*	313(64.0)	*	*
Non-Qatari	484(41.0)		160(36.1)		176(36.0)		
Gender							
Boys	611(51.7)	*	252(56.9)	*	262(53.6)	*	*
Girls	570(48.3)		191(43.1)		227(46.4)		
Age							
12 year	391(33.1)		154(34.8)		153(31.3)		
13 year	360(30.5)	0.001	156(35.2)	*	190(38.9)	0.012	0.004
14 year	430(36.4)		133(30.0)		146(29.9)		
Type of School							
Public	862(73.0)	*	309(69.8)	*	338(69.1)	*	*
Private	319(27.0)		134(30.2)		151(30.9)		
Area							
Urban	691(58.5)	*	271(61.2)	*	281(57.5)	*	*
Semi Urban	490(41.5)		172(38.8)		208(42.5)		

* Non significant
**By Chi-square test

Spacing, however, were observed with one segment in 125 (5.9%) of the children, 76 (3.6%) with two segment spacing, and 1,912 (90.5%) without any spacing. For each socio-demographic variable of spacing, the differences between its categories were not significant (completely for ethnicity and age) except gender (only no spacing and one segment spacing), type of school (only one segment spacing), and residential area (only one segment spacing).

Overall, there were no significant differences between the no spacing, one segment spacing, and two segment spacing by all socio-demographic variables except gender and residential area.

Table 5: Distribution of socio-demographic characteristics by spacing.

Variable	Spacing						Overall P-Value**
	No Spacing n=1912(90.5) n(%)	P-Value**	One Segment n=125(5.9) n(%)	P-Value**	Two Segment n=76(3.6) n(%)	P-Value**	
Ethnicity							
Qatari	1179(61.7)	*	70(56.0)	*	44(57.9)	*	*
Non-Qatari	733(38.3)		55(44.0)		32(42.1)		
Gender							
Boys	1038(54.3)	0.003	50(40.0)	0.002	37(48.7)	*	0.006
Girls	874(45.7)		75(60.0)		39(51.3)		
Age							
12 year	619(32.4)		47(37.6)		32(42.1)		
13 year	650(34.0)	*	37(29.6)	*	19(25.0)	*	*
14 year	643(33.6)		41(32.8)		25(32.9)		
Type of School							
Public	1354(70.8)	*	102(81.6)	0.009	53(69.7)	*	*
Private	558(29.2)		23(18.4)		23(30.3)		
Area							
Urban	1119(58.5)	*	84(67.2)	0.050	40(52.6)	*	0.033
Semi Urban	793(41.5)		41(32.8)		36(47.4)		

* Non significant
**By Chi-square test

5.3 Prevalence of and response to the OH knowledge questionnaire

Children's responses to the OH knowledge questions by gender are presented in Table 6. A great majority, 1,920 (90.9%) of the children were aware that good dental health is important for good general health. More than two-thirds, 1,495 (70.8%) of the children responded that they care about their teeth as much as any part of their body. Most of the children were aware of the importance of the teeth in chewing, talking and appearance 1,768 (83%).

Almost a majority of the respondents, 2,029 (96%), think it is important to keep teeth clean and 1,754 (83%) knew that clean teeth prevent bad breath, prevent tooth decay, and keep teeth healthy and beautifully. About 1,433 (67.8%) identified that tooth brush, dental floss, and mouth wash all together are the best cleaning aid. After each meal tooth brushing was observed by a very small group of children, just 78 (3.7%), followed by twice a day, 730 (34.5%), while the majority brushed only once a day, 1,147 (54.3%). About 942 (44.6%) of the children recognized dental floss as a cleaning device for between the teeth, which means that the importance of cleaning between teeth was apparently less well understood, as 845 (40%) of the children thought that cleaning between teeth by using a tooth brush is adequate and 149 (7.1%) don't know the right way.

A large number, 687 (32.5%) of children thought incorrectly that one must visit the dentist only in case of pain in one's teeth. A great majority, 2,005 (94.9%) of the children knew that sweets (chocolate/candies) could cause tooth decay. However, a large number of children were not aware of the cariogenic potential of soft drinks, 824 (39%), and sweetened milk, 2,067 (97.8%).

Less than half, 822 (38.9%), of the children actually had heard about fluoride and only 506 (23.9%) correctly identified the action of fluoride as preventing tooth decay. Only 66 (3.1%) of the children recognized fluoridated water as a source of fluoride while 1,151 (54.5%) of the children were not aware of any method of getting fluoride.

Both toothache and cavities in teeth could be a sign of tooth decay, only 1,174 (55.6%), and 356 (16.8%), respectively, correctly answered the question about the sign of tooth decay. More than half, 1,193 (56.5%), of the children identified that good dental hygiene, eating less sweets, using fluoride, and regularly visiting the dentist all together could prevent tooth decay.

About 1,339 (63.4%) thought that blood on the tooth brush could be a sign of gum disease. Also, 1,482 (70.1%) of the children recognized healthy gums do not bleed and only 1,341 (63.5%) correctly identified that symptoms of gum disease include swelling, redness of gums, bad smell from mouth and bleeding from gums.

Approximately 1,151 (54.5%) of the children knew that the best way to maintain optimum gingival health was to clean their teeth daily and 444 (21%) did not know. Slightly less than half, 1,022 (48.4%), of the children couldn’t define the meaning of plaque and only 761 (36%) could recognized that dental plaque can lead to tooth decay.

Table 6: Distribution of OH knowledge by gender

Variables	Total N=2113(%)	Male n=1125(53.2%)	Female n=988(46.8%)
1. Do you think good dental health is important for good general health?			
Yes	1920(90.9)	1006(89.4)	914(92.5)
No	67(3.2)	44(3.9)	23(2.3)
I don't know	126(6.0)	75(6.7)	51(5.2)
2. Do you care about your teeth as much as any part of your body?			
Yes	1495(70.8)	736(65.4)	759(76.8)
No	404(19.1)	268(23.8)	136(13.8)
I don't know	214(10.1)	121(10.8)	93(9.4)
3. What is the importance of teeth?			
Chewing	211(10.0)	140(12.4)	71(7.2)
Talking	46(2.2)	33(2.9)	13(1.3)
Appearance	88(4.2)	55(4.9)	33(3.3)
All of the above	1768(83.7)	897(79.7)	871(88.2)
4. Do you think it is important to keep your teeth clean?			
Yes	2029(96.0)	1056(93.9)	973(98.5)
No	84(4.0)	69(6.1)	15(1.5)
5. If "Yes" Why do you think it is important?			
To prevent bad breath	72(3.4)	58(5.2)	14(1.4)
To prevent tooth decay	121(5.7)	91(8.1)	30(3.0)
To keep teeth healthy & beautiful	166(7.9)	120(10.7)	46(4.7)
All of the above	1754(83.0)	856(76.1)	898(90.9)
6. Which of the following is the best cleaning aid?			
Tooth brush	588(27.8)	384(34.1)	204(20.6)
Dental floss	41(1.9)	30(2.7)	11(1.1)
Mouth wash	51(2.4)	39(3.5)	12(1.2)
All of the above	1433(67.8)	672(59.7)	761(77.0)
7. Teeth should be cleaned at least:			
Once a day	1147(54.3)	571(50.8)	576(58.3)
Twice daily	730(34.5)	368(32.7)	362(36.6)
After each meal	78(3.7)	62(5.5)	16(1.6)
Once a week	158(7.5)	124(11.0)	34(3.4)
8. The best way to clean between your teeth is to:			
Use a toothbrush	845(40.0)	504(44.8)	341(34.5)
Use dental floss	942(44.6)	430(38.2)	512(51.8)
Use toothpick	177(8.4)	104(9.2)	73(7.4)
I don't know	149(7.1)	87(7.7)	62(6.3)
9. How often one must visit the dentist?			
Every three months	749(35.4)	373(33.2)	376(38.1)
Every six months	537(25.4)	209(18.6)	328(33.2)
Once a year	140(6.6)	101(9.0)	39(3.9)
Only when pain in your tooth	687(32.5)	442(39.3)	245(24.8)
10. Which of the following diet causes tooth decay? *			
Sweet(chocolate/candies)	2005(94.9)	1043(92.7)	962(97.4)
Soft drinks	1289(61.0)	656(58.3)	633(64.1)
Fresh milk	65(3.1)	44(3.9)	21(2.1)
Vegetables	710(33.6)	327(29.1)	383(38.8)
Sweetened milk	46(2.2)	40(3.6)	6(0.6)
Fresh fruits	38(1.8)	34(3.0)	4(0.4)

Variables	Total N=2113(%)	Male n=1125(53.2%)	Female n=988(46.8%)
11. Have you heard about fluoride?			
Yes	822(38.9)	396(35.2)	426(43.1)
No	1291(61.1)	729(64.8)	562(56.9)
12. What does fluoride do?			
It makes teeth white	345(16.3)	190(16.9)	155(15.7)
It helps protect teeth from decay	506(23.9)	222(19.7)	284(28.7)
It makes teeth grow	38(1.8)	31(2.8)	7(0.7)
I don't know	1224(57.9)	682(60.6)	542(54.9)
13. The best way to get fluoride is to:			
Have a dentist put fluoride on your teeth	302(14.3)	191(17.0)	111(11.2)
Brush your teeth with fluoride tooth paste	594(28.1)	272(24.2)	322(32.6)
Drink water that has fluoride in it	66(3.1)	30(2.7)	36(3.6)
I don't know	1151(54.5)	632(56.2)	519(52.5)
14. Which of the following can be a sign of tooth decay?			
Toothache	1174(55.6)	605(53.8)	569(57.6)
Bleeding gums	162(7.7)	112(10.0)	50(5.1)
Calculus	421(19.9)	257(22.8)	164(16.6)
Cavities in teeth	356(16.8)	151(13.4)	205(20.7)
15. I can avoid tooth decay:			
By good dental hygiene	477(22.6)	310(27.6)	167(16.9)
By eating less sweets	103(4.9)	78(6.9)	25(2.5)
By using fluoride	91(4.3)	64(5.7)	27(2.7)
By going to dentist regularly	249(11.8)	139(12.4)	110(11.1)
All of the above	1193(56.5)	534(47.5)	659(66.7)
16. Blood on your toothbrush may be a sign of:			
Gum disease	1339(63.4)	622(55.3)	717(72.6)
Tooth decay	278(13.2)	198(17.6)	80(8.1)
I don't know	496(23.5)	305(27.1)	191(19.3)
17. Healthy gums do not bleed!			
True	1482(70.1)	742(66.0)	740(74.9)
False	193(9.1)	121(10.8)	72(7.3)
I don't know	438(20.7)	262(23.3)	176(17.8)
18. Symptoms of gum diseases include:			
Swelling and redness of gums	265(12.5)	173(15.4)	92(9.3)
Bad smell from mouth	132(6.2)	105(9.3)	27(2.7)
Bleeding from gums	375(17.7)	242(21.5)	133(13.5)
All of the above	1341(63.5)	605(53.8)	736(74.5)
19. The best way to keep your gums healthy:			
Eat a good diet	270(12.8)	152(13.5)	118(11.9)
Clean your teeth everyday	1151(54.5)	591(52.5)	560(56.7)
Take vitamins	248(11.7)	132(11.7)	116(11.7)
I Don't know	444(21.0)	250(22.2)	194(19.6)
20. What is plaque?			
A toothpaste	158(7.5)	119(10.6)	39(3.9)
A layer of germs on the teeth	776(36.7)	337(30.0)	439(44.4)
A plastic coating for teeth	157(7.4)	90(8.0)	67(6.8)
I don't know	1022(48.4)	579(51.5)	443(44.8)
21. Dental plaque can lead to tooth decay:			
Yes	761(36.0)	362(32.2)	399(40.4)
No	194(9.2)	114(10.1)	80(8.1)
I don't know	1158(54.8)	649(57.7)	509(51.5)

*****multiple response question (more than one response possible)

In Table 7, the distribution of socio-demographic characteristics by OH knowledge is displayed. For each socio-demographic variable of OH knowledge, the differences between its categories were significant except age, residential area and type of school (only moderate OH knowledge).

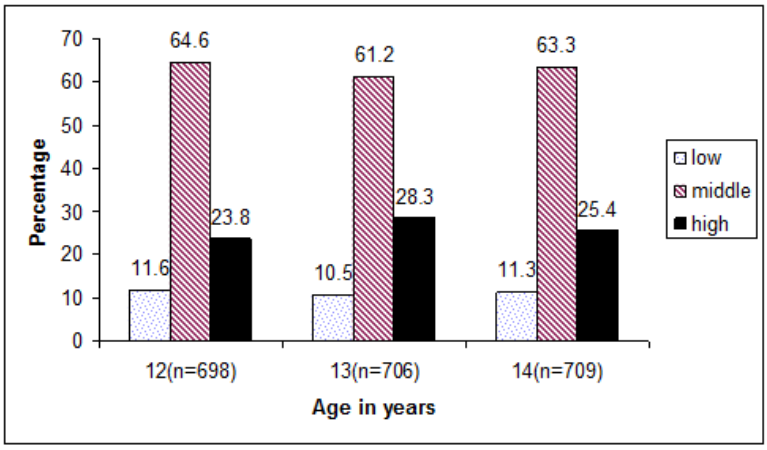
Overall, there were highly significant differences between children with poor OH knowledge, children with moderate OH knowledge, and children with high OH knowledge by all socio-demographic variables except age and residential area. Furthermore, Figure 8 presents the distribution of the children's OH knowledge level by age. A higher proportion of the children in all age groups (12-14 years) demonstrated a medium level of knowledge.

Table 7: Distribution of socio-demographic characteristics by OH knowledge.

Variable	Oral Health Knowledge						Overall P-Value**
	Poor(0-7) n=235(11.2) n(%)	P-value**	Moderate (8-14) n=1332(63.0) n(%)	P-Value**	High(15-21) n=546(25.8) n(%)	P-Value**	
Ethnicity							
Qatari	164(69.8)	0.004	861(64.6)	<0.001	268(49.1)	<0.001	<0.001
Non-Qatari	71(30.2)		471(35.4)		278(50.9)		
Gender							
Boys	190(80.9)	<0.001	757(56.8)	<0.001	178(32.6)	<0.001	<0.001
Girls	45(19.1)		575(43.2)		368(67.4)		
Age							
12 year	76(32.3)		454(34.1)		168(30.8)		
13 year	71(30.2)	*	435(32.7)	*	200(36.6)	*	*
14 year	88(37.4)		443(33.3)		178(32.6)		
Type of School							
Public	149(63.4)	0.004	950(71.3)	*	410(75.1)	0.027	0.004
Private	86(36.6)		382(28.7)		136(24.9)		
Area							
Urban	145(61.7)	*	775(58.2)	*	323(59.2)	*	*
Semi Urban	90(38.3)		557(41.8)		223(40.8)		

* Non significant
**By Chi-square test

Figure 8: Distribution of children's OH knowledge level by age.



5.4 Sources of OH knowledge

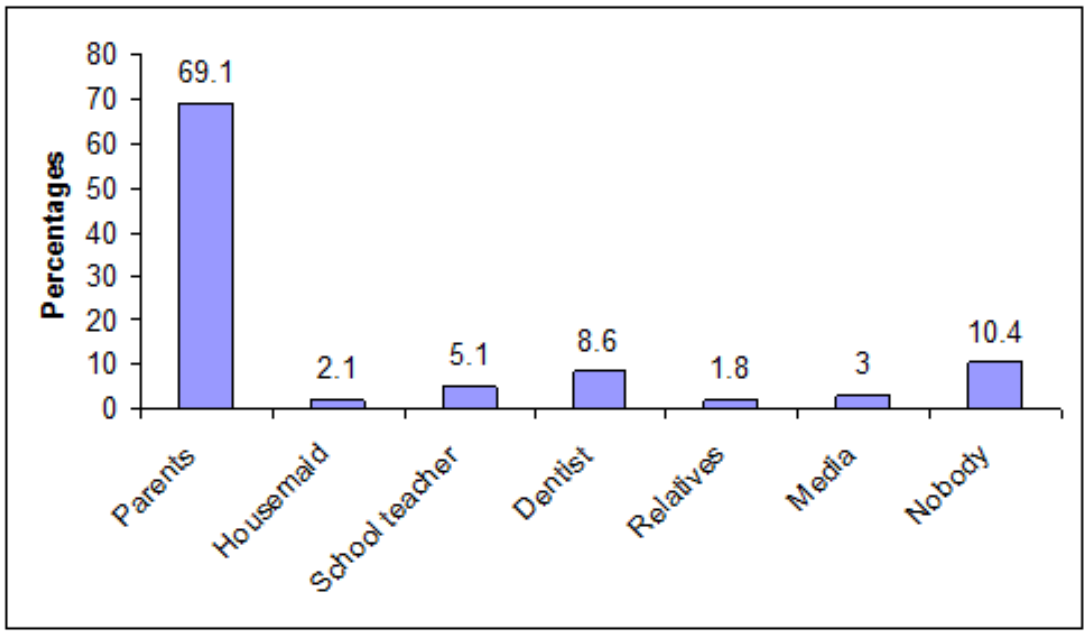
Table 8 and Figure 9 highlight the reported sources of children's information about OH. Parents were the most popular, 1,460 (69.1%), source of OH information for the children followed by dentists, 181 (8.6%), school teachers, 107 (5.1%) and media (television, radio, newspaper, journal), 64 (3%). Very few children reported house maid, 45 (2.1%), and relatives, 37 (1.8%), as the most popular source of OH information. By gender, although parents were the most popular source of OH information, however, it was slightly higher for male than female children.

Table 8: Sources of OH information by gender.

Variables	Total N=2113(%)	Male n=1125(53.2%)	Female n=988(46.8%)	P-value**
Who taught you how to clean your teeth?				
Parents	1460(69.1)	754(67.0)	706(71.5)	0.027
House maid	45(2.1)	27(2.4)	18(1.8)	0.358
School teacher	107(5.1)	58(5.2)	49(5.0)	0.837
Nobody	219(10.4)	119(10.6)	100(10.1)	0.731
Dentist	181(8.6)	110(9.8)	71(7.2)	0.033
Relatives	37(1.8)	24(2.1)	13(1.3)	0.153
Media "Television, radio, news-paper, journal"	64(3.0)	33(2.9)	31(3.1)	0.785

**By Chi-square test

Figure 9: Sources of OH information.



5.5 Prevalence of and response to life style variables

5.5.1 Passive smoking

In Table 9, about 757 (35.8%) of the school children reported that at least one household member smoked, whereas 1,356 (64.2%) had never been exposed to household smoking up to the time of the survey. For each socio-demographic variable of passive smoking, the differences between its categories were highly significant except age and gender (only children reported that at least one household member smoked).

Overall, there were highly significant differences between children who reported that at least one household member smoked, and children who had never been exposed to household smoking up to the time of the survey by all socio-demographic variables except ethnicity and age.

Table 9: Distribution of socio-demographic characteristics by passive smoking.

Variable	Passive Smoking				Overall P-Value**
	Yes n=757(35.8) n (%)	P-Value**	No n=1356(64.2) n (%)	P-Value**	
Ethnicity					
Qatari	470(62.1)	<0.001	823(60.7)	<0.001	*
Non-Qatari	287(37.9)		533(39.3)		
Gender					
Boys	382(50.5)	*	743(54.8)	0.001	0.056
Girls	375(49.5)		613(45.2)		
Age					
12 year	231(30.5)		467(34.4)		
13 year	263(34.7)	*	443(32.7)	*	*
14 year	263(34.7)		446(32.9)		
Type of School					
Public	530(70.0)	<0.001	979(72.2)	<0.001	0.002
Private	227(30.0)		377(27.8)		
Area					
Urban	412(54.4)	0.002	831(61.3)	<0.001	0.033
Semi Urban	345(45.6)		525(38.7)		

* Non significant
**By Chi-square test

5.5.2 TV viewing

Table 10 presents the number of hours that the school children spent watching TV on a daily basis. Almost half of the children, 1,057 (50%) aged 12-14 years watched > 2 hours of TV a day. For each socio-demographic variable of TV viewing, the differences between its categories were significant except gender (only those children who watched > 2 hours of TV a day).

Overall, there was a highly significant difference between children who watched ≤ 2 hours of TV a day and children who watched > 2 hours of TV a day in all socio-demographic variables.

Table 10: Distribution of socio-demographic characteristics by TV watching.

Variable	Watching Television				Over all P-Value**
	≤ 2 hrs n=1056(50.0) n (%)	P-Value**	> 2 hrs n=1057(50.0) n (%)	P-Value**	
Ethnicity					
Qatari	600(56.8)	<0.001	693(65.6)	<0.001	<0.001
Non-Qatari	456(43.2)		364(34.4)		
Gender					
Boys	603(57.1)	<0.001	522(49.4)	*	<0.001
Girls	453(42.9)		535(50.6)		
Age					
12 year	304(28.8)		394(37.3)		
13 year	386(36.6)	<0.001	320(30.3)	0.002	<0.001
14 year	366(34.7)		343(32.5)		
Type of School					
Public	731(69.2)	<0.001	778(73.6)	<0.001	0.026
Private	325(30.8)		279(26.4)		
Area					
Urban	578(54.7)	<0.001	665(62.9)	<0.001	<0.001
Semi Urban	478(45.3)		392(37.1)		

* Non significant
**By Chi-square test

5.5.3 Internet use

Table 11 presents the number of hours that the school children spent using the internet on a daily basis. Slightly less than half of the children, 972 (46%) aged 12-14 years used > 2 hours of internet a day. For each socio-demographic variable of internet use, the differences between its categories were significant except age and gender (only those children who used > 2 hours of internet a day).

Overall, there was a highly significant difference between children used the internet ≤ 2 hours a day and children used the internet > 2 hours a day in all socio-demographic variables except ethnicity and type of school.

Table 11: Distribution of socio-demographic characteristics by using the internet.

Variable	Internet User				Overall P-Value**
	≤ 2 hrs n=1141(54.0) n (%)	P-Value**	> 2 hrs n=972(46.0) n (%)	P-Value**	
Ethnicity					
Qatari	681(59.7)	<0.001	612(63.0)	<0.001	*
Non-Qatari	460(40.3)		360(37.0)		
Gender					
Boys	646(56.6)	<0.001	479(49.3)	*	<0.001
Girls	495(43.4)		493(50.7)		
Age					
12 year	378(33.1)		320(32.9)		
13 year	403(35.3)	*	303(31.2)	*	0.059
14 year	360(31.6)		349(35.9)		
Type of School					
Public	810(71.0)	<0.001	699(71.9)	<0.001	*
Private	331(29.0)		273(28.1)		
Area					
Urban	629(55.1)	<0.001	614(63.2)	<0.001	<0.001
Semi Urban	512(44.9)		358(36.8)		

* Non significant
**By Chi-square test

5.5.4 Dietary habits

Table 12-22 show data concerning dietary habits. A great majority, 2,100 (99.4%), of the children consume sugar containing snacks (candy, soft drinks, chocolate, jelly, ice cream, cookies) in-between meals (Table 13), where 750 (35.6%) of the children recorded several daily intakes of sugar containing snacks (Table 15). For each socio-demographic variable of sugar containing snacks, the differences between its categories were significant except age.

Overall, there were no significant differences between children who consumed sugar containing snacks and children who did not consume sugar containing snacks in all socio-demographic variables except gender.

Table 12: Distribution of socio-demographic characteristics by sugar containing snacks in-between meals.

Variable	Sugar containing snacks				Over all P-Value**
	Yes n=2100(99.4) n (%)	P-value**	No n=13(0.6) n (%)	P-value**	
Ethnicity					
Qatari	1282(61.0)	<0.001	11(84.6)	<0.001	*
Non-Qatari	818(39.0)		2(15.4)		
Gender					
Boys	1114(53.0)	<0.001	11(84.6)	<0.001	0.046
Girls	986(47.0)		2(15.4)		
Age					
12 year	692(33.0)		6(46.2)		
13 year	704(33.5)	*	2(15.4)	*	*
14 year	704(33.5)		5(38.5)		
Type of School					
Public	1498(71.3)	<0.001	11(84.6)	<0.001	*
Private	602(28.7)		2(15.4)		
Area					
Urban	1235(58.8)	<0.001	8(61.5)	<0.001	*
Semi Urban	865(41.2)		5(38.5)		

* Non significant
**By Chi-square test

In Table 13 and 14, although 1,374 (65%) of the participants consume sugar containing snacks within one hour of bed time, only 464 (22%) consume sugar containing snacks within one hour of bed time once or more than once on a daily basis.

For each socio-demographic variable of snack within one hour of bed time, the differences between its categories were significant except gender (only those children who snacks within one hour to bed time).

Overall, there were significant differences between children who consume snacks within one hour of bed time and children who do not consume snacks within one hour of bed time in all socio-demographic variables except residential area.

Table 13: Distribution of socio-demographic characteristics by consumption of sugar containing snacks within one hour of bed time.

Variable	Snack within one hour to bed time				Overall P-Value**
	Yes n=1374(65.0) n (%)	P-value**	No n=739(35.0) n (%)	P-value**	
Ethnicity					
Qatari	863(62.8)	<0.001	430(58.2)	<0.001	0.038
Non-Qatari	511(37.2)		309(41.8)		
Gender					
Boys	706(51.4)	*	419(56.7)	<0.001	0.020
Girls	668(48.6)		320(43.3)		
Age					
12 year	494(36.0)		204(27.6)		
13 year	422(30.7)	0.013	284(38.4)	<0.001	<0.001
14 year	458(33.3)		251(34.0)		
Type of School					
Public	1017(74.0)	<0.001	492(66.6)	<0.001	<0.001
Private	357(26.0)		247(33.4)		
Area					
Urban	825(60.0)	<0.001	418(56.6)	<0.001	*
Semi Urban	549(40.0)		321(43.4)		

* Non significant
**By Chi-square test

Table 14: Frequency of sugar containing snacks consumption by gender.

Variables	Total N=2113(%)	Male n=1125(53.2%)	Female n=988(46.8%)	P-Value**
Frequency of eating or drinking sugar containing snacks in-between meals				
Never	19(0.9)	13(1.2)	6(0.6)	
Occasionally(not every day)	841(39.7)	453(40.3)	388(39.3)	0.013
Once a day	503(23.8)	290(25.8)	213(21.6)	
More than once a day	750(35.6)	369(32.8)	381(38.6)	
Frequency of eating or drinking sugar containing snacks within one hour to bed time				
Never	739(34.9)	416(37.0)	316(32.0)	
Occasionally(not every day)	910(43.1)	445(39.6)	468(47.4)	<0.001
Once per day	249(11.8)	156(13.9)	95(9.6)	
More than once a day	215(10.2)	108(9.6)	109(11.0)	

**By Chi-square test

Almost 1,771 (83.8%) of children consume dairy products containing snacks (cheese, milk, yogurt) in-between meals (Table 15), where 920 (43.6%) consume dairy products containing snacks once or more than once on a daily basis (Table 16). For each socio-demographic variable of consuming dairy products in between meals, the differences between its categories were highly significant except gender (only those children who do not consume dairy products containing snacks) and residential area (only those children who do not consume dairy products containing snacks).

Overall, there were significant differences between children who consume dairy products containing snacks in-between meals and children who do not consume dairy products containing snacks in-between meals in all socio-demographic variables except ethnicity.

Table 15: Distribution of socio-demographic characteristics by consumption of dairy products containing snacks.

Variable	Dairy product in between meals				Overall P-Value**
	Yes n=1771(83.8) n (%)	P-Value**	No n=342(16.2) n (%)	P-Value**	
Ethnicity					
Qatari	1090(61.5)	<0.001	203(59.4)	<0.001	*
Non-Qatari	681(38.5)		139(40.6)		
Gender					
Boys	962(54.3)	<0.001	163(47.7)	*	0.024
Girls	809(45.7)		179(52.3)		
Age					
12 year	633(35.7)		65(19.0)		
13 year	574(32.4)	0.030	132(38.6)	<0.001	<0.001
14 year	564(31.8)		145(42.4)		
Type of School					
Public	1284(72.5)	<0.001	225(65.8)	<0.001	0.012
Private	487(27.5)		117(34.2)		
Area					
Urban	1059(59.8)	<0.001	184(53.8)	*	0.039
Semi Urban	712(40.2)		158(46.2)		

* Non significant
**By Chi-square test

Table 16: Frequency of consumption of dairy products containing snacks by gender.

Variables	Total N=2113(%)	Male n=1125(53.2%)	Female n=988(46.8%)	P-value**
Frequency of eating or drinking dairy products containing snacks				
Never	342(16.2)	164(14.6)	178(18.0)	
Occasionally (not every day)	851(40.3)	409(36.4)	442(44.7)	<0.001
Once a day	513(24.3)	313(27.8)	200(20.2)	
More than once a day	407(19.3)	239(21.2)	168(17.0)	

**By Chi-square test

In table 17 and 18, approximately 1,567 (74.2%) drink tea in-between meals, where 436 (20.6%) reported once per day and 364 (17.2%) reported more than once a day. For each socio-demographic variable of consuming tea in between meals, the differences between its categories were significant except age (only those children who drink tea in-between meals).

Overall, there were significant differences between children who consume tea in-between meals and children who do not consume tea in-between meals in all socio-demographic variables except type of school and residential area.

Table 17: Distribution of socio-demographic characteristics by tea consumption.

Variable	Tea consumption				Overall P-Value**
	Yes n=1567(74.2) n (%)	P-value**	No n=546(25.8) n (%)	P-value**	
Ethnicity					
Qatari	1003(64.0)	<0.001	290(53.1)	0.039	<0.001
Non-Qatari	564(36.0)		256(46.9)		
Gender					
Boys	873(55.7)		252(46.2)	0.011	<0.001
Girls	694(44.3)	<0.001	294(53.8)		
Age					
12 year	555(35.4)		143(26.2)		
13 year	517(33.0)	*	189(34.6)	<0.001	<0.001
14 year	495(31.6)		214(39.2)		
Type of School					
Public	1118(71.3)	<0.001	391(71.6)	<0.001	*
Private	449(28.7)		155(28.4)		
Area					
Urban	924(59.0)	<0.001	319(58.4)	<0.001	*
Semi Urban	643(41.0)		227(41.6)		

* Non significant
**By Chi-square test

Table 18: Frequency of tea consumption by gender.

Variables	Total N=2113(%)	Male n=1125(53.2%)	Female n=988(46.8%)	P-Value**
Frequency of drinking tea in-between meals				
Never	546(25.8)	250(22.2)	296(29.9)	
Occasionally (not every day)	767(36.3)	393(34.9)	374(37.8)	<0.001
Once per day	436(20.6)	255(22.6)	181(18.3)	
More than once a day	364(17.2)	227(20.2)	137(14.0)	

**By Chi-square test

Almost 1,692 (80.1%) chewing gum in-between meals (Table 19), where 321 (15.2%) reported once a day and 569 (26.9%) reported more than once a day (Table 20). For each socio-demographic variable of chewing gum in-between meals, the differences between its categories were significant except gender (only those children who chewing gum) and age.

Overall, there were no significant differences between children who chew gum in-between meals and children who do not chew gum in-between meals in all socio-demographic variables except gender and residential area.

Table 19: Distribution of socio-demographic characteristics by chewing gum.

Variable	Chewing gum				Overall P-Value**
	Yes n=1692(80.1) n (%)	P-value**	No n=421(19.9) n (%)	P-value**	
Ethnicity					
Qatari	1034(61.1)	<0.001	259(61.5)	<0.001	*
Non-Qatari	658(38.9)		162(38.5)		
Gender					
Boys	833(49.2)	*	292(69.4)	<0.001	<0.001
Girls	859(50.8)		129(30.6)		
Age					
12 year	560(33.1)		138(32.8)		
13 year	561(33.2)	*	145(34.4)	*	*
14 year	571(33.7)		138(32.8)		
Type of School					
Public	1204(71.2)	<0.001	305(72.4)	<0.001	*
Private	488(28.8)		116(27.6)		
Area					
Urban	954(56.4)	<0.001	289(68.6)	<0.001	<0.001
Semi Urban	738(43.6)		132(31.4)		

* Non significant
**By Chi-square test

Table 20: Frequency of chewing gum by gender.

Variables	Total N=2113(%)	Male n=1125(53.2%)	Female n=988(46.8%)	P-value**
Frequency of chewing gum in-between meals:				
Never	421(20.0)	289(25.7)	132(13.4)	
Occasionally (not every day)	802(37.9)	456(40.5)	346(35.0)	<0.001
Once a day	321(15.2)	190(16.9)	131(13.3)	
More than once a day	569(26.9)	190(16.9)	379(38.4)	

**By Chi-square test

In all, 1,037 (49.1%) of the children reported skipping eating breakfast on a daily basis (Table 21). For each socio-demographic variable of eating breakfast regularly, the differences between its categories were all significant.

Overall, there were significant differences between children eating breakfast regularly and children not eating breakfast regularly in all socio-demographic variables except ethnicity and type of school.

Table 21: Distribution of socio-demographic characteristics by eating breakfast regularly.

Variable	Eating breakfast regularly				Overall P-Value**
	Yes n=1076(50.9) n (%)	P-value**	No n=1037(49.1) n (%)	P-value**	
Ethnicity					
Qatari	640(59.5)	<0.001	653(63.0)	<0.001	*
Non-Qatari	436(40.5)		384(37.0)		
Gender					
Boys	637(59.2)	<0.001	488(47.1)	0.007	<0.001
Girls	439(40.8)		549(52.9)		
Age					
12 year	396(36.8)		302(29.1)		
13 year	361(33.6)	0.002	345(33.3)	<0.001	<0.001
14 year	319(29.6)		390(37.6)		
Type of School					
Public	771(71.7)	<0.001	738(71.2)	<0.001	*
Private	305(28.3)		299(28.8)		
Area					
Urban	671(62.4)	<0.001	572(55.2)	<0.001	0.001
Semi Urban	405(37.6)		465(44.8)		

* Non significant
**By Chi-square test

In table 22, although 480 (22.7%) of the children reported skipping eating lunch regularly, for each socio-demographic variable of eating lunch regularly, the differences between its categories were significant except gender (only those children who not eating lunch regularly) and age.

Overall, there were no significant differences between children eating lunch regularly and children not eating lunch regularly in all socio-demographic variables except ethnicity and residential area.

Table 22: Distribution of socio-demographic characteristics by eating lunch regularly.

Variable	Eating Lunch regularly				Over all P-Value**
	Yes n=1633(77.3) n (%)	P-value**	No n=480(22.7) n (%)	P-value**	
Ethnicity					
Qatari	955(58.5)	<0.001	338(70.4)	<0.001	<0.001
Non-Qatari	678(41.5)		142(29.6)		
Gender					
Boys	886(54.3)	<0.001	239(49.8)	*	*
Girls	747(45.7)		241(50.2)		
Age					
12 year	532(32.6)		166(34.6)		
13 year	557(34.1)	*	149(31.0)	*	*
14 year	544(33.3)		165(34.4)		
Type of School					
Public	1171(71.7)	<0.001	338(70.4)	<0.001	*
Private	462(28.3)		142(29.6)		
Area					
Urban	930(57.0)	<0.001	313(65.2)	<0.001	0.001
Semi Urban	703(43.0)		167(34.8)		

* Non significant
**By Chi-square test

Table 23: Mean caries indices by socio-demographic and other characteristics among school children in Qatar (N=2,113).

	DT Mean(SD)	MT Mean(SD)	FT Mean(SD)	DMFT Mean(SD)	Carries free n=317 (15%)
Age (in years) ***					
12 (n=698)	3.51(3.0)	0.11(0.45)	1.00(1.6)	4.62(3.2)	107(33.8)
13 (n=706)	3.83(3.4)*	0.13(0.47)	0.84(1.47)	4.79(3.5)*	126(39.7)
14 (n=709)	4.25(3.4)*	0.15(0.47)	1.10(1.86)	5.50(3.7)*	84(26.5)
Gender**					
Male (n=1125)	3.80(3.3)	0.11(0.4)	0.83(1.5)	4.74(3.4)	185(58.4)
Female (n=988)	3.94(3.2)	0.15(0.5)	1.14(1.8) §	5.23(3.6)§	132(41.6)
Nationality: **					
Qatari (n=1293)	3.79(3.3)	0.15(0.5)	0.94(1.6)	4.89(3.5)	199(62.8)
Non Qatari (n=820)	3.97(3.2)	0.90(0.3)	1.03(1.6)	5.10(3.5)	118(37.2)
Area**					
Urban	3.79(3.2)	0.12(0.4)	1.00(1.7)	4.91(3.5)	204(64.4)
Semi Urban	3.97(3.3)	0.14(0.4)	0.95(1.5)	5.06(3.4)	113(35.6)
Type of school**					
Public(n=1509)	3.97(3.4)	0.14(0.5)	1.01(1.7)	5.11(3.6)	230(72.6)
Private(n=604)	3.61(2.9) §	0.10(0.3)	0.91(1.5)	4.62(3.08) §	87(27.4)
BMI***					
$<5^{th}$ percentile (n=105)	4.09(3.4)	0.14(0.6)	1.17(1.7)	5.40(3.9)	18(5.7)
5^{th}-85^{th} percentile (n=1691)	3.90(3.3)	0.13(0.4)	0.99(1.7)	4.98(3.5)	244(77.0)
85^{th}-95^{th} percentile (n=212)	3.66(3.3)	0.13(0.4)	0.93(1.6)	4.72(3.5)	39(12.3)
$>95^{th}$ percentile (n=105)	4.10(3.3)	0.08(0.4)	0.64(1.2)	4.85(3.5)	16(5.0)
Frequency of tooth brushing***					
Once a week (n=158)	5.08(4.0)	0.12(0.4)	0.82(1.4)	6.01(3.8)	29(9.1)
Once a day (n=1147)	3.73(3.0)*	0.11(0.4)	0.74(1.5)	4.58(3.2)*	172(54.3)
Twice a day (n=730)	3.85(3.1)*	0.13(0.4)	1.00(1.7)	5.03(3.4)*	105(33.1)
After each meal (n=78)	3.81(3.3)*	0.13(0.5)	0.98(1.6)	4.92(3.5)*	11(3.5)
Oral health knowledge***					
0-7 (poor) (n=235)	4.93(3.4)	0.10(0.3)	0.83(1.6)	5.86(3.5)	35(11)
8-14 (moderate) (n=1332)	3.84(3.3)*	0.14(0.4)	0.93(1.6)	4.91(3.5)*	195(61.5)
15-21 (high) (n=546)	3.45(3.1)*	0.11(0.4)	1.16(1.8)	4.73(3.5)*	87(27.4)
Exposure to passive smoking**					
Yes(n=757)	4.15(3.3)	0.14(0.5)	0.90(1.4)	5.19(3.4)	105(33.1)
No(n=1356)	3.70(3.2) §	0.12(0.4)	1.02(1.7)	4.85(3.5) §	212(66.9)
Daily watching television**					
≤2 hrs(n=1056)	3.16(3.0)	0.10(0.3)	0.72(1.3)	3.98(3.3)	227(71.6)
>2 hrs(n=1057)	4.56(3.3) §	0.16(0.5)	1.24(1.8) §	5.96(3.4) §	90(28.4)
Daily of internet use**					
≤2 hrs(n=1141)	3.10(2.9)	0.10(0.3)	0.81(1.4)	4.01(3.2)	236(74.4)
>2 hrs(n=972)	4.76(3.4) §	0.16(0.5)	1.18(1.8)	6.10(3.5) §	81(25.6)
Sugary snacks 1 hour before bedtime**					
Yes(n=1374)	4.79(3.3)	0.17(0.5)	1.23(1.8)	6.19(3.3)	91(28.7)
No(n=739)	2.14(2.3) §	0.05(0.2) §	0.51(1.1) §	2.70(2.5) §	226(71.3)
Dairy products containing snacks in-between meals**					
Yes(n=1771)	3.63(3.2)	0.12(0.4)	0.97(1.6)	4.71(3.4)	296(93.4)
No(n=342)	5.09(3.4) §	0.20(0.5)	1.01(1.6)	6.30(3.4) §	21(6.6)
Drinking tea in-between meals**					
Yes(n=1567)	3.67(3.1)	0.13(0.4)	0.92(1.5)	4.72(3.4)	255(80.4)
No(n=546)	4.43(3.5) §	0.11(0.4)	1.16(1.8)	5.69(3.7) §	62(19.6)

		DT Mean(SD)	MT Mean(SD)	FT Mean(SD)	DMFT Mean(SD)	Carries free n=317 (15%)
Chewing gum in-between meals**		3.76(3.2)	0.13(0.4)	0.96(1.6)	4.86(3.5)	261(82.3)
Yes(n=1692)		4.26(3.4) §	0.11(0.4)	1.03(1.8)	5.40(3.5) §	56(17.7)
No(n=421)						
Eating breakfast regularly**						
Yes(n=1076)		2.89(2.8)	0.11(0.4)	0.80(1.5)	3.80(3.2)	245(77.3)
No(n=1037)		4.87(3.4) §	0.15(0.5)	1.17(1.7)	6.19(3.4) §	72(22.7)
Eating lunch regularly**						
Yes(n=1633)		3.51(3.0)	0.12(0.4)	0.95(1.6)	4.59(3.3)	274(86.4)
No(n=480)		5.06(3.7) §	0.15(0.5)	1.06(1.7)	6.27(3.6) §	43(13.6)
Teeth irregularity						
	Crowding***					
	0 (n=1181)	3.52(3.1)	0.15(0.5)	0.96(1.6)	4.63(3.4)	189(59.6)
	1 (n=443)	3.67(3.3)	0.09(0.3)	0.94(1.5)	4.69(3.4)	79(24.9)
	2 (n=489)	4.88(3.5)*	0.12(0.4)	1.06(1.7)	6.06(3.6)*	49(15.5)
	Spacing***					
	0 (n=1912)	3.87(3.3)	0.12(0.4)	0.97(1.6)	4.96(3.5)	284(89.6)
	1 (n=125)	4.00(3.1)	0.18(0.5)	1.17(2.0)	5.35(3.6)	16(5.0)
	2 (n=76)	3.57(2.8)	0.16(0.5)	0.82(1.3)	4.55(3.1)	17(5.4)

*p<0.01 vs. group 1; § p<0.01; DT=Decayed Teeth, FT=Filled Teeth, MT=Missing Teeth, DMFT=Decayed, Missing and Filled Teeth
** By student's *t*-test
***By One way ANOVA test

5.6 Prevalence of DC

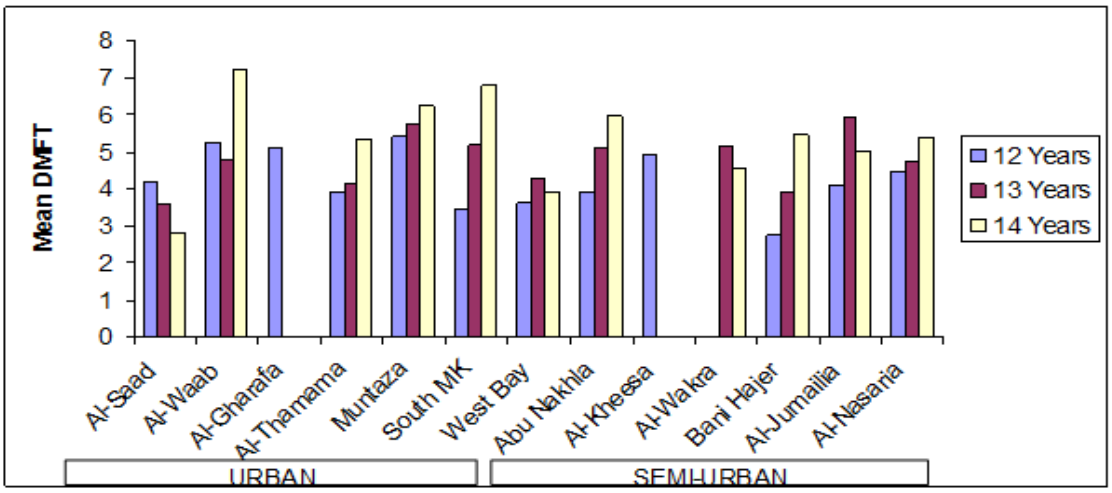
In Table 23, the total school children participating in the study was 2,113, only 317 (15%) were caries free indicating that the caries prevalence in school children in Qatar was 85%. The mean DMFT value for 12 year old children was 4.62 (±3.2), the mean DMFT value for 13 year old children was 4.79 (±3.5), and the mean DMFT value for 14 year old children was 5.5 (±3.7). This indicated that as the age of the children increased from 12 to 14 years old, DC increased.

Analysis of the DMFT showed that the mean DT values were 3.51 (±3.0), 3.83 (±3.4), and 4.25 (±3.4), respectively, for the 12, 13 and 14 years old. The mean MT values were 0.11 (±0.45), 0.13 (±0.47), and 0.15 (±0.47), respectively, for the 12, 13 and 14 years old. The mean FT values were 1.00 (±1.6), 0.84 (±1.47), and 1.10 (±1.86),

respectively, for the 12, 13 and 14 years old. It is obvious that the DT component was the major constituent of the DMFT Index.

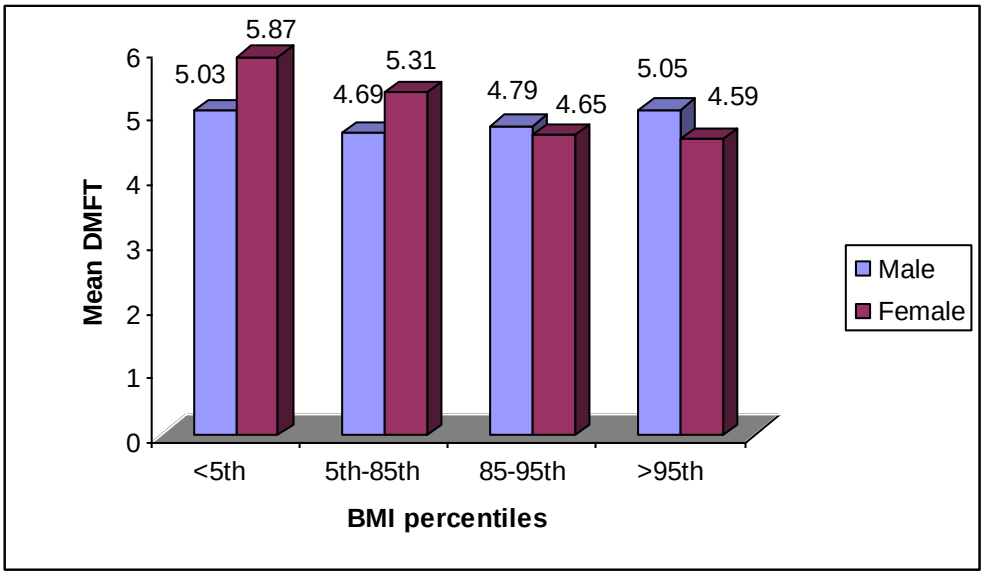
Female children had a higher mean DMFT value 5.23 (±3.6) than male children 4.74 (±3.4). Qatari children had a lower mean DMFT value 4.89 (±3.5) than non-Qatari children 5.10 (±3.5). Children residing in urban areas had a lower mean DMFT value 4.91 (±3.5) than children residing in semi urban areas 5.06 (±3.4) (Figure 10). Private school children were found to have a lower mean DMFT value 4.62 (±3.08) than public school children 5.11 (±3.6).

Figure 10: Distribution of mean DMFT in different areas by age groups.



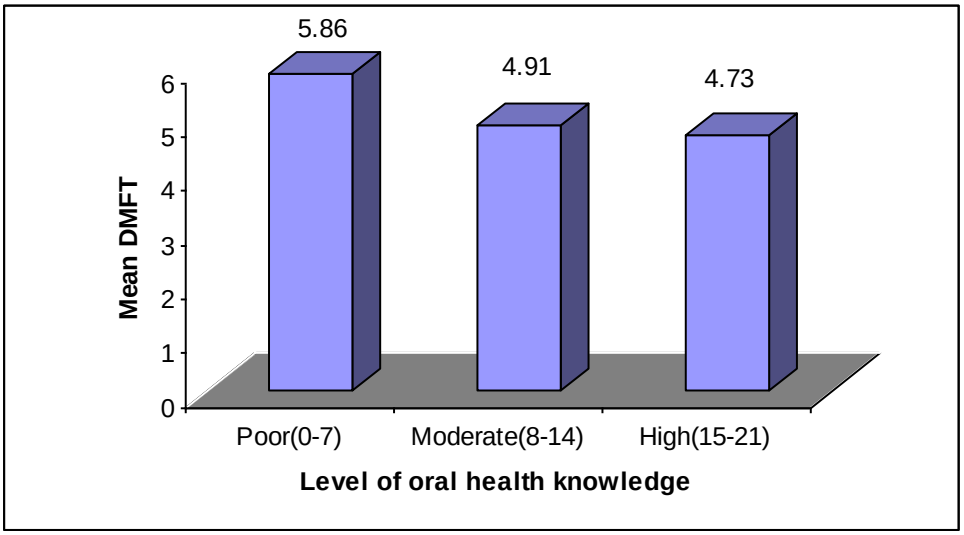
By comparing the mean DMFT values among BMI groups, the results from the study portrayed that there was no sufficient evidence of association between BMI and DMFT (Table 23 and Figure 11).

Figure 11: Bar diagram showing mean DMFT of children by BMI and gender.



Moreover, the children brushing their teeth once a week 6.01 (±3.8) had significantly higher DMFT value than those brushing teeth only once a day 4.58 (3.2 %), twice a day 5.03 (±3.4), or after each meal 4.92 (±3.5) (Table 23). Figure 13 shows that the higher the OH knowledge scores, the lower the mean DMFT value. Additionally, those children with a poor OH knowledge score had significantly higher DMFT (DMFT = 5.86) than those with a moderate (DMFT = 4.91) or high (DMFT = 4.73) OH knowledge scores.

Figure 12: Distribution of DMFT according to level of OH knowledge.



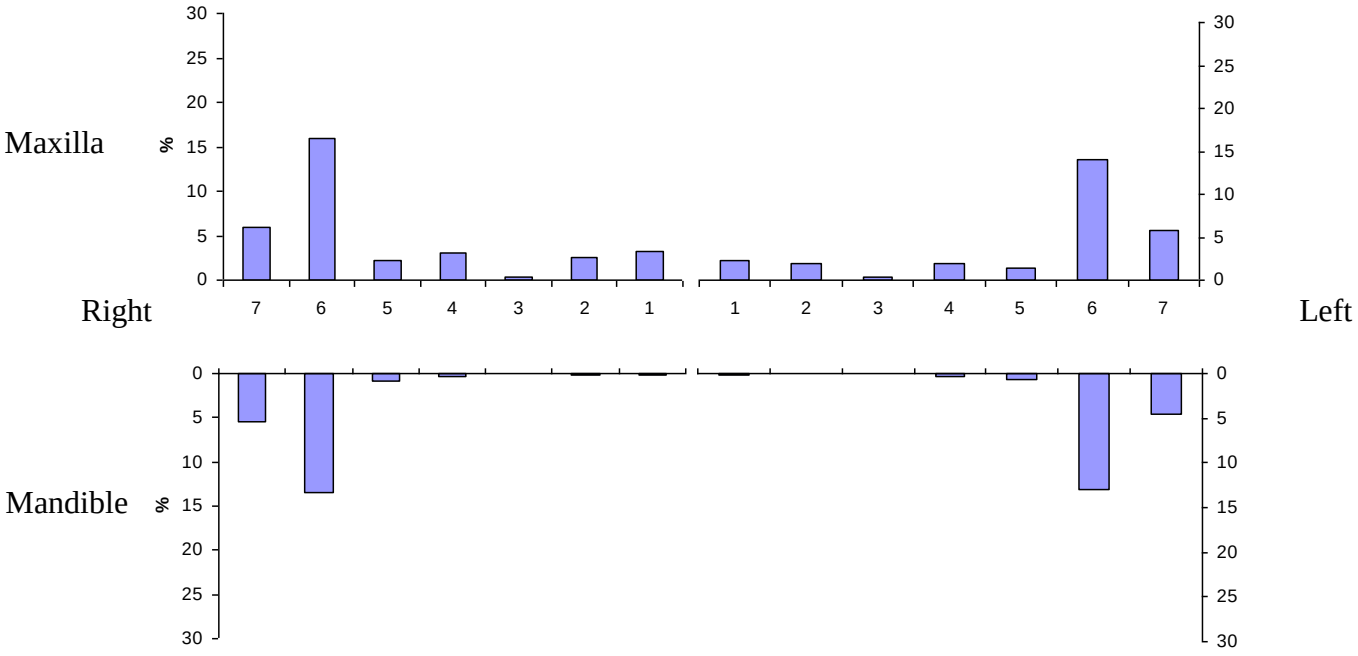
Furthermore, the distribution of decayed teeth by arch and tooth number of these school children is shown in Table 24 and Figure 13. Caries lesion was not evenly distributed among different tooth types. The most commonly affected teeth in the maxilla were the first molars (29.9%), followed by second molars (11.8%), central incisors (5.5%), second premolars (4.9%), lateral incisors (4.5%) and second premolars (3.6%). The most commonly affected teeth in the Mandible were the first molars (26.3%), followed by second molars (10%), second premolars (1.51%), first premolars (0.61%), central incisors (0.26%) and lateral incisors (0.20%). The least affected teeth were Canines in both maxilla (0.77%) and mandible (0.10%).

When comparing the maxillary and mandibular arch, the frequency of caries was more in the maxilla (60.9%) than in the mandible (39.1%).

Table 24: Distribution of decayed teeth (N=5,032) by arch and tooth number.

	Tooth	Decayed teeth		
		Right	Left	Total
Maxilla	1	166 (3.3)	111 (2.2)	277 (5.5)
	2	130 (2.6)	99 (1.9)	229 (4.5)
	3	20 (.39)	19 (.38)	39 (.77)
	4	153 (3)	96 (1.9)	249 (4.9)
	5	110 (2.2)	70 (1.4)	180 (3.6)
	6	802 (15.9)	706 (14)	1508 (29.9)
	7	300 (6)	292 (5.8)	592 (11.8)
	Total			3074 (60.9)
	Tooth	Decayed teeth		
		Right	Left	Total
Mandible	1	7 (.14)	6 (.12)	13 (.26)
	2	6 (.12)	4 (.08)	10 (.20)
	3	3 (.06)	2 (.04)	5 (.10)
	4	16 (.32)	13 (.29)	29 (.61)
	5	40 (.80)	36 (.71)	76 (1.51)
	6	677 (13.4)	648 (12.9)	1325 (26.3)
	7	270 (5.4)	230 (4.6)	500 (10)
	Total			1958 (39.1)

Figure 13: Distribution of decayed teeth (N=5,032) by arch and tooth number.



The distribution of missing teeth by arch and tooth number is shown in Table 25 and Figure 14. The most commonly missing teeth in the maxilla were the first molars (54.7%), followed by second premolars (5.08%), first premolars (3.9%), second molars (1.17%), central incisors (0.78%) and lateral incisors (0.39%). The most commonly missing teeth in the mandible were the first molars (19.5%), followed by second premolars (4.3%), second premolars (6.64%), second molars (2.73%) and central incisors (0.39%).

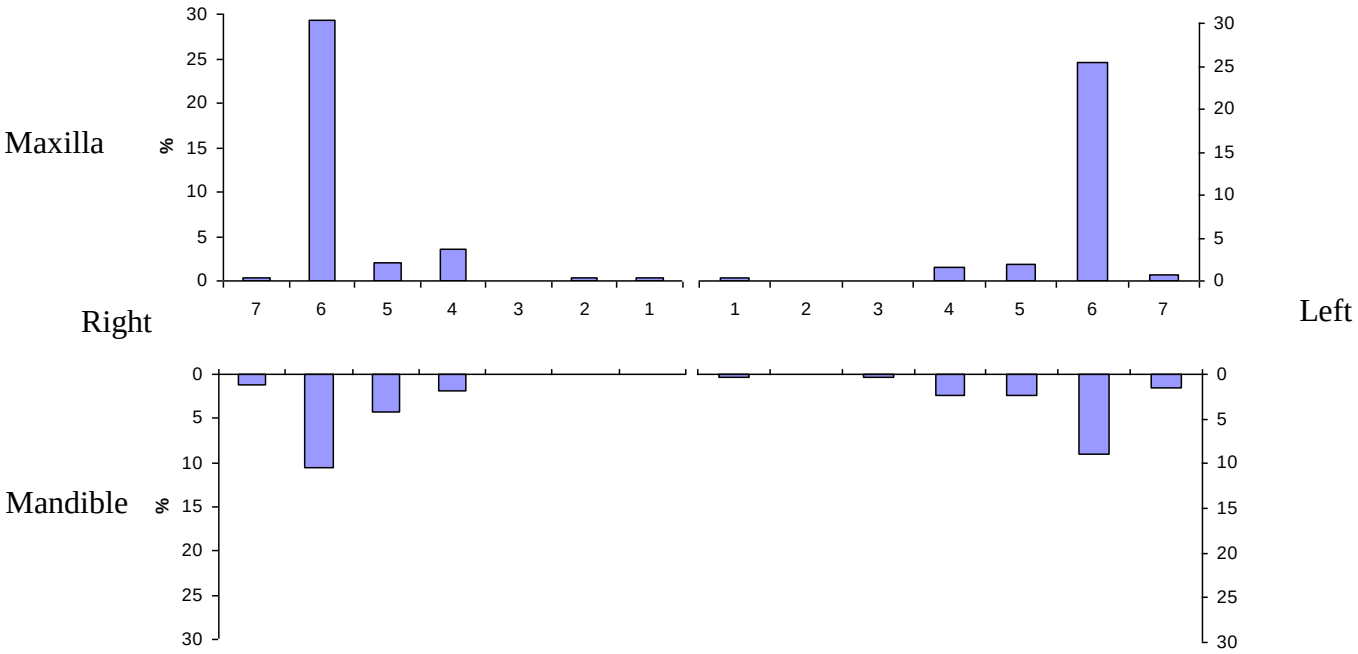
None of the lateral incisors were missing in the mandible. The least affected teeth were canines in both the maxilla and the mandible, where none of the canines were missing in the maxilla and only one tooth in the mandible.

When comparing the maxillary and mandibular arch, the frequency of missing teeth was more in the maxilla (66.1%) than in the mandible (33.9%).

Table 25: Distribution of missing teeth (N=256) by arch and tooth number.

	Tooth	Missing teeth		
		Right	Left	Total
Maxilla	1	1 (.39)	1 (.39)	2 (.78)
	2	1 (.39)	0 (0)	1 (.39)
	3	0 (0)	0 (0)	0 (0)
	4	9 (3.52)	4 (1.56)	13 (5.08)
	5	5 (1.95)	5 (1.95)	10 (3.9)
	6	75 (29.3)	65 (25.4)	140 (54.7)
	7	1 (.39)	2 (.78)	3 (1.17)
	Total			169 (66.1)
	Tooth	Missing teeth		
		Right	Left	Total
Mandible	1	0 (0)	1 (.39)	1 (.39)
	2	0 (0)	0 (0)	0 (0)
	3	0 (0)	1 (039)	1 (.39)
	4	5 (1.95)	6 (2.34)	11 (4.3)
	5	11 (4.30)	6 (2.34)	17 (6.64)
	6	27 (10.5)	23 (9)	50 (19.5)
	7	3 (1.17)	4 (1.56)	7 (2.73)
	Total			87 (33.9)

Figure 14: Distribution of missing teeth (N=256) by arch and tooth number.



The distribution of filled teeth by arch and tooth number is shown in Table 26 and Figure 15. The most commonly filled teeth in the maxilla were the first molars (47.1%), followed by second molars (7.5%), first premolars (2.96%), second premolars (2.70%), central incisors (0.79%), lateral incisors (0.63%) and canines (0.22%).

The most commonly filled teeth in the mandible were the first molars (31.2%), followed by second molars (3.92%), second premolars (1.85%) and first premolars (0.90%). None of the central incisors, lateral incisors and canines was filled in the mandible.

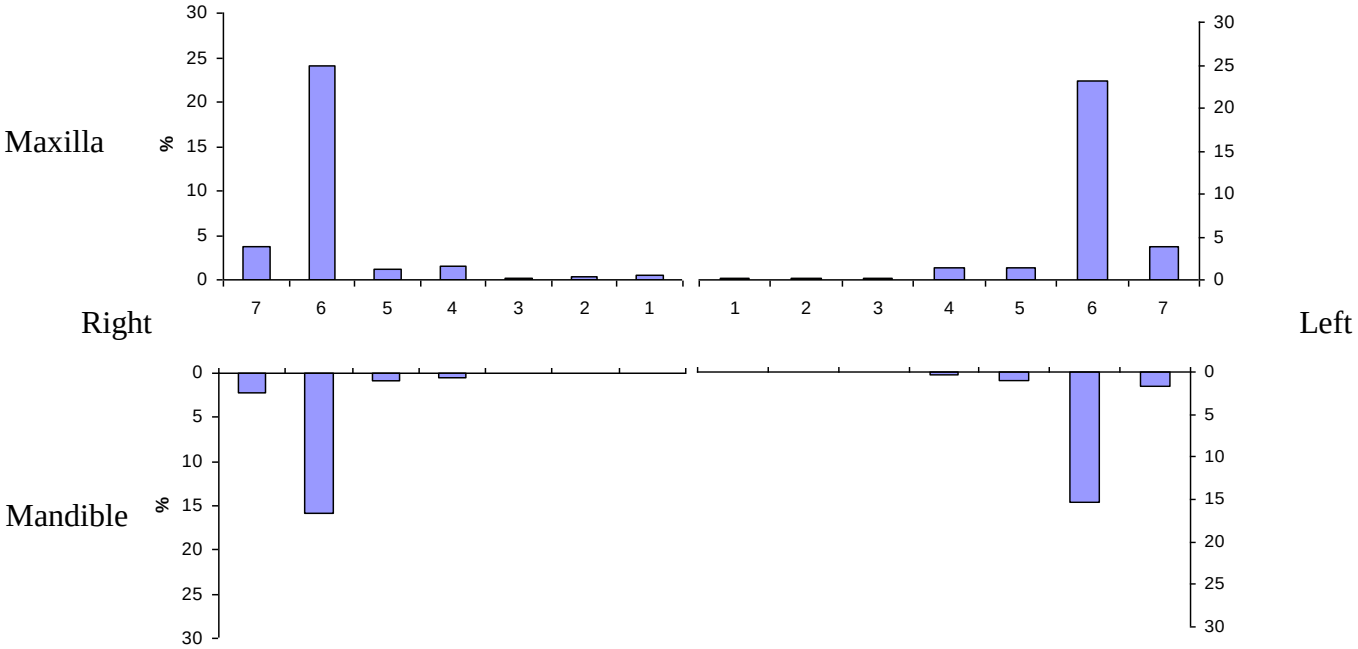
When comparing the maxillary and mandibular arch, the frequency of filled teeth was more in the maxilla (62%) than in the mandible (38%).

Table 26: Distribution of filling teeth (N=1,890) by arch and tooth number.

	Tooth	Filling teeth		
		Right	Left	Total
Maxilla	1	10 (.53)	5 (.26)	15 (.79)
	2	7 (.37)	5 (.26)	12 (.63)
	3	2 (.11)	2 (.11)	4 (.22)
	4	30 (1.58)	26 (1.37)	56 (2.96)
	5	24 (1.27)	27 (1.43)	51 (2.70)
	6	453 (24)	438 (23.1)	891 (47.1)
	7	70 (3.7)	71 (3.8)	141 (7.5)
	Total			1175 (62)

	Tooth	Filling teeth		
		Right	Left	Total
Mandible	1	0 (0)	0 (0)	0 (0)
	2	0 (0)	0 (0)	0 (0)
	3	0 (0)	0 (0)	0 (0)
	4	10 (.53)	7 (.38)	17 (.90)
	5	16 (.85)	19 (1)	35 (1.85)
	6	298 (15.8)	291 (15.4)	589 (31.2)
	7	41 (2.17)	33 (1.75)	74 (3.92)
	Total			715 (38)

Figure 15: Distribution of filling teeth (N=1,890) by arch and tooth number.



5.7 Prevalence of BMI

As shown in Table 27 and Figure 16, the prevalence of underweight, normal weight, overweight, and obesity was 5.0%, 80.0%, 10.0%, and 5.0% respectively. For each socio-demographic variable of BMI, the differences between its categories were not significant except ethnicity (only those children with normal weight, overweight and obese) and age (only those children with underweight and overweight).

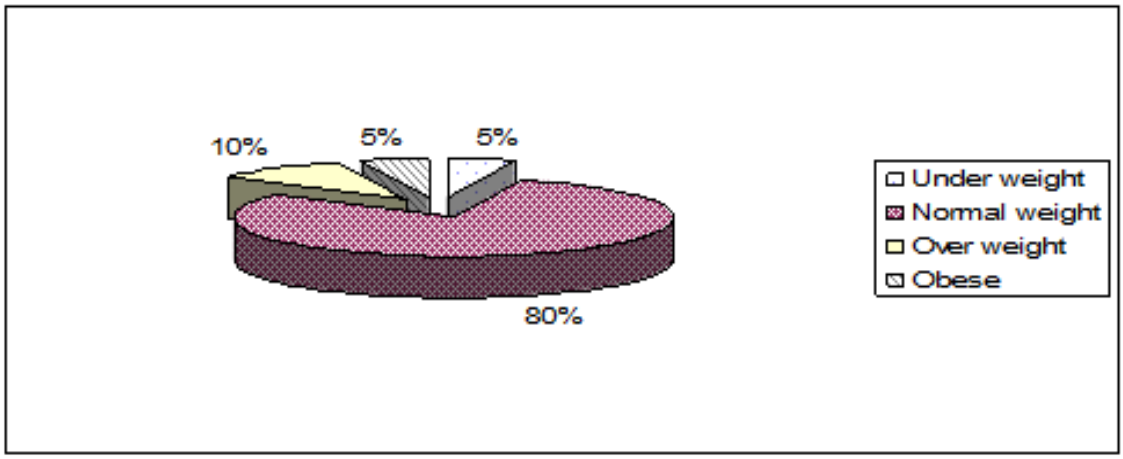
Overall, there were no significant differences between children who were underweight, normal weight, overweight, and obese in all socio-demographic variables except ethnicity and age.

Table 27: Distribution of socio-demographic characteristics by BMI.

Variable	Body Mass Index								Overall P-Value**
	<5th percentile (underweight) n=105(5.0) n (%)	P-Value**	5th-85th percentile (normal) n=1691(80.0) n (%)	P-Value**	85th-95th percentile (overweight) n=212(10.0) n (%)	P-Value**	>95th percentile (obese) n=105(5.0) n (%)	P-Value**	
Ethnicity									
Qatari	61(58.1)	*	992(58.7)	<0.001	155(73.1)	<0.001	85(81.0)	<0.001	<0.001
Non-Qatari	44(41.9)		699(41.3)		57(26.9)		20(19.0)		
Gender									
Boys	59(56.2)	*	895(52.9)	*	112(52.8)	*	59(56.2)	*	*
Girls	46(43.8)		796(47.1)		100(47.2)		46(43.8)		
Age									
12 year	40(38.1)		565(33.4)		60(28.3)		33(31.4)		
13 year	41(39.0)	0.059	572(33.8)	*	62(29.2)	0.015	31(29.5)	*	0.021
14 year	24(22.9)		554(32.8)		90(42.5)		41(39.0)		
Type of School									
Public	83(79.0)	*	1213(71.7)	*	146(68.9)	*	67(63.8)	*	*
Private	22(21.0)		478(28.3)		66(31.1)		38(36.2)		
Area									
Urban	69(65.7)	*	1004(59.4)	*	114(53.8)	*	56(53.3)	*	*
Semi- Urban	36(34.3)		687(40.6)		98(46.2)		49(46.7)		

* Non significant
**By Chi-square test

Figure 16: Pie diagram showing the percentage distribution of children based on BMI percentile.



5.8 Correlation between DMFT and independent variables

Correlation between DMFT and independent variables such as level of OH knowledge, teeth irregularity (crowding and spacing), and life style variables (e.g. watching TV, using the internet daily for more than 2 hours, passive smoking, and dietary habits) among 12-14 year old school children in Qatar were calculated using Kendall's tau-b for ordinal scale variables and Cramer's V for nominal scale variables (Table 28).

All independent variables had highly significant correlation with DMFT except consumption of sugar containing snacks in-between meals (P = 0.499), and the frequency of chewing gum in-between meals (P = 0.438).

The level of OH knowledge was found to be negatively correlated (r = -0.077) with the DMFT. Watching TV and using the internet for > 2 hours was positively correlated (r = 0.279 and 0.296) to DMFT. Also, exposure to passive smoking was found to be positively correlated (r = 0.095) with the DMFT. As if for the children exposed to the smoke environment the DMFT mean value increased (Table 23). The

study supports the hypothesis that children who miss or skipped main meals, such as breakfast or lunch on a regular basis, consumed more snacks in-between meals are, therefore, exposed to more carbohydrates and get more DT. However, eating breakfast and lunch regularly was found to be negatively correlated (r = -0.217 and -0.374) with the DMFT.

Furthermore, the consumption of sugar containing snacks within one hour before bed time and its frequency both were positively correlated (r = 0.448 and 0.392) to DMFT. The findings of the study support the concept that children with low incidence of DT consumed more dairy products containing snacks in-between meals; drank more tea; and chewed gum more than those with high DT incidence (Table 24). Moreover, consumption of diary product containing snacks and its frequency, drinking tea, chewing gum and its frequency were found to be negatively correlated (r = -0.151, -0.082, -0.103, -0.056, -0.056, and -0.013) with the DMFT (Table 29).

Finally, a statistically significant correlation ($P < 0.001$) was observed between the presence of crowding and spacing and DMFT value. However, the correlation between presence of crowding and DMFT was found to be positively correlated (r = 0.116), while the correlation between presence of spacing and DMFT was found to be negatively correlated (r = -0.202).

Table 28: Bivariate correlation coefficients between DMFT and independent variables.

Variables	Correlation Coefficient (r)	P-value
Level of oral health knowledge*	-0.077	<0.001
Watching television daily for more than 2 hours**	0.279	<0.001
Using internet daily for more than 2 hours**	0.296	<0.001
Passive smoking**	0.095	0.011
Eating lunch regularly**	-0.217	<0.001
Eating breakfast regularly**	-0.374	<0.001
Consumption of sugar containing snacks between meals**	0.064	0.499
Frequency of sugar containing snacks per day? *	0.072	<0.001
Consumption of sugar containing snacks within one hour before bedtime**	0.448	<0.001
Frequency of sugar containing snacks within one hour before bedtime? *	0.392	<0.001
Consumption of dairy product containing snacks in between meals**	-0.151	<0.001
Frequency of dairy product containing snacks? *	-0.082	<0.001
Drinking tea in between meals**	-0.103	<0.001
Frequency of drinking tea? *	-0.056	0.001
Chewing gum in between meals**	-0.056	0.003
Frequency of chewing gum in between meals? *	-0.013	0.438
Teeth irregularity (crowding) **	0.116	<0.001
Teeth irregularity (Spacing) **	-0.202	<0.001

*By Kendall's tau-b test (ordinal scale variable)
**By Cramer's V test (nominal scale variable)

5.9 Univariable logistic regression analysis of predictors for DC among children in Qatar

Differences in continuous variables between two groups were measured through student t-test and among more than two groups were measured through one way ANOVA. DMFT Index score was categorized binary into children with and without caries. Assumptions for logistic regression were assessed by identifying the multicollinearity between all exposure variables. Univariable logistic regression was employed to identify association between different exposure variables and DC (Table 29).

Table 29: Univariable logistic regression analysis of predictors for DC among children in Qatar (N=2,113).

Variables	Crude OR (95% CI)*	P-value**
Gender		
Male	1	0.048
Female	1.23(1.10-1.63)	
Residential area		
Urban	1	0.030
Semi-urban	1.32(1.03-1.69)	
Teeth crowding		
None	1	
One segment	1.10(0.67-1.17)	0.002
Two segment	1.71(1.23-2.39)	
Teeth spacing		
None	1.65(0.95-2.87)	
One segment	1.96(0.92-4.17)	0.159
Two segment	1	
Number of hours watching TV		
≤2 hrs	1	<0.001
>2 hrs	2.94(2.27-3.82)	
Number of hours using internet		
≤2 hrs	1	<0.001
>2 hrs	2.87(2.19-3.75)	
Sugary snacks 1 hour before bedtime		
No	1	
Yes	6.21(4.77-8.09)	<0.001
Frequency of sugary snacks within 1 hr before bedtime		
Never	1	
Occasionally	5.79(4.30-7.79)	
Once a day	6.52(3.84-11.07)	<0.001
More than once a day	8.31(4.44-15.56)	
Dairy products containing snacks in-between meals		
Yes	1	
No	3.07(1.94-4.85)	<0.001
Frequency of eating dairy products containing snacks		
Never	2.61(1.63-4.19)	
Occasionally	1.01(0.73-1.36)	<0.001
Once a day	1.41(0.98-2.07)	
More than once a day	1	
Drinking tea in-between meals		
Yes	1	0.006
No	1.52(1.13-2.04)	
Frequency of drinking tea in between meals		
Never	1.46(1.10-2.15)	
Occasionally	1.10(0.65-1.28)	0.041
Once a day	0.99(0.68-1.45)	
More than once a day	1	
Eating breakfast regularly		
Yes	1	<0.001
No	3.95(2.99-5.22)	
Eating lunch regularly		
Yes	1	<0.001
No	2.05(1.46-2.88)	
Oral health knowledge		
0-7 (poor)	2.33(1.39-3.92)	
8-14 (moderate)	1.13(0.86-1.48)	0.006
15-21 (high)	1	

*Outcome variable (1=caries, 0=caries free). Odds ratios based on univariable logistic regression analysis, **two sided P values based on -2log likelihood ratio

Female children were found to be more at risk to DC than male children and the difference was marginally significant (P = 0.048). Children resident in semi-urban areas were found to be more at risk to DC than children resident in urban areas and the difference was statistically significant (P = 0.030). Children with teeth crowding were found to be more at risk to DC than children with regular teeth and the difference was statistically highly significant (P = 0.002). On the other hand, children with spacing between teeth were found to be less at risk to DC than children without spacing between teeth and the difference was statistically insignificant (P = 0.159).

Children watching TV or using the internet > 2 hours on a daily basis were more at risk to DC and the difference was statistically highly significant (P < 0.001). Both the children consuming sugar containing snacks within one hour of bed time, and the frequency of sugary snacks consumed within one hour of bed time were more at risk to DC than children who do not consumed sugary snacks within one hour before bedtime and the difference was highly significant (P < 0.001).

Overall, children consuming dairy products containing snacks and drinking sugar-free tea in-between meals were less at risk to DC and the difference was statistically highly significant (P < 0.001 and 0.006). Moreover, children who reported drinking tea more than once a day were found to be less at risk to DC than children who never, occasionally, or once a day drink tea. Also, children missing or skipping eating breakfast or lunch regularly were more at risk to DC and the difference was statistically highly significant (P < 0.001). Furthermore, children with high OH knowledge were less at risk to DC than children with poor OH knowledge and the difference was highly significant (P = 0.006).

5.10 Multivariable logistic regression analysis of predictors for DC among children in Qatar

In Table 30, variables significant at 10% level of significance at the univariable level were carried forward into multivariable logistic regression analysis through best subset method. Variables having P values < 5% levels of significance in the multivariable logistic regression model were considered significant. Adjusted odds ratios with 95% confidence intervals were calculated for all the significant variables in the final model. Model adequacy was assessed through the Hosmer and Lemeshow goodness of fit test. P-value for the test was > 0.05 suggesting that the model was a good fit to the data.

Table 30: Multivariable logistic regression analysis of predictors for DC among children in Qatar (N=2,113).

Variables	Adj. OR (95% CI)*	P-value**
Residential area:		
Urban	1	0.006
Semi-urban	1.48(1.12-1.96)	
Number of hours watching Television:		
≤2 hrs	1	0.048
>2 hrs	1.37(1.03-1.87)	
Sugar containing snacks 1 hour before bed time:		
No	1	<0.001
Yes	4.32(3.20-5.86)	
Dairy products containing snacks in-between meals:		
Yes	1	0.018
No	1.79(1.10-2.91)	
Eating breakfast regularly:		
Yes	1	0.001
No	1.77(1.28-2.44)	

*Model adjusted for age, Outcome variable (1=caries, 0=caries free). Adjusted odds ratios based on multivariable logistic regression analysis (Adjusted OR, By Hosmer and Lemeshow goodness of fit test)

**2 sided p values based on -2 log likelihood ratio

Overall, only five variables remained in the final multivariable logistic regression analysis for DC among children in Qatar. Children resident in semi-urban areas were found to be more at risk to DC than children resident in urban areas and the difference was statistically highly significant (P = 0.006). Children watching television > 2 hours daily were more at risk to DC and the difference was statistically marginally significant (P = 0.048). Children consuming sugar containing snacks within one hour of bed time were more at risk to DC than children who do not and the difference was statistically highly significant (P < 0.001).

Furthermore, children consuming dairy products containing snacks in-between meals were less at risk to DC and the difference was statistically significant (P = 0.018). Finally, children missing or skipping eating breakfast regularly were more at risk to DC than children who eat breakfast regularly and the difference was statistically highly significant (P = 0.001).

6. DISCUSSION

This study presented a comprehensive overview and information about the DC, level of OH knowledge, teeth irregularity, BMI, and other life style variables (TV viewing, internet use, passive smoking and dietary habits) among 12-14 year old school children in Qatar. To the best of our knowledge, this study represents the first study of its kind that explored these issues among school children in Qatar.

The following section deals with important methodological issues and the findings of the study are described and discussed in detail. This section ends with the future implications, conclusion and recommendations, which are useful for the planning and designing of preventive OH services in Qatar.

6.1 Design and methodological issues

In this study, sample calculation and sampling procedures were optimized to ensure that the results of this study could be generalized to all 12-14 year old school children in Qatar, thus minimizing selection bias.

Effect on non-response error: Adequacy of response rates may be rated as good (more than 80%), acceptable (70-79%), suspect (55-69%), and unacceptable (less than 55%) (Locker, 2000). The response rate in this study was good (96%), giving further strength to the validity of the study.

The present study was conducted in school, because it is considered as one of the best places for OH promotion, where all children irrespective of their socioeconomic status or ethnicity, can be reached (WHO, 1996). Furthermore, schools are microcosms of the larger community, and provide excellent opportunities for integrating OH into the curriculum that is acceptable, appropriate and effective (U.S Department of Health and Human Services; Healthy People 2010, 2000).

It is important to target school children as they represent the future leaders of their countries. If they can be influenced to adopt healthier lifestyles, they might function as multipliers to their families and surrounding communities. School children also are empowered to take control over their own health early in their lives and are encouraged to develop positive attitudes toward preventive measures. This is particularly crucial when they grow up were they are challenged and exposed to risk factors such as tobacco and alcohol use and poor dietary practices. They become more mobile and travel independently, and engage more in high-risk activities, subjecting themselves to infections that predispose to general and OH problems (WHO, 2003).

The 12-14 year old school children were selected in this study because: (1) it is likely at these ages that all permanent teeth, except third molars, will have erupted; (2) these age groups are considered as the global monitoring age for caries for international comparisons and monitoring of disease trends (Aggeryd, 1983; WHO, 1997); (3) children who are below 12 years are too young to understand and complete questionnaires by themselves; and (4) in addition, sedentary life style, such as frequent consumption of sweets, sugary foods and drinks, which have been identified by several researchers (Petersen *et al*., 2001; Zhu *et al*., 2003) as predisposing factors to DC, are more prominent among these age groups.

In this study the DMFT Index using the WHO diagnostic criteria to identify DC has been used. The WHO criteria, however, grouped different stages of the DC process into one code (decayed), without differentiating the various stages of DC (initial and advanced lesion, non-cavitated and cavitated lesions), which may subsequently under- or over-estimate DC experience and its severity (Pine and Harris, 2007). While some other studies used different diagnostic criteria to identify DC, such as the International Caries Diagnosis and Assessment System (ICDAS), that feasible to differentiate

between various stages of DC (initial and advanced lesions, non-cavitated and cavitated lesions) (Braga *et al*., 2009). The DMFT Index using the WHO diagnostic criteria to identify DC has been used in this study for a couple of reasons:

First: the majority of the studies followed the WHO criteria for diagnosing DC, hence allowing more comparisons between different populations.

Second: although including initial lesions (non-cavitated lesions) in epidemiological surveys may help in early detection of caries, the WHO identifies DC by excluding initial lesions from the diagnostic criteria due to concerns over reliability and increases the examiner variability (Kidd *et al*., 2003), thus making data unreliable. Some researchers have raised doubts regarding the reliability of including initial lesions (non-cavitated lesions) in determining caries prevalence (Kidd *et al*., 2003).

There are a variety of approaches to surveying individuals, each with their particular strengths and weaknesses. The most common approaches include paper and pencil questionnaires in administration room, electronic by distribution of questionnaires via fax or internet, questionnaires delivered by mail, face-to-face interviews, and telephone interviews. The mode of survey administration can have serious effects on the accuracy and quality of the data obtained (Bowling, 2005). Electronic methods restrict the survey to individuals who have access to fax or computer, familiarity with keyboards, do not provide an opportunity for individuals to clarify and understand questions, and also do not provide an opportunity for examiner to ensure that the individuals answer all questions on the form. Moreover, incompatibilities in software or hardware may hinder or prevent a response. When questionnaires delivered by mail, the amount of time needed to distribute and receive answers can be wasted. Also, mailed questionnaires restrict the survey to individuals who can be reached by

mail. In personal face-to-face interviews, the participants may not be willing to express their views especially with sensitive questions. Also, face-to-face interviews may create the potential for interviewer to intentionally or unintentionally influence the answers. Telephone methods require access to, or ownership of a telephone and no control for the environment (presence of outsiders affecting responses). Overall, within all previously mentioned modes of administration, there are many potential influences on responses. Thus, for all previous reasons, the paper and pencil self-administrated survey questionnaire in classroom has been used for collecting the data to overcome all disadvantages of the other methods, and also as it is cost effective.

The approach taken in this research was quantitative, utilizing close-ended questions format in a structured paper and pencil self-administrated survey questionnaire. Prior to the questionnaires administration the questions were pre-tested among group of children (thirty children) in order to assess reliability and validity. Two quite different reasons for using close-ended as opposed to open-ended questions have been distinguished in the literatures (Schuman and Presser, 1979). First, close-ended questions are more easily analyzed (every answer given a number so that a statistical interpretation more easily assessed). Second, close-ended questions take less time for the researcher to evaluate it. On the other hand, open-ended questions allow respondents to use their own words (use widely divergent terminology), which is difficult to compare the meaning of the response. Also, use open-ended questions may have illegible writing which is technically challenging and time consuming.

There are many measures that can be employed to record obesity levels. Among those commonly used are the Body Mass Index (BMI), skin fold thickness, and waist circumference. BMI, one of the most commonly used, refers to a number calculated from an individual's weight and height. Although it does not measure body fat

directly, it can be reliably used to categorize individuals according to their weight status. The International Obesity Task Force (IOTF) recommends the use of BMI percentiles based on the studies conducted on children aged 2-18 years from different parts in the world (Cole *et al*., 2000). However, there has not been a universally standardized BMI estimate that can be used on different populations reliably, as the BMI by the WHO can lead to under-or over-estimation of obesity levels.

The literature documents different ways of measuring the extent of smoke exposure in non-smokers. One way is to measure the nicotine and cotinine levels in blood, urine and saliva (National Research Council, 1986). Another way is by using a survey questionnaire (Ayo-Yusuf *et al*., 2007; Tanaka *et al*., 2010). It is obvious that measuring nicotine and cotinine levels in blood is more objective than surveys, but there are some disadvantages. Because of the invasiveness of this method and because body-fluid samples may need to be collected, many school children and their parents may refuse to participate. Furthermore, there is marked variability among the different laboratories in their ability to detect these body-fluid samples. Finally, this method is more expensive, which may limit the sample size (Kum-Nji *et al*., 2006). For simplicity, most of the researches conducted in this area rely on surveys to evaluate passive smoking effects on children (U.S Department of Health and Human Services; Children and secondhand smoke exposure, 2007). Surveys have the advantage of being less invasive, easily used in large-scale epidemiologic studies, and less expensive. So, the survey method has been selected in this study.

Both, the American Academy of Pediatrics, (2001) and the Canadian Paediatric Society, (2003) recommend that screen time (TV viewing and internet use) in children be limited to $\leq$ 2 hours per day. Accordingly, in this study TV viewing and internet

use ≤ 2 hours per day has been used as a guide to detect wither the children spent too much time on TV and the internet or not.

Moreover, the clinical registration of crowding and spacing of the dentition in this study were determined according to the criteria described by Björk *et al*., (1964). The Björk method has been frequently used in many studies (Ng'ang'a *et al*., 1996; Rwakatema *et al*., 2006), hence enables comparability of the presence of crowding and spacing findings among similar studies.

6.2 Dental caries

Although there is a plethora of published studies of DC experience among different age groups in different regions around the world, there is no data on DC experience in the literature with regard to Qatar. Hence, the present study was the first attempt in Qatar to assess the prevalence of DC. The study showed that data on DC among 12-14 year old school children in Qatar raises great concern as the prevalence of DC in the study sample was 85%. Only 15% of the examined children were caries-free. This high caries prevalence of 85% if it remains unattended and untreated, will result in the severity of the disease increasing in the future. The data reflects on poor oral hygiene and low awareness about OH. Additionally, the current estimates indicate that the WHO 2000 goals are still unmet for children in Qatar (WHO, 2000).

Moreover, mean DMFT was 4.62 (±3.2), 4.79 (±3.5), and 5.50 (±3.7), respectively, for the ages 12, 13 and 14 years old. These DMFT means fall within the "high" category (DMFT 4.5-6.5) as defined by the WHO (2000), and are greater than the global goal of three or less decayed, missing or filled teeth for the year 2000 (WHO, 2000). Interestingly, this study found that as the age of the children increased from 12 to 14 years old, more and more teeth become carious, thus, the prevalence of DC

increased. This is in agreement with other researchers (Wyne, 2004; Yabao *et al*., 2005; Shingare *et al*., 2012). This could be due to the poor awareness about OH and neglect of dental treatment needs. Therefore, a strict preventive program has to be implemented in school children including fluoride supplements, topical fluoride and fluoride varnish applications, dietary counseling, meticulous oral hygiene maintenance, fissure sealants applications, and regular dental checkups.

In addition, the present study, which was the first of its kind in Qatar, showed a higher caries prevalence and DMFT mean when compared to studies from other countries (Table 31). Comparing the findings with data from a range of other Eastern Mediterranean region countries, the mean DMFT value for 12-14 year old school children in Qatar obtained in this study was among the second highest in the Eastern Mediterranean region countries, it is only exceeded by Saudi Arabia in which DMFT value was 5.94 (Al-Sadhan, 2006).

Furthermore, The DMFT score for the 12 year olds in the study 4.79 (±3.2) was higher than reports from other regions of the world such as Nepal (1.6), India (.86), Malaysia (.58), Philippines (2.4), Mexico (3.1), Brazil (2.9), Peru (3.9), Puerto Rico (3.8), Albania (3.8), and Italy (1.9) (Table 31). However, comparisons of the present findings with those of other studies must be cautiously undertaken because of different sample sizes and varying age ranges of the participating children.

Table 31: Selected research studies on caries prevalence and DMFT for different countries.

Area	Author/Year	Country	Sample size	Age	% of caries	DMFT
Eastern Mediterranean region countries	El-Nadeef *et al*., 2009	United Arab Emirates	1323 1328	12 15	54% 65%	1.6 2.5
	Al-Mutawa *et al*., 2006	Kuwait		12 14	26.4% 21.7%	2.6 3.4
	Al-Sadhan, 2006	Saudi Arabia	205	12-14	93.7%	5.94
	Ahmed *et al*., 2007	Iraq	392	12	62%	1.7
	Pakpour *et al*., 2011	Iran	380	12-16	20%	2.62
	Nurelhuda *et al*., 2009	Sudan	1109	12	30.5%	.42
Other countries from different regions of the world	Subedi *et al*., 2011	Nepal	325	12-13	53.2%	1.6
	Grewal *et al*., 2011	India	520	9-12	52.3%	.86
	Masood *et al*., 2012	Malaysia	1830		70.5%	.58
	Yabao *et al*., 2005	Philippines	1200	6-12	68.2%	2.4
	Casanova-Rosado *et al*., 2005	Mexico	1640	12	49.4%	3.11
	Jamelli *et al*., 2010	Brazil	689	12	71.8%	2.9
	Delgado-Angulo *et al*., 2009	Peru	90	12	83.3%	3.93
	Elias-Boneta *et al*., 2003	Puerto Rico	1435	12	81%	3.8
	Hysi *et al*., 2010	Albania	372	12	85.5%	3.8
	Milciuviene *et al*., 2009	Lithuania	5910	12 15	85.5% 92.9%	3.7 5.6
	Pieper and Schulte, 2004	Germany		12	45.7%	1.24
	Campus *et al*., 2008	Italy	1333	13-18	59.1%	1.94

The decay component (DT) was the major contributor in the DMFT value in this study. This is consistent with the results of other studies conducted on similar age groups in Saudi Arabia and Sudan (Al-Sadhan *et al*., 2006; Nurelhuda *et al*., 2009). This is interpreted to mean that there is an immediate need for providing restorative dental services to these age groups.

As regard to gender, in this study, female children had a higher mean DMFT value 5.23 (±3.6) than male children 4.74 (±3.4). Female children were found to be more at risk to DC than male children and the difference was marginally significant (P value 0.048). Similar findings have been reported among both Egyptian school children (Abdulaziz *et al*., 1999) and Indian school children (Shingare *et al*., 2012). This could be due to dietary habits and frequent snacking of female children during food

preparation. The observation of higher caries risk among females could be also related to fluctuating hormonal levels during puberty (Lukacs and Largaespada, 2006). However, this is opposite to the findings obtained among Saudi Arabian children where male children had higher mean DMFT value than female children (Al-Sadhan *et al*., 2006). Moreover, a technical report by FDI, (International Dental Federation, 1988) attributed the higher prevalence of caries in girls to their earlier eruption of permanent teeth that were exposed for longer periods of time to the risk of decay.

In relation to residential area, children residing in urban areas had a lower mean DMFT value 4.91 (±3.5) than children residing in semi urban areas 5.06 (±3.4). Children resident in semi-urban areas were found to be more at risk to DC than children resident in urban areas and the difference was statistically significant in both univariable (P value=0.030) and multivariable (P value=0.006) logistic regression analysis. This might be due to the fact that the distribution of dental services clinics in semi urban areas is less than in urban areas in Qatar. Also this might be due to the differences in the eating habits and ways of living between the two groups. In addition, school children residing at semi-urban areas have more access to and consume more sweetened snacks and drinks than school children residing in urban areas. However, this is opposite to the findings reported by other research (Mafuvadze *et al*., 2013) among 12 year old children in Zimbabwe. This might be a direct reflection of different socio-economic situation in both Qatar and Zimbabwe.

In Qatar, children from higher socioeconomic backgrounds generally were enrolled in private school as opposed to children from lower socioeconomic backgrounds who attended mainly public schools. Thus, type of school was used in this research to cover all children from different socioeconomic backgrounds. The results of the study showed that private school children had lower mean DMFT value 4.62 (±3.08) than

public school children 5.11 (±3.6). This is consistent with the findings reported by other research (Piovesan *et al*., 2011). It could be due to that children from private school were from a higher socioeconomic level, which might have given them a higher opportunity to access dental care clinics.

No difference were found between the mean DMFT values of Qatari and non-Qatari children 4.89 (±3.5) and 5.10 (±3.5), respectively, indicating that there were no differences in the ways of living.

The results of the present research found a marked variation in caries distribution by tooth number and arch (Table 25 and Figure 14). The mandibular incisors and canines were least likely to be affected by DC, while maxillary and mandibular molars were the most frequently attacked by DC. Similar findings were reported by Udoye *et al*., (2009) in Nigerian children and El-Nadeef *et al*., (2009) in United Arab Emirates children. This could be due to the anatomical form of molars (deep pits and fissures of occlusal surface and wide proximal surfaces) which probably makes them more retentive to cariogenic food particles and plaque, and difficult to access for effective oral hygiene, therefore more prone to caries attack. While incisors and canines have smooth labial and lingual surfaces that makes them least retentive to cariogenic food particles and plaque.

In this study, DC was more prevalent in the maxillary arch (60.9%) than mandibular arch (39.1%). This is in agreement with the study carried out in Turkey (Demirci *et al*., 2010), and Pakistan (Qazi *et al*., 2011). The lower prevalence of DC in the mandibular arch in the present study may be due to the reason that mandibular teeth are less subjected to dryness due to protective mechanism of saliva.

6.3 OH knowledge

Concerning OH knowledge, not surprisingly, only 546 (25.8%) school children reported a high level (15-21 score) of OH knowledge. These data reflects that there is a growing chasm between the practice of dentistry in Qatar and the OH needs of the nation. This could be due to the lack of an organized and systematic OH education program in the country. Most of the children 1920 (90.9%) had satisfactory understanding of importance of good dental health and information about the functions of teeth. However, a considerable number of children 345 (16.4%) were not aware of all the functions of teeth. Appropriate knowledge about the functions of teeth is likely to enhance dental care among these children.

In this study the OH knowledge levels (poor, moderate, and high) were influenced by socioeconomic factors, notably gender, ethnicity, and type of school. The results are in line with previous reports (Smyth *et al*., 2007; Attaullah *et al*., 2010). These differences in OH knowledge levels could be the result of the different educational level between the children. Different authors have explained effects of inequality of access to oral healthcare services on OH knowledge, if we do take into account the educational and motivational activities of the dentists in healthcare facilities and communities (Redmond *et al*., 1999: Goel *et al*., 2005).

Tooth brushes were the most commonly used oral hygiene aids 588 (27.8%), this is in agreement with findings obtained among children in Saudi Arabia and Kuwait (Al-Sadhan *et al*., 2006; Al-Ansari *et al*., 2006). However, the use of dental floss 942 (44.6%) to clean in-between teeth was still not very popular among school children in Qatar as evident in this study.

Furthermore, nearly 730 (34.5%) of the children brushed their teeth twice daily, and only 78 (3.7%) brushed their teeth after each meal, compared with 60.5% in Saudi Arabia (Wyne *et al*., 2005). Lack of child OH education programs in Qatar might explain these findings. In Norway, Austria, Germany, Denmark, and Sweden, 73% - 83% of the children as young as 11 years old brushed more often than once a day (Kuusela *et al*., 1997). Those who brush their teeth more than once a day by 12 years of age are more likely to continue to do so throughout their teenage years and into adulthood (Koivusilta *et al*., 2003). Appropriate knowledge about the frequency of tooth brushing on a daily basis is likely to enhance dental care among these children.

About 942 (44.6%) of the children recognized dental floss as a cleaning device for between the teeth, which means that the importance of cleaning between teeth was apparently less well understood and school children were unaware that dental floss helps prevent dental diseases. This result indicates that improvement in knowledge toward the use of dental floss is needed and is consistent with other studies (Farsi *et al*., 2004).

In agreement with the reports by the WHO, (1996) and Cheah *et al* (2010), the majority of the children, 687 (32.5%), visited their dentist only when they had dental pain. This attitude could be explained in terms of fear due to previous negative dental visit experience or negligence of parents. Approximately a quarter of the children, 537 (25.4%), had a regular visit every six months. This could be due to the low awareness of importance of routine dental visits for dental check-ups. In the literature, a consensus has not been reached on the optimum periodicity for an oral examination by a dentist, but at least one contact per year is highly recommended (Satcher, 2000).

The children's knowledge about sweets (chocolates/candies) as a cariogenic diet was quite adequate, 2,005 (94.9%). However, only 46 (2.2%) of the children considered sweetened milk as harmful for dental health; requiring appropriate guidance in this area.

It was also seen in this study that less than half of the children, 822 (38.9%), had actually heard about fluoride and only 506 (23.9%) correctly identified that fluoride prevents DC. Similarly, very few children, 66 (3.1%), recognized fluoridated water as the most efficient source of fluoride. These results are similar to studies carried out in other countries such as Saudi Arabia and Canada (Wyne *et al*., 2004; Hamilton and Coulby, 1991), and indicate the need for the educating of children about the benefits of fluoride to teeth. Fluoride, especially when provided consistently in drinking water or dentifrice, helps maintain more resistance to DC that counteracts the effects of acids produced from the bacterial metabolism of dietary carbohydrates (Burt and Pai, 2001).

The children's awareness regarding periodontal health was satisfactory in terms of recognizing signs and symptoms of gum diseases, and identifying the best way of preventing gum diseases. Although, some studies have reported unsatisfactory knowledge of periodontal health among school children (Cheah *et al*., 2010), the results of the present study were in agreement with several previous studies that showed satisfactory knowledge about periodontal health (Woolfolk *et al*., 1989; Oliveria *et al*., 2000; Wyne *et al*., 2004 and 2005).

Only 776 (36.7%) children were able to define plaque, and only 761 (36%) recognized that dental plaque can lead to tooth decay. This finding suggests that awareness regarding the harmful effects of dental plaque should be raised.

6.4 Sources of OH knowledge

The present study found that parents were the most popular, 1,460 (69.1%), source of OH information for children; this is in agreement with the findings of Woolfolk *et al.,* (1989). Followed by dentists, 181 (8.6%), school teachers, 107 (5.1%), and media, 64 (3%). As children spend most of their daily time with their parents, the optimal way to raise children's dental health awareness would be to furnish accurate information to parents. There is a need, therefore, to increase provision of OH information to the parents.

However, in Qatar, unfortunately we should not expect that if we concentrate on parents we will get great results as regards to improvement of OH knowledge in their children; this is because the majority of households in Qatar have six to seven children (Qatar Statistics Authority, 2013), while most Western Europe countries have a relatively large number of households with only one child (Iacovou and Skew, 2010). The household size may play a role as a barrier to enhance OH knowledge, as focusing on one child is different to focusing on six to seven children (Megan, 2002; Owuamanam and Alowolodu, 2010). Hence, new studies should address the effects of household size on OH knowledge program.

6.5 Teeth irregularities

Studying the prevalence of crowding and spacing (malocclusion) and assessment of its treatment needs in a community are important steps in the planning of dental services. A large number of studies on the prevalence of crowding and spacing of teeth in different populations, race and origin have been published (Table 32). Keeping in mind the divergence in prevalence figures may depend on differences

in the registration methods, ethnic, sample size, as well as varying age range among the population examined.

Table 32: Selected research studies on teeth crowding and spacing for different countries.

Author/Year	Country	Sample size	Age	Crowding	Spacing
Al-Balkhi and Zahrani., 1994	Saudi Arabia	641	5-46	49.5%	28.6%
Al-Huwaizi *et al*., 2002	Iraq	6957	13	31.9%	17.5%
Danaei *et al*., 2007	Iran	900	12-15	31.1%	21.3%
Sharma, 2010	Nepal	350	8-36	52.9%	30%
Naveen Kumar *et al*., 2010	India	2010	12-15	37.4%	9.2%
Baskaradoss *et al*., 2013	India	1800	11-15	41.2%	12.4%
Thilander *et al*., 2001	Colombia	4724	5-17	52.1%	25.9%
Mtaya *et al*., 2009	Tanzania	1601	12-14	14.1%	21.9%
Ng'ang'a *et al*., 1996	Kenya	912	13-15	19.0%	14.0%
Sandeep *et al*., 2012	Rwanda	243	10-30	71.2%	9.9%

Similar to the most of other communities, the population studied in this research had more incidences of crowding of teeth, 932 (44.1%), than spacing, 201 (9.5%), thus showing the general trend worldwide that crowding is more prevalent than spacing. The high prevalence of teeth crowding in school children in Qatar 932 (44.1%) could be due to lack of preventive orthodontic therapy in the country. Keeping in mind, many factors such as evolutionary trends, heredity, environmental effects, and tooth size have been implicated as causes of dental crowding and spacing (Moorrees and Reed., 1964; Lundstrom., 1969; Doris *et al*., 1981). Hence, the demand for orthodontic treatment seems to be great in Qatar children.

Moreover, the study found a statistically highly significance correlation between the presence of crowding and spacing and DMFT value (P value < 0.001). Furthermore, children with teeth crowding were found to be more at risk to DC than children with regular teeth and the difference was statistically highly significant (P value 0.002). This finding is consistent with that found in Hungarian and Italian children (Gabris *et al*., 2006; Nobile *et al*., 2007). On the other hand, children with spacing between teeth

were found to be less at risk to DC than children without spacing between teeth and the difference was statistically insignificant (P value 0.159).

In this study boys, 514 (24.3%), had more crowding than girls, 418 (19.8%), and girls, 114 (5.3%), had more spacing than boys, 87 (4.1%). It is well known that there are developmental differences in tooth eruption time between boys and girls, as well as between individual children; some are early and some late. This is also valid for the present sample, as it is of different ages and gender. Due to these great individual variations, it would seem to increase the probability of detecting gender differences in crowding and spacing in the present sample.

Correspondingly, Qatari children had more crowding and spacing, 596 (28.2%), and 114 (5.3%), respectively, than non-Qatari children, 336 (15.9%), and 87 (4.1%), respectively. Several studies have shown variations in spacing and crowding conditions between and within different ethnic groups (Mugonzibwa *et al.*, 2008). These variations could be due to environmental factors and genetic ones.

6.6 BMI

The overall prevalence of underweight, overweight, and obesity in this research was 5%, 10%, and 5% respectively. This contrasts with the reports undertaken by Bener (2006), in different age groups (12-17 year) in Qatar, which found a significantly higher percentage of underweight, overweight, and obesity (7.2%, 23.8% and 6.3% respectively). The reason for the lower prevalence in this research could be that the government of Qatar has given more opportunities for physical activity for school children in recent years.

This research found that a higher prevalence of overweight and obesity status among boys, 112 (52.8%) and 59 (56.2%), respectively, than girls, 100 (47.2%) and 46 (43.8%), respectively. Some countries showed significant gender differences in overweight and obesity prevalence of children. In particular, reports from Lebanon (Sibai *et al*., 2003), Turkey (Oner *et al*., 2004) and Saudi Arabia (El Mouzan *et al*., 2010) showed higher rates among boys than among girls. On the other hand, Bahrain, Egypt and Tunisia demonstrated the opposite trend (Musaiger, 2011). But over weight and obese status was not different by gender in India (Sharma and Hedge, 2009).

The prevalence of overweight and obesity among Qatari children, 155 (73.1%) and 85 (81%), respectively, was higher compared to non-Qatari children, 57 (26.9%) and 20 (19%), respectively, and the difference between the two groups was highly significant. In contrast to many parts of the world, the prevalence of overweight and obesity status in Qatari children is alarming. This increase has been related in part to adopting a sedentary life style, behavioral changes, reduced energy expenditure due to less physical activities, increased dietary intake and easy access to energy-dense meals and fast food.

Table 33, presents selected research studies on overweight and obesity status of different populations. The reasons for the higher prevalence of overweight and obesity could be that these young people are eating more fast food and have little opportunity for physical activity because of the hot climate.

Table 33: Selected research studies on overweight and obesity for different countries.

Author	Country	Sample size	Age	Overweight	Obesity
El Mouzan *et al*., 2010	Saudi Arabia	3625	13-18	26.6%	12.9%
Al-Matroushi, 2005	United Arab Emirates	7814	10-19	21.4%	12.1%
El-Bayoumy *et al*., 2009	Kuwait	2701	10-14	30.7%	14.5%
Musaiger, 2011	Egypt	3009	10-18	13.3%	7.1%
Sibai *et al*., 2003	Lebanon	296	10-19	20.8%	5.3%
Taheri and Kazemi, 2009	Iran	1967	12-14	4.8%	1.5%
Oner *et al*., 2004	Turkey	989	12-17	10.9%	1.8%

In this investigation we found no association between BMI and DC (Table 23). Indeed, the literature does not indicate consistent findings across countries and sometimes within the same country (Table 34). Differences in the age ranges of populations studied, ethnicity, and the number of children examined could explain some of the variations.

Although there was no association between DC and BMI, there is evidence that they do share common factors (Tramini *et al*., 2009). This validates a conjoined prevention approach that tackles both issues, and may prove to be a beneficial and cost-effective strategy to deliver health promotion and education.

Table 34: Selected research studies on the association between BMI and DC for different countries.

Author	Country	Sample size	Age	Conclusion
Moreira *et al*., 2006	Brazil	3330	12-15	No Association between obesity and DC.
Bailleul-Forestier *et al*., 2007	France	82	12-18	Significant association between BMI and DC.
Tramini *et al*., 2009	France	835	12	No association between BMI and DC.
Narksawat *et al*., 2009	Thailand	862	12-14	Higher prevalence of DC in normal and thin than overweight and obese children.
Sharma and Hegde, 2009	India	500	8-12	Higher prevalence of DC in overweight and obese children.
Gokhale *et al*., 2010	India	100	3-14	Higher prevalence of DC in overweight and obese children.

6.7 Life style variables

A number of sedentary life style variables had been studied in this research (passive smoking, TV viewing, internet use and dietary habits).

6.7.1 Passive smoking

Approximately, 757 (35.8%) of the children reported that someone in the house smoked cigarettes. More Qatari children, 470 (62.1%), had been exposed to passive smoking than non-Qatari children, 287 (37.9%). This is probably explained by cultural issues that Qatari parents are more likely to allow other family members or friends to smoke at their homes even when they themselves are non-smokers. Also, unlike adults, children who are exposed to cigarette smoke usually do not complain and when they express their complaints the parents do not pay attention to them or reprimand them.

Additionally, more children in public schools, 530 (70%), had been exposed to passive smoking than children in private schools, 227 (30%), and the difference between the two groups is highly significant (P value < 0.001). Several studies have shown that lower socio-economic status and lower educational level are associated with higher smoke exposure in the household (Jarvis *et al*., 1992; Delpisheh *et al*., 2006; Shiva and Padyab, 2008).

Furthermore, boys had been exposed to passive smoking, 382 (50.5%), more than girls, 375 (49.5%). This could imply that boys are less supervised by parents due to cultural factors and hence could more easily be exposed to passive smoking outside their homes.

Overall, exposure to passive smoking was found in this study to be positively correlated with the DMFT (P value=0.001). As children are exposed to the smoke

environment the DMFT mean value increases. Our results are in agreement with previous studies that found a positive association between passive smoking and DC among Japanese, United States, United Kingdom and South African children (Tanaka *et al*., 2010; Aligne *et al*., 2003; Williams *et al*., 2000; Ayo-Yusuf *et al*., 2007).

A possible explanation for this observation could be related to the fact that smoking habits contributed to low buffering of saliva and reduced amylase secretion, which is a protective factor against DC (Wikner and Soder, 1994; Avsar *et al*., 2009). Another explanation for our observation could be related to that exposure to tobacco smoke, which contains numerous chemical toxins, might predispose children to infection through suppression or modulation of the immune system (Kum-Nji *et al*., 2006). As DC results from chronic bacterial infection in the oral cavity, a potential pathway linking passive smoking and caries might be attributed to alterations in host responses.

6.7.2 TV viewing and internet use

Concerning TV viewing and internet use, almost half of the children, 1,057 (50%), spent more than two hours watching television and 972 (46%) of the children spent more than two hours using the internet. Additionally, our study found that girls tended to spend more time on the TV and internet, than boys. A possible explanation for this finding is that in Qatar due to cultural factors, boys have much greater opportunities than girls to spend time outdoors. Since girls spend more time indoors, they are more likely to spend their time watching television or using the internet. In contrast a study (Cooper, 2006) undertook an overview of research published in the last 20 years and found that boys tended to spend more time using the internet than girls. However, the differences between Cooper's (2006) findings and the findings of

the current study might be due to several reasons. First, the studies that Cooper (2006) reviewed included children of a wider age bracket, while the current study was with children aged (12-14 years). Second, Cooper's (2006) studies included computer use only, while the current study inquired about both TV and internet use. Third, Cooper's (2006) review included more western, African and far eastern countries, while the current study was undertaken only in Qatar, which is of the predominantly Muslim faith were boys have relatively more liberty and opportunities for out-door activities than girls. Hence, cultural differences between various societies might explain the differences between Cooper's (2006) findings and the current study finding.

Furthermore, children in public schools spent more time watching TV and using the internet than children in private schools. This could be explained by the findings of a study conducted in Qatar, which found that children of lower socio-economic status were allowed by their parents to play outside and participate in physical activities more than those of higher socio-economic status (Bener, 2006). As a result, those of lower socio-economic status spend less time indoors watching TV and using the internet.

To the best of our knowledge this study is the first of its kind to link excessive TV viewing and internet use with DC. There is only one recently published study by Ghimire and Rao (2013), linked between TV advertisements programs with children OH, and suggested that TV advertisements programs should focus on OH related instructions, healthy eating practices and information on regular visits to the dentist. However, it would be difficult to prove that TV viewing and using the internet has a direct effect on DC, given the multifactorial nature of DC, but a significant correlation between these poor lifestyle habits (watching TV and using internet > 2 hours) and

children's DC has been found in the present study. Thus, more research is needed to clarify and understand these findings.

Overall, watching TV and using the internet on a daily basis for > two hours was found in this study to be positively correlated with the DMFT (P value <0.001). As if the children watch TV and use the internet on a daily basis for > two hours, the DMFT mean value increased. Furthermore, children watching TV and using the internet on a daily basis for > two hours were found to be more at risk to DC than children who do not. A clear explanation for this finding is unknown, but, it could be that children who spent time on TV and the internet are less likely to spend time doing physical activities. Moreover, their exposure to advertising programs on TV or the internet; encourages them to eat advertised fast food and high sugar snacks (Ghimire and Rao, 2013).

6.7.3 Dietary habits

In 1746, Pierre Fauchard, the "father of dentistry", reported that sugary foods contributed to tooth destruction (Sarll, 2005). In this study a majority of the children, 2,100 (99.4%), consume sugar containing snacks (candy, soft drinks, chocolate, jelly, ice cream, cookies) in-between meals, of which 750 (35.5%) do so more than once a day and 503 (23.8%) at least once a day.

Additionally, 1,374 (65%) consume sugar containing snacks within one hour to bed time, in which 215 (10.2%) do so more than once a day and 249 (11.8%) at least once a day.

Unhealthy eating practices, such as a high frequency of eating sugar containing snack and consuming sugar within one hour before bedtime was found to be positively

correlated to DMFT for school children in Qatar (P value < 0.001). The results generally have supported the idea that the frequency of sugar containing snacks per day increases caries prevalence, and the risk of caries increases when sugar is consumed within one hour before bedtime. This is in agreement with Levine, (2001).

Generally, the study have supported the idea that consumption of sugar containing snacks in-between meals leads to DC, but the risk of DC increases when the frequency of sugar containing snacks per day increase. Also, the DC severity is likely more dependent upon frequency of the consumption of sugar containing snacks than the total amount consumed. Thus, the frequency of consumption sugar containing snacks would seem to be more important than the actual amount eaten. These findings are in agreement with several previous publications (Gustafsson *et al*., 1954; Naylor, 1986).

The prevalence of consuming sugar containing snacks in-between meals or within one hour of bed time in the present study was higher in children resident in urban areas than children resident in semi urban areas. These results are in agreement with previous studies among Sudanese, Swedish and Finnish children (Emslie, 1966; Samuelson *et al*., 1971; Honkala *et al*., 1982). The assumption for this finding is that the urban populations have a greater exposure to manufactured foods, which have more sugar.

Furthermore, in an attempt to study more unhealthy eating practices, our findings showed that 1,037 (49.1%) skip eating breakfast regularly and 480 (22.7%) skip eating lunch regularly. Additionally, the study found that Qatari children tend to skip breakfast and lunch more than non-Qatari children, boys tend to skip breakfast and lunch more than girls, children in public schools tend to skip breakfast and lunch

more than private schools and children resident in urban areas tend to skip breakfast and lunch more than children residents in semi urban areas. These variations in ethnicity, gender, type of school and residential areas may be attributed to differences in genetic, socioeconomic and environmental factors.

The study confirmed that there is a negative correlation between skipping main meals (breakfast and lunch) and DMFT. Also, the study found that children eating breakfast and lunch regularly were found to be less at risk to DC than children skipping main meals. These findings confirmed the results of other researches, which suggested that main meals, mainly breakfast and lunch, are usually high in protein and fat, often skipped altogether, school children who miss breakfast or lunch are more likely to snack during the day and snacks have relatively higher sugar content than main meals. Skipping main meals could lead to an increase in sugar consumption during the day, which in turn may influence caries prevalence (Summerbell *et al*., 1995).

Moreover, Dye *et al*., (2004), study if the regular consumption of breakfast is associated with less DC in children and found that children eating breakfast on a daily basis were less likely to experience caries. This is in agreement with the result of this study.

In this research, 1,771 (83.8%) of the children consumed dairy products containing snacks in-between meals. As for socio-demographic factors, boys consumed dairy products in between meals more than girls and children resident in urban areas tend to consumed dairy products in between meals more than children resident in semi urban areas. These findings support other results of this study and give an explanation to why in this study there were more DC in girls than boys and in children resident in semi urban areas more than children resident in urban areas.

Furthermore, the results of this research found a significant negative correlation between DMFT and dairy product containing snacks in-between meals (P value < 0.001), and children consuming dairy products in-between meals were found to be less at risk to DC than children who do not. This finding is in agreement with other researches that linked dairy products (cheese, yogurt and milk) and their inhibition action on DC and suggested that dairy products containing meals increase calcium concentration and thus probably protect against DC (Bowen *et al*., 1991; Gedalia *et al*., 1994; Moynihan *et al*., 1999, 2002).

However, DC can be effectively controlled by good dietary advice, although it would be unfortunate if public hopes were raised to believe that a good diet alone would solve the problem of DC. If between-meal snacking is unavoidable, it is important to recommend food and drinks that contain lower caries risk such as eating cheese or yogurt and drinking milk to neutralize the acidogenic effects of dietary sugars and this could be included as part of routine preventive care (The Dairy Council, 2001; Palacois *et al*., 2009).

Whereas chewing gum was traditionally considered harmful to teeth, in recent years, much research has focused on investigation into the effect of chewing gum on DC. Much of these researches had fallen into two approaches, in the first approach; chewing gum provides the delivery of a therapeutic, anti-caries agent, such as fluoride. The second approach concentrated on the action of saliva stimulation by the chewing of gum. Further, it is well-known that chewing gum increases the salivary flow rate which, in turn, increases the buffering capacity of the saliva that provides beneficial effects on inhibiting the development of DC (Szoke *et al*., 2001). The result of this study provides confirmation that there is a negative correlation between

chewing gum and DMFT, which has been suggested by several previous publications (Mickenautsch *et al*., 2007).

In the last few years, an increased attention has been focused on the natural plant extracts, especially those containing phenolic compounds with antibacterial and antioxidant properties. Tea is one of the important dietary sources of these compounds (Sharma *et al*., 2007). Tea has been found to lower the incidences of various pathological conditions, such as cardiovascular disease, strokes, obesity, diabetes, inflammatory conditions and the aging process (Abd Allah *et al*., 2011). Moreover, tea has been shown to afford significant protection against Parkinson's disease, Alzheimer's disease and ischemic damage (Rohde *et al*., 2011).

In dental literature, research on the oral effects of tea has been intriguing. Tea showed various degrees of inhibition against the growth of streptococcus mutans and lactobacillus bacteria which are the main pathogenic species involved in the initiation and development of DC (Hamilton-Miller, 2001). A recent study in the UK found that 14-year-old children who drank tea (whether with added sugar or not) had a significantly lower DMFT (Jones *et al*., 1999). This finding is in agreement with the current study's finding in which there is a negative correlation between drinking tea and DMFT (P value < 0.001). Furthermore, in this study children who drank tea were found to be less at risk to DC than non-tea drinkers.

In this study, 1,567 (74.2%) of the children were found to drink tea in-between meals, of which boys consumed tea more than girls, Qatari children consumed tea more than non-Qatari children and children resident in urban areas tend to consumed tea in-between meals more than children resident in semi urban areas. These findings support results of this study and give an explanation to why we get more DC in girls

than boys, non-Qatari children more than Qatari children and children resident in semi urban areas more than children resident in urban areas.

The results of this epidemiological study demonstrated that prevalence and intensity of DC experience in Qatar is alarming. This could be explained by many factors such as changing lifestyles of the population, inadequate use of dental health services, lack of family support in dental health care and OH habits formation in children, high frequency of sugar consumption and in-complete awareness about the positive effects of fluoride toothpaste use. In addition, inadequate dissemination of information on OH in the country made the problem worse.

Qatar has not yet developed a system in which routinely regular dental visits are the accepted norm. In addition, an OH education program has not been launched either. It appears, therefore, that the population needs to be educated about the advantages of regularly visiting a dentist. For the DC prevalence among the children to be reduced and the OH to be improved, responsible policymakers would need to develop and implement appropriate OH promotion and care programs for use in schools and primary healthcare centers.

Across Europe, a variety of successful community-based public OH programs exist. These focus on the delivery of preventive treatments, increasing awareness and enhancing public education to encourage healthy life styles and self-care. Approximately 40 years ago, Danish children's OH was among the poorest in Europe. However, a targeted and proactive approach to deliver preventive care within the public OH care service has had significant results. During a 28 year period, the DMFT Index in 12-year-old Danish children declined from 5 to 0.7 (Patel, 2012).

In Slovenia, a caries preventive program was based on tooth brushing with fluoride toothpaste, during the period of 10 years, DMFT dropped from 5.1 to 1.8 among 12 year olds (Veric, 2000). Carvalho *et al*., (2001), reported that after using home-based and a professional dental health care program, during a 15 year period, the DMFT Index among 12 year old Belgian children declined from 7.5 to 1.6, and the percentage of caries free children increased from 4% to 50%. In Germany, following the introduction of intensive preventive measures such as fissure sealants, during a 6 year period, the DMFT Index among 12 year old children declined from 2.4 to 1.2 (Pieper and Schulte, 2004). The authors concluded that implementation of an appropriate OH promotion and care polices by health authorities could considerably improve OH and decline the DMFT Index. Thus, the formulation of a clear and feasible national OH strategy focused on providing basic oral care for all children, using the resources available became a mandatory request.

Another focus of attention for OH authorities should be on the process of policies that promote the behavioral changes regarding dietary habits at a national level that can be achievable through restrictions on advertising of unhealthy food, legislation to control unhealthy food, ban on the sales of unhealthy and sugary foods in and around schools, and better accessibility to healthy food.

Last but not least, all together Supreme Council of Health in Qatar, dentists, school teachers, media, parents and children themselves are able to arrest the progression and to decrease caries prevalence all over the country.

7. LIMITATIONS, STRENGTHS AND FUTURE RESEARCH

Notwithstanding its strengths and advantages, this study has some limitations, and it is appropriate to discuss the limitation points of the study.

First, this research is being evaluated on the basis of responses to the questionnaires and self-reported data. Measurement errors due to misinterpretation of questions and memory errors are subject to occur (Marquis *et al*., 1986). To overcome this problem the questions were worded simply and a pilot study was performed. Furthermore, the researcher was always available during the completion of the questionnaire, and the children were encouraged to approach the researcher whenever they needed clarification of any points.

Second, the DC in this research were identified only with clinical examination, no radiographs were taken, which may over- or under-estimate the actual magnitude of the problem. This limitation applies to all studies using the WHO criteria for DC diagnosis (Al-Sadhan, 2006; Campus *et al*., 2008; Tramini *et al*., 2009; Mtaya *et al*., 2009).

Third, another possible limitation of this research lies in the DMFT Index using the WHO diagnostic criteria to identify DC. The WHO criteria, however, measures the presence of decay, or lack thereof, without differentiating the various stages of DC (initial and advanced lesion, non-cavitated and cavitated lesions), which may subsequently under- or over-estimate DC experience and severity (Pine and Harris, 2007). New research using a new caries assessment index such as the International Caries Diagnosis and Assessment System (ICDAS), that makes it feasible to differentiate between various stages of DC (initial and advanced lesion, non-cavitated

and cavitated lesions) (Braga *et al*., 2009) should be considered in the future to address more details about DC in Qatar.

Fourth, in the present research only caries teeth were recorded on a diagnostic chart without determining which tooth surfaces were affected by caries. Further study is needed to include decayed, missing and filled surfaces (DMFS).

Fifth, unfortunately, the current study did not differentiate between different kinds of sweets consumed by children. It is possible that some sweets may have been sugar-free, although most children in Qatar prefer sweets that contain sugar.

Sixth, passive smoking was assessed by questionnaire reports and was not validated by measurements of biomarkers, such as salivary, serum or urine cotinine levels. Using questionnaires may result in response bias due to children's feelings of guilt if they avowal that their parents smoke.

Seventh, in Qatar, children from higher socioeconomic backgrounds generally are likely to be enrolled in private schools as opposed to children from lower socioeconomic backgrounds who attend mainly public schools. Thus, type of school was used as a proxy of socioeconomic backgrounds for the children. Further studies should be undertaken to address more appropriate measures of socioeconomic class inequalities in relation to DC, such as parental income and parental occupation.

Eighth, it is also important to note that the survey asked about TV viewing and internet use, and did not specifically ask about video games (e.g. Nintendo, PlayStation). Although some children would have included this under the TV viewing and internet use questions, other may have been underestimated in the present study.

Ninth, the clinical registration of crowding and spacing of the dentition in this study were determined according to the criteria described by Björk *et al*., (1964), and following WHO (1997) guide lines. Therefore, no quantitative or qualitative measurement for crowding and spacing was done in any arches (mild, moderate or severe crowding and spacing). It was just recorded as either present or absent in either of the dental arch. Also, no segregation was done for maxillary (upper teeth) or mandibular (lower teeth) arch. However, the Björk method has been frequently used in many studies (Ng'ang'a *et al*., 1996; Rwakatema *et al*., 2006), hence enables comparability of the presence of crowding and spacing findings among similar studies.

Finally, the study design was cross sectional; therefore, evidence about prediction of casual relationships cannot be confirmed. Undoubtedly, further longitudinal studies are required to overcome this limitation. Therefore, the data derived from our analysis should be interpreted wisely with caution, taking into account all the previous limitations points.

Despite these limitations, this study has several strengths. First, the children represented diverse age, gender, ethnicity, and areas. Second, the number of schools selected (16 schools) including both government and private schools was high in comparable to other studies. Third, the response rate in this study was good 2113 (96%) children, giving further strength to the validity of the study. The remaining non-response 78 (4%) children were excluded from the study because they did not provide complete responses in their questionnaires. Fourth, to the best of our knowledge this study is the first of its kind to link excessive TV viewing and internet use with DC. There is only one recently published study by Ghimire and Rao (2013), linked between TV advertisements programs with children OH, and suggested that

TV advertisements programs should focus on OH related instructions, healthy eating practices and information on regular visits to the dentist.

Future research should be developed in several ways, these include:

- Given the results of the current study, future research opportunities include more detailed cross-sectional and longitudinal studies targeting different age groups. More in-depth dietary information could assist in defining nutritional risk factors for caries development.

- It is common practice in Qatar to consume tea with milk and, as yet, there is no consensus on whether proteins in milk might reduce the anti-cariogenic effect of tea. Further studies could clarify the effect of adding milk to the anti-cariogenic properties of tea. Moreover, the study investigated the impact of drinking tea and its frequency with DC, although a lot of questions remain about drinking tea and its effects on DC. Key questions remain such as; What is the effect of different tea brands available in the market? What is the effect of different types of tea (black, green, white)? What is the effect of different quantities of tea (how much tea need to drink)? How long tea needs to be steeped for the most benefit? Finally, What is the effect of adding sugar to the tea (tea with or without sugar). Further research is needed to discover more health benefits of tea on DC.

- The study assessed the impact of chewing gum and its frequency with DC, but did not assessed the total duration of chewing gum use and the relative efficacy of different chewing gum available in the market. To address these issues, future research needs to consider more rigorous study designs, head-to-

head comparisons of all chewing gum available in the market at optimal doses, and higher methodological quality.

- Furthermore, one of the findings of the study showed that there is an association between DC and passive smoking on the school children. Further research is needed to study the prevalence of DC and active smoking among junior high school students to clarify this association between DC and smoking.

- In this study only the prevalence of crowding and spacing as teeth irregularities were identified. Future research is needed to study more malocclusions patterns such as open bite, cross bite and deep bite. Such information is worthy for orthodontists and public health policy makers in order to improve orthodontic services.

- Moreover, future research should focus on studying more factors other than those studied in this research such as the association between consanguineous marriage and DC, and association between Asthma and DC as these phenomena are widely spread in this region.

8. RECOMMONDATIONS

The following recommendation can be drawn from this research:

The prevalence of DC reaches a very serious level in Qatar among children and highlights an urgent need to expand the available dental services in the country. Efforts should be made into strengthening dental services, including the building of infrastructures needed for optimal dental care around the country. Expansion is required in the number of facilities, size of the workforce and the amount of funding. If the expansion of dental services is not initiated, there could be a serious negative impact upon the future of the OH in Qatar.

The provincial health authorities should be encouraged to develop a nationally-oriented OH care promotion strategy aimed at further improvements of oral self-care practices, regular dental visiting habits of children and better control of oral disease.

The findings of the study suggest that awareness on the importance of OH need to be enhanced among school children in Qatar. Also, the study recommends that the optimal way to raise children's oral and general health awareness would be through furnishing parents and school teachers with accurate information. Parents and school teachers should be invited regularly for presentations on oral and general health.

Support school-based OH programs by recruiting an oral hygienist on a full-time basis to visit the schools, screen the children, refer if necessary, and initiate appropriate oral hygiene and dental educational activities.

From a dietary point of view, the study recommends that the best advice for reducing caries risk is to reduce the frequency of consumption of sugars-containing snacks and to limit their consumption to mealtimes only. It is also advisable to avoid sugars-

containing snacks close to bed time (within one hour). If between-meal snacking is unavoidable, it is important to recommend snacks that are proven to have anti-cariogenic effects, such as cheese, yogurt, chew gum, drink milk and tea after meals. In addition, caries preventive efforts in school children should include information on the importance of maintaining breakfast and regular main meals.

Implementation of community-based preventive OH programs on healthy diet and practices of adequate oral hygiene should be promoted in schools through integration into the school curriculum and services to combat the growing problem of DC.

The need to reduce sedentary behaviors and to promote a more active and healthy lifestyle becomes essential. The study suggests that the clinicians and public health interventionists should encourage active lifestyles and healthy environments to balance the energy intake of children.

Furthermore, the dental profession has an important role to play in shaping the future of OH. The profession's intervention is needed for development of healthy lifestyles, such as healthy diets low in sugars and personal hygiene, effective use of fluoride, and development an OH system that is oriented toward oral disease prevention and health promotion.

The results of the study provide one more piece of evidence indicating that passive smoking is harmful and that all children should be allowed to grow up in a smoke-free environment. A smoke-free environment should be mandated by law, not by voluntary policies. Legislation requiring all indoor work-places and public places to be 100% smoke-free environments should be enacted. Voluntary polices are not an acceptable response to protection (WHO, 2007). Since the home is often the highest source of passive smoking exposure for children, public educational activities to

reduce passive smoking exposure in the home should be implemented. Education to promote smoke-free homes can be conducted by sending messages informing the public, particularly parents, of the impact of passive smoking exposure in the home and have urged them to make their homes smoke-free.

Although obesity has a complex development, involving environmental, physiologic, and genetic factors, the basic cause of this condition is an imbalance between energy intake and energy expenditure. Strategies to increase physical activities should include reductions in the amount of time spent in sedentary activities such as spent long time watching TV, playing video games, and using the internet. Also, public health policies should focus on revising school curricula by incorporating more time for enjoyable physical activities.

Moreover, it is highly recommended that all policy makers and public health authorities in Qatar strengthen their work for raising awareness and translation of sound knowledge about risk factors of DC, poor OH, overweight and obesity, passive smoking, long time watching TV and using the internet on children to the parents, school teachers and children themselves.

The study suggest that all research bodies in the country such as the Qatar National Research Fund, the Hamad Medical Corporation Research Center and Qatar University, should support more researches into the side effects of DC, poor OH, overweight and obesity, passive smoking, extensive watching of TV and using the internet on children. So, they can support health policy makers to effectively orientate strategies towards health promotion and disease prevention.

9. CONCLUSIONS

This research provides information about DC, level of OH knowledge, teeth irregularity, BMI, and other life style variables (TV viewing, internet use, passive smoking and dietary habits) among 12-14 year old school children in Qatar, which is useful in terms of designing preventive OH programs and planning dental services in the country. Within the limitation of the study, the research highlights the following findings:

1. The prevalence of DC among school children in Qatar is 85%. The mean DMFT value is 4.62 (±3.2), 4.79 (±3.5), and 5.5 (±3.7) for the 12, 13 and 14 year old children respectively. These values reach a very serious level and it is above the recommended level of the WHO (not more than three decayed, missing, and filled permanent teeth (DMFT) at the age of 12 years).

2. The OH knowledge in Qatar is below the satisfactory level. Only one quarter (25.8%) of school children reported a high level (15-21 score) of OH knowledge.

3. The population studied in this research had more incidences of crowding of teeth (44.1%) than spacing (9.5%), which means a high proportion of children need orthodontic therapy in the country.

4. The overall prevalence of underweight, overweight, and obesity in this research was 5%, 10%, and 5% respectively.

5. Almost half of the children (50%) spent > two hours watching television and 46% of the children spent > two hours using the internet daily.

6. Approximately 35.8% of the children in Qatar had exposure to passive smoking.

7. Concerning dietary habits:

    - The majority of the children (99.4%) consume sugar containing snacks (candy, soft drinks, chocolate, jelly, ice cream, cookies) in-between meals.

    - Approximately 65.0% of the children consume sugar containing snacks (candy, soft drinks, chocolate, jelly, ice cream, cookies) within one hour of bed time.

    - Almost 49.1% skip eating breakfast regularly and 22.7% skip eating lunch regularly.

    - Around 83.8% of the children consume dairy products containing snacks in-between meals.

    - Overall 74.2% of children drink tea in-between meals and 80.1% chewing gum in-between meals.

8. Parents (69.1%) are the most popular source of OH information for the children followed by dentists (8.6%), school teachers (5.1%) and media (3%).

9. All variables studied in this research were affected by socio-demographic factors, but, significant inequalities were found in the following:

    - Female children were more at risk to DC than male children.

    - Children resident in semi-urban areas were significantly more at risk to DC than children resident in urban areas.

10. The occurrence of DC is significantly associated with the level of OH knowledge, teeth irregularity, and life style variables (e.g. TV viewing, internet use, passive smoking, and dietary habits).

A. The following were less at risk to DC:

- Children with high OH knowledge were significantly less at risk to DC than children with poor or moderate OH knowledge.
- Children with spacing teeth were less at risk to DC than children without spacing teeth.
- Children consuming dairy products containing snacks in-between meals were significantly less at risk to DC than children who do not.
- Children consuming tea in-between meals were significantly less at risk to DC than children who do not.
- Children chewing gum in-between meals were significantly less at risk to DC than children who do not.
- Children eating main meals (breakfast and lunch) regularly were significantly less at risk to DC than children who do not.

B. The following were more at risk to DC:

- Children with crowding teeth were significantly more at risk to DC than children without crowding teeth.
- Children watching TV > 2 hours daily were significantly more at risk to DC than children watching TV ≤ 2.

- Children using internet > 2 hours daily were significantly more at risk to DC than children using internet ≤ 2.

- Children consuming sugary snacks 1 hour before bedtime were significantly more at risk to DC than children who do not.

11. Although there is no sufficient evidence to correlate between DC and BMI, it is proven that they do share common factors, which validate a conjoined prevention approach that tackles both issues.

12. Comparing the findings with data from other Eastern Mediterranean region countries, the mean DMFT value for 12-14 year old school children in Qatar obtained in this study were among the second highest in the Eastern Mediterranean region countries.

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APPENDICES

APPENDIX A

The DMFT value for categorizing the severity of caries.

Source: World Health Organization, Global Oral Data Bank, 2000.

	DMFT Mean Value
Very low	0.0-1.1
Low	1.2-2.6
Moderate	2.7-4.4
High	4.5-6.5
Very high	> 6.6

APPENDIX B

12 - 14 year old school children in the 2011 - 2012 academic year.

Source: Office of the Director of General Education, Supreme Education Council, State of Qatar, Academic year 2011-2012.

Age	12 years	13 years	14 years	Total
Gender and Nationality				
Male Qatari	3825	3909	3856	11590
Female Qatari	3911	3904	3830	11645
Male Non-Qatari	2769	2902	2880	8551
Female Non-Qatari	2792	2953	2909	8654
Total	13297	13668	13475	40440

- Total male student 12 – 14 years old = 20141
- Total Female student 12 – 14 years old = 20299
- Total Qatari student 12 – 14 years old = 23235
- Total non-Qatari student 12 – 14 years old = 17205

APPENDIX C

Students in government and private schools and universities by gender and education level, State of Qatar, Academic year 2011-2012.

Source: Qatar Statistics Authority.

Educational Level	School type	Year 2011/2012	
		Female	Male
Pre-primary	G	3,173	2,411
	P	11,296	12,636
Primary	G	21,515	19,645
	P	24,778	29,047
Intermediate	G	11,815	10,671
	P	8,484	9,470
Secondary	G	11,279	11,071
	P	5,386	6,396
Total	G	47,332	43,348
	P	49,494	57,099
	Total	97,726	101,347
Universities	G	7,454	2,339
	P	2,400	3,159
	Total	9,854	5,498

*G=Government, P=Private.

APPENDIX D

Dental caries, oral health and life style variables among school children in Qatar.

Name: Class:

School name:

1-Do you think good dental health is important for good general health? A-Yes* B-No C-I don't know
2-Do you care about your teeth as much as any part of your body? A-Yes* B-No C-I don't know
3-What is the importance of teeth? A-Chewing B-Talking C-Appearance D-All of the above*
4-Do you think it is important to keep your teeth clean? A-Yes* B-No
5-If "Yes" why do you think it is important? A-To prevent bad breath C-To keep teeth healthy and beautiful B-To prevent tooth decay D-All of the above*
6-Which of the following is the best cleaning aid? A-Tooth brush B-Dental floss C-Mouth wash D-All of the above*
7-Teeth should be cleaned at least: A-Once a day C-After each meal* B-Twice daily* D-Once a week
8-The best way to clean between your teeth is to: A-Use a toothbrush B-Use dental floss* C-Use toothpick D-I don't know
9-How often one must visit the dentist? A-Every three months C-Once a year B-Every six months* D-Only when pain in your tooth
10-Which of the following diet causes tooth decay? A-Sweet (Chocolate/Candies*) C-Fresh milk E-Sweetened milk* B-Soft drinks* D-Vegetables F-Fresh fruits
11-Have you heard about fluoride? A-Yes* B-No
12-What does fluoride do? A-It makes teeth white C-It makes teeth grow B-It helps protect teeth from decay* D-I don't know

13-The best way to get fluoride is to:
A-Have a dentist put fluoride on your teeth C-Drink water that has fluoride in it*
B-Brush your teeth with fluoride tooth paste D-I don't know

14-Which of the following can be a sign of tooth decay?
A-Toothache* B-Bleeding gums C-Calculus D-Cavities in teeth*

15-I can avoid tooth decay:
A-By good hygiene C-By using fluoride E-All of the above*
B-By eating less sweets D-By going to the dentist regularly

16-Blood on your toothbrush may be a sign of:
A-Gum disease* B-Tooth decay C-I don't know

17-Healthy gums do not bleed !
A-True* B-False C-I don't know

18-Symptoms of gum diseases include:
A-Swelling and redness of gums C-Bleeding from gums
B-Bad smell from mouth D-All of the above*

19-The best way to keep your gums healthy:
A-Eat a good diet C-Take vitamins
B-Clean your teeth every day* D-I don't know

20-What is plaque?
A-A toothpaste C-A plastic coating for teeth
B-A layer of germs on the teeth* D-I don't know

21-Dental plaque can lead to tooth decay.
A-Yes* B-No C-I don't know

22-Who taught you how to clean your teeth?
A-Parents C-School teacher E-Dentist G-Media (television, Radio,
B-House maid D-Nobody F-Relatives News paper, Journal)

23-Does anyone living in your house (other than you) smoke cigarettes?
A-Yes B-No

24-Number of hours watching television on a daily basis.
A- $\leq$ 2 hours B- > 2 hours

25-Number of hours using internet on a daily basis.
A- $\leq$ 2 hours B- > 2 hours

26-Have sugar containing snack (candy, soft drinks, chocolates, jelly, ice cream, cookies) in-between-meals?
A-Yes B-No

27-Frequency of eating or drinking sugar containing snack?
A- Never B-Occasionally (Not every day) C-Once per day. D-More than once per day

28-Have sugar containing snack within one hour to bed time?
A-Yes B-No

29-Frequency of eating or drinking sugar containing snack within one hour to bed time?
A- Never B-Occasionally (Not every day) C-Once per day. D-More than once per day

30-Have dairy products containing snack (cheese. milk, yogurt) in-between- meals? A-Yes B-No
31-Frequency of eating or dairy products containing snack? A- Never B-Occasionally (Not every day) C-Once per day. D-More than once per day
32-Drinking tea in-between-meals? A-Yes B-No
33-Frequency of drinking tea in-between-meals? A- Never B-Occasionally (Not every day) C-Once per day. D-More than once per day
34-Chewing gum in-between-meals? A-Yes B-No
35-Frequency of chewing gum in-between-meals? A- Never B-Occasionally (Not every day) C-Once per day. D-More than once per day
36-Eating breakfast regularly? A-Yes B-No
37-Eating lunch regularly? A-Yes B-No

* Appropriate response

APPENDIX E

استبيان عن صحة الفم والأسنان

اسم الطالب : .....

الصف: ..... **اسم المدرسه:** .....

1- هل تعتقد أن صحة الأسنان الجيدة هي مهمة لصحة جيدة بوجه عام؟ 1- نعم 2- لا 3- لا أعرف
2-هل تهتم بأسنانك بقدر اهتمامك بأي جزء من جسمك؟ 1- نعم 2- لا 3- لا أعرف
3- ما هي أهمية الأسنان؟ 1 - مضغ الطعام 2-التحدث 3- المظهر 4 - كل ما سبق
4 -هل تعتقد أن من المهم المحافظة على أسنانك نظيفة؟ 1- نعم 2- لا
5 -إذا كان الجواب "نعم" لماذا تعتقد أنه من المهم المحافظه على اسنان نظيفة؟ 1 - لمنع رائحة الفم الكريهة 2- لمنع تسوس الأسنان 3- للحفاظ على أسنان صحية وجميلة 4- كل ما سبق
6 - أي مما يلي هي أفضل طرق تنظيف الأسنان؟ 1-فرشاة الاسنان 2- خيط الأسنان 3- غسول الفم 4- كل ماسبق
7- يجب تنظيف الأسنان على الأقل : 1- مرة في اليوم 2 - مرتين يوميا 3- بعد كل وجبة 4- مرة في الأسبوع
8- إن أفضل طريقة لتنظيف ما بين الأسنان هو : 1 - استخدام فرشاة الأسنان 2 – استخدام خيط الأسنان 3- استخدام أعواد الأسنان 4- لا أعرف
9-كم مرة يجب أن نقوم بزيارة طبيب الأسنان؟ 1- كل ثلاثة أشهر 2 - كل ستة أشهر 3- مرة في السنة 4- فقط عندما نشعر بآلام في الأسنان
10 -أي من الأطعمة التالية تسبب تسوس الأسنان؟ 1 - الحلو (شوكولا / الحلويات) 2 - المشروبات الغازية 3 - الحليب الطازج 4 – الحليب المحلى 5 - الخضروات 6- الفواكه الطازجة
11-هل سمعت عن الفلورايد؟ 1 – نعم 2- لا
12-ماذا يفعل الفلورايد؟ 1- يجعل الأسنان بيضاء 2 - يساعد على حماية الأسنان من التسوس 3- يجعل الأسنان تنمو 4- لا أعرف

13 -إن أفضل طريقة للحصول على الفلورايد هي :

1 - عن طريق طبيب الأسنان 2 - فرش الأسنان باستخدام معجون الأسنان الذي يحتوي على الفلورايد 3- شرب ماء يحتوي على الفلورايد 4- لا أعرف

14-أي مما يلي يمكن أن يكون علامة تسوس الأسنان؟

1 - وجع الأسنان 2- نزيف اللثة 3- ظهور ترسبات وتكلسات من الجير على الأسنان 4- التجاويف في الأسنان

15 - يمكنني تجنب تسوس الأسنان :

1- بواسطة النظافة الجيدة للأسنان 2- أكل حلويات قليله 3 – باستخدام الفلورايد 4- الذهاب إلى طبيب الأسنان بانتظام 5 – جميع ما ذكر

16 -الدم على فرشاة الأسنان الخاصة بك قد يكون علامة على :

1 - مرض اللثة 2- تسوس الأسنان 3 - لا أعرف

17 - اللثة السليمة لا تنزف ؟

1 - صحيح 2- خطأ 3- لا أعرف

18-أعراض أمراض اللثة ما يلي :

1 - تورم واحمرار اللثة 2 - رائحة سيئة من الفم 3 - نزيف من اللثة 4- كل ماسبق

19-إن أفضل طريقة للحفاظ على صحة اللثه :

1 - اتباع نظام غذائي جيد 2 - تنظيف أسنانك كل يوم 3 - تناول الفيتامينات 4- لا أعرف

20-ما هو البلاك او الجير ؟

1- معجون للأسنان 2- طبقة من الجراثيم على الأسنان 3- طلاء من البلاستيك على الأسنان 4- لا أعرف

21 – بلاك أو جير الأسنان يمكن أن يؤدي إلى تسوس الأسنان.

1- نعم 2- لا 3- لا أعرف

22-من علمك كيف تنظف أسنانك؟

1- احدى الوالدين 2 - خادمة البيت 3- المعلمين في المدرسة 4-لا أحد

5- طبيب الأسنان 6 - أقارب 7-وسائل الإعلام (تلفزيون، راديو ، مجلة، جريده)

23 -هل يوجد أي شخص يعيش في منزلك (غيرك) يدخن السجائر؟

1- نعم 2- لا

24-عدد ساعات مشاهدتك التلفزيون يوميا.

1- اقل أو يساوي ساعتين 2- اكثر من ساعتين

25 -عدد ساعات استخدام الانترنت يوميا؟

1- اقل أو يساوي ساعتين 2- اكثر من ساعتين

26-هل تتناول وجبة خفيفة تحتوي على السكر (الحلوى والمشروبات الغازية والشوكولاته، والجيلي، والآيس كريم والكعك) في الفترات الفاصلة بين وجبات الطعام؟

1- نعم 2- لا

27-كم مرة تشرب أو تأكل وجبة خفيفة تحتوي على السكر؟

1 – أبدا 2- أحيانا (وليس كل يوم) 3 - مرة واحدة كل يوم. 4 أكثر من مرة في اليوم الواحد

28-هل تتناول وجبة خفيفة تحتوي على السكر في غضون ساعة واحدة قبل وقت النوم؟ 1 - نعم 2- لا
29 - كم مرة تشرب أو تأكل وجبة خفيفة تحتوي على السكر في غضون ساعة واحدة قبل وقت النوم؟ 1 - أبدا 2-أحيانا (وليس كل يوم) 3- مرة واحدة كل يوم 4- أكثر من مرة في اليوم الواحد
30- هل تناول وجبة خفيفة تحتوي على منتجات الألبان (الحليب واللبن او الجبن) في الفترات الفاصلة بين الوجبات؟ 1 - نعم 2- لا
31 – كم مرة تشرب أو تأكل وجبة خفيفة تحتوي على الألبان ؟ 1 - أبدا 2-أحيانا (وليس كل يوم) 3- مرة واحدة كل يوم 4- أكثر من مرة في اليوم الواحد
32-هل تشرب شاي في الفترات الفاصلة بين الوجبات؟ 1 - نعم 2- لا
33- كم مرة تشرب شاي في الفترات الفاصلة بين الوجبات؟ 1- أبدا 2- أحيانا (وليس كل يوم) 3 - مرة واحدة كل يوم 4- أكثر من مرة في اليوم الواحد
34-هل تتناول العلكة (اللبان) في الفترات الفاصلة بين الوجبات؟ 1- نعم 2- لا
35 كم مرة تتناول العلكة (اللبان) في الفترات الفاصلة بين الوجبات؟ 1- أبدا 2- أحيانا (وليس كل يوم) 3- مرة واحدة كل يوم 4- أكثر من مرة في اليوم الواحد
36 هل تتناول الافطار بشكل يومي و منتظم؟ 1- نعم 2- لا
37 هل تتناول وجبة الغداء بشكل يومي و بانتظام؟ 1 - نعم 2- لا

APPENDIX F

EXAMINATION FORM

Name:	Date:
Area:	ID No.
School:	Class:
Age:	Boy ( ) Girl ( )
Examiner:	Recorder:
Weight:	Height:
BMI =	

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

	Permanent
0	Sound
1	Decayed
2	Filled and Decayed
3	Filled, no Decay
4	Missing due to caries
5	Missing, other reason
6	Sealant
7	Bridge abutment, crown
8	Unerupted

DMFT: D M F =

☐ Crowding in the incisal segments

0 = No crowding
1 = One segment crowded
2 = Two segment crowded

☐ Spacing in the incisal segments

0 = No spacing
1 = One segment spaced
2 = Two segment spaced

APPENDIX G

Dental caries, oral health and life style variables among school children in Qatar.

My name is Mohammed. I am a dentist working on a project about dental caries at University of Gloucestershire in England. Dental caries is a condition that happens as a result of the presence of acids in the mouth (bacteria) that lead to damage the tooth. There is growing concern amongst dentists in all over the world about the prevalence of dental caries, especially in schoolchildren. However, we do not know the prevalence of dental caries in Qatar. Therefore, I aim to develop a project about dental caries and study a number of factors that may initiate it among schoolchildren in our country. An important part of this project will be developed in the schools of Qatar. The project will include an oral examination too see the number of missing, decayed and restored teeth in your child. All the dental instruments will be sterilised. The weight and length of your child will be measured. This examination will be conducted at school. I will also advise your child on how to prevent dental caries.

To evaluate the factors that could cause dental caries, your child will be asked to complete a questionnaire with information about his/her oral health knowledge. The questionnaire will be answered at school and confidential. It is important to note that only the research team will have access to the information collected and it will be stored securely. Therefore, I can assure you that all the information will be kept confidential.

I should be most grateful for your consent to include your child in this study. Your child participation in this study is entirely voluntary. If you are willing to co-operate, please would you complete and sign the written consent form attached to this letter. Your child may also sign the form if he/she wishes. Your child will not be included in this project without your authorization. Therefore, it is necessary that you return the completed consent form if you wish your child to take part. In this way, your child will have the chance to be dentally examined.

Finally, you are free to ask as many questions as you like before, during or after this research, should you decide to consent to participate in this research.

Thank you very much for taking the time to read this letter.

I hope to meet your child soon.

Yours faithfully

Dr Mohammed Al-Darwish

APPENDIX H

Dental caries, oral health and life style variables among school children in Qatar.

WRITTEN CONSENT FORM

Please read, sign and return this form to school.

Full name of the parent/guardian:

Name of the child:

- I have read the information contained in the enclosed letter. I know that the dentist will examine the teeth and measure the weight and length of my child at school. I also know that my child will be asked to answer a questionnaire at school and that this questionnaire is confidential.
- I know that my child will not be included in this study without my written permission. I understand that participation in this study is not compulsory.
- I affirm that my participation and my consent to my child inclusion are voluntary. I consent to my child being examined and completing the questionnaire record.

Parent/Guardian's signature:

Date:

WRITTEN CONSENT FORM

- I have read the information contained in the enclosed letter.
- I know that the dentist will examine my teeth and measure my weight at school. I also know that I will be asked to answer a questionnaire at school and that this questionnaire is confidential.
- I affirm that my participation is voluntary.

Child signature:

Date:

APPENDIX I

Letter to the school principal

School name:

Address:

Date:

Dear sir/Madam

I write to seek your agreement for Mohammed Al-Darwish, who is a registered postgraduate (PhD) student in the University of Gloucestershire, to carry out the field work for his study in Qatar. He will determine the prevalence of dental caries in schoolchildren in Qatar and a number of factors that my initiate it. This field work is part of the original design of his study and it is essential for his PhD studies.

No study has published data relating to the prevalence of dental caries in Qatar. This is despite the growing concern regarding the prevalence of dental caries especially amongst children. The study will help to determine the prevalence of dental caries in schoolchildren and provide strategies for its prevention.

The protocol of the project requires the dentist to dentally exam 12-14 years old children in 15 selected schools in Qatar, and to ask the children to complete a questionnaire with information about his/her oral health knowledge together with dietary habits questionnaire.

If your school is willing to co-operate, please sign this written consent form and provide the list of your schoolchildren who are between 12-14 years old, it would be very useful if the list included the name and date of birth of the children. It is important to emphasize that the contact with the children will be made throughout the school. The researcher will send a letters to parents, explaining the aims of the project and asking for their permission to include their children in the study. It is very grateful if this information could be given as soon as possible, in order to prepare the letters and send them to the parents.

If you require any further information regarding the protocol or have any queries regarding the proposed study, the researcher would be very happy to answer them and can be contact at 55818189.

Yours sincerely,

School principal signature

APPENDIX J

Dental caries, oral health and life style variables among school children in Qatar.

Letter to the parents after dental examination

Dear parents/guardians of .....

Thank you for your consent to include your child in this study. Dental examination has been undertaken for your child.

*Your child needs to be seen by a dentist due to presence of dental caries ☐

*Your child does not need to be seen by a dentist at the moment but need to be seen for regular checkup after 6 months ☐

Thank you again for your cooperation.

Yours truly

Dr Mohammed Al-Darwish

APPENDIX K

UNIVERSITY OF GLOUCESTERSHIRE
at CHELTENHAM and GLOUCESTER

CERTIFICATE

This is to confirm that



.....

Participate in the project entitled "**Dental caries, oral health and life style variables among school children in Qatar**".

Dr. Mohammed Al-Darwish