OBESITY AND ORAL HEALTH AMONG ADOLESCENTS IN THE UNITED ARAB EMIRATES

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Declaration

This thesis contains no material that has been accepted for the award of any other degree or diploma in any university. To the best of the candidate's knowledge and belief, the thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

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Abstract

Aims: To investigate the relationship between oral health and obesity in adolescents attending Public and Private Schools in Sharjah City, United Arab Emirates. **Methods:** 1094 adolescents attending secondary school in Sharjah City were asked to participate in a randomised cross-sectional study**,** (QMREC2007/60). Two separate structured questionnaires were used to determine; 1. The demographic details, dietary habits, physical activity and oral hygiene practice from the adolescents and 2. Socio-economic and general health from their guardian. A two part clinical examination i) dental caries (WHO, 1997) and oral cleanliness (Pitts et al., 1997), ii) measurement of height and weight to calculate BMI was also carried out. Data analysis included descriptive, univariate and multiple regressions. **Results:** Full dataset on 803 adolescents was obtained and used for analysis. The study response rate of 93% resulted in 50 % male, 40% UAE nationals and 66% attending Private school. The mean DMFT was 3.19 (SD 2.9), 25% were caries free, mean BMI was 21 and 15% were obese. A significant association between DMFT and BMI was found (r=0,097, p=0.006), with each extra 10 point in BMI there was a 0.57 increase in DMFT. The DMFT predictive model confirmed significant association of father's education ($p<0.001$), gender ($p=0.008$) and ethnicity ($p=0.001$). Positive significance of age ($p<0.001$), consumption of tea with sugar ($p=0.024$) and soft drinks ($p<0.001$), whereas three daily meals ($p=0.009$) and visiting the dentist ($p=0.007$) were protective. The BMI model confirmed positive significance of age ($p<0.001$), school fees ($p=0.005$), obesity in family ($p<0.001$) and soft drink consumption ($p<0.001$). Three daily meals ($p=0.007$) and increased drinking frequency of milk ($p=0.026$) were found to be protective. **Conclusions:** Analysis of the final model suggests that there is no clear relationship between obesity and dental caries, but that the consumption of soft drinks was a leading predictor for both diseases (obesity and dental caries).

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Chapter 1. Introduction

Increased urbanization and economic development in most countries around the world in the past decade has led to significant change in diet, pattern of work and more sedentary lifestyle (WHO, 2003). This adverse dietary change is toward higher consumption of sugar, fat and reduced intake of dietary fibre, fruit and vegetables (Drewnowski, 2003). This is often referred as a “nutrition transition” which is the causal factor for many chronic systemic diseases such as hypertension, stroke, coronary heart disease and diabetes. This global change and “nutrition transition” with adverse health effect include a growing rate of childhood obesity (Drewnowski and Popkin, 1997).

Although genetic factors play an important role in the development of obesity, the dramatic rise in prevalence of obesity is best explained by behavioural and environmental changes such as exposure to the “obesogenic “ environment which has resulted from technological advances (Kopelman, 2000).

The dietary habits and lifestyle of residents of Arab countries (Gulf State /Arabian Gulf) have also changed dramatically as a result of the increase in income from oil revenue (Musaiger, 1993). The UAE is a country that has achieved significant development in a short period of time. The standard of living has improved in that luxurious lifestyles have also resulted in change in behaviour of UAE people with more junk food being consumed, people being less active due to high technology and more dependence on household servants (Abdul Ghaffor 1997).

The prevalence of obesity among children and adults has increased in the Gulf Region (Al-Sendi et al., 2003, Al-Mahroos and Al-Roomi, 1999, Al-Rukban, 2003),

including UAE (Al-Haddad et al., 2000, Al-Haddad et al., 2005). Moreover, there is good evidence that supports the association between dietary habits such as frequency, binge eating pattern, snacking and excessive consumption of fat and sugar and obesity (Slyper, 2004, Utter et al., 2008). There are also studies which support that diet affects oral health in many ways such as development of oral cancer, periodontal disease and dental caries (Petersen, 2008, Moynihan, 2003), theses explain that dental caries and obesity are mulifactorial and they share common risk factors (Gerdin et al., 2008).

Despite a marked decline in dental caries in developed countries over the past 30 years, dental caries is still a major health problem in some developing countries that have increased their consumption of sugar and inadequate exposure to fluoride (WHO, 2003). The prevalence of dental caries in United Arab Emirates is not well documented; there are a few studies that report high prevalence of dental caries in pre-school children (Hashim et al., 2006, Al-Hosani and Rugg-Gunn, 1998, Al Mughery et al., 1991).

The association between obesity and many systemic chronic diseases is well established (Kopelman, 2000), the association between obesity and dental caries among children has been investigated in several countries but with conflicting result (Willershausen et al., 2007, Moreira et al., 2006).

The literature essentially represents studies in western countries. Unfortunately in the Middle-East few studies have been carried out in this field. Therefore, the overall aim of this study is to investigate the association between obesity and oral health among adolescents in the United Arab Emirates.

Chapter 2. Literature Review

This chapter presents a review of the literature on the prevalence and aetiology of obesity and dental caries. It also provides some insight into the current controversy in the literature in relation to association between obesity and dental caries. Finally a review of the literature on self-esteem and its association with obesity and dental caries is discussed.

2.1 Definition of obesity

A simple definition of obesity is an excess of body fat. For adults there is a clear definition for obesity and Body Mass Index (BMI) has achieved international acceptance as a standard for the assessment of obesity with a clear cut-off point of 30 kg/m² (Guillaume, 1999b) and it is based on research evidence that links BMI to health risk, such as cardiovascular disease (Colditz et al., 1995) or diabetes (Libman and Arslanian, 2007, Libman et al., 2003). In contrast to adults, the definition of obesity in children is more complex for several reasons. Firstly they have less disease related to obesity, secondly because children are growing; a further complexity arises because of growing child which is also tied with age. A literature review on childhood obesity indicated that criteria used to assess obesity in children and adolescents varied widely with a wide variety of definition (Chinn, 2006, Guillaume, 1999a, Cole et al., 2000) and no rigorous scientific definition or cut-off point (Luciano et al., 2003, Luciano et al., 2001).

2.1.1 Choosing cut-off points

Assessing obesity in children based on Body Mass Index (BMI) requires cut-off points. For children agreeing on an appropriate cut-off point is more complicated because Body Mass Index in childhood changes substantially with age. Children do not reach BMI 25 and 30 until they are fully mature. Therefore, the

anthropometric cut-off for children is adjusted for age and sex (Burniat et al., 2002).

BMI for age percentile charts for boys and girls are available depending on reference population, various cut-off points have been published to define obesity (Rolland-Cachera et al., 1991, Conde and Monteiro, 2006, Cole et al., 2000). For example, BMI reference curve for children and adolescents is available in France (Rolland-Cachera et al., 1991) which is based on the Quetelet Index (Weight/Height^2) and age. This was devised from 494 French children followed from the age of 1 month, of whom 117 were observed until the age of 16 years old. Based on this longitudinal study of growth, a national reference chart was established to be used by clinicians and epidemiologists. Similarly, in Brazil, a national reference was established for nutrition status (underweight, overweight and obese) based on 13,279 males and 12,823 females aged 2-19 years old from the National Nutrition and Health Survey database (1989) (Conde and Monteiro, 2006).

The BMI value can also be analyzed using Center of Disease Control and Prevention (CDC) Growth Chart (CDC/NCHS, 2000), which was developed to evaluate the nutritional status of US children. This originated from a large representative survey carried out between 1963 and 1994. Previously in the 1970's, multiple growth charts were developed by NCHS (National Center for Health Statistics), and were adopted by WHO for worldwide use. Later the Centers for Disease Control and Prevention (CDC) modified the 1977 NCHS growth curve and developed a modified version, this was again adopted by WHO and has been widely used internationally. This recommended that for children and adolescents,

overweight was defined as a BMI between the 85th and 95th percentile for age and sex and obesity a BMI of ≥ 95th percentile. Similarly, further different growth reference charts have been constructed in the United Kingdom, main UK Growth References currently used are demonstrated in Table 2-1.

Choosing cutoff points that could be internationally representative or act as a “gold standard” for obesity is complex due to the difficulty in choosing an appropriate reference (Burniat et al., 2002).

Therefore, in contrast to Must and colleagues who published value (percentile) solely from North American population (Must et al., 1991) or Conde and Monteiro that suggested value based on purely Brazilian population data (Conde and Monteiro, 2006). The International Obesity Task Force (IOTF) used a novel approach, by pooling data from 2-18 year old children sampled from six different countries: Brazil, Great Britain, The Netherlands, Hong Kong, Singapore and United States. This large international cross sectional survey established standard cut-off points adjusted for age and gender to define childhood obesity and overweight (Cole et al., 2000). Centile curves were constructed for each national sample of over 10,000 subjects and the results were averaged across the six countries and presented either in curve or in a tabular form for overweight and obesity for age range of 2-18 years by gender (Appendix I).

There have been strong arguments as to whether it is appropriate to use national or international reference data for defining paediatric obesity. For example, the international reference has been proposed in the United Kingdom. However, this could create a clinical problem as the national reference permits assessment of

both overweight and underweight on a single clinical form, while International reference does not cover the underweight. Therefore, in clinical practice this can cause confusion by using two different charts (national reference data for underweight and international reference data for overweight). An additional reason for using national reference data to monitor BMI is that reference is derived from the same data sets. However, the international reference data will facilitate global comparison of obesity whilst the national BMI reference data is also safe, practical and sufficiently strong and can be recommended for use in clinical and national epidemiological studies (Reilly, 2002).

Table 2-1: UK growth references in current use

References	Publication	Age	Measurements
Gairdner-Pearson (GP)	Gairdner &Pearson 1997	28 weeks to 2 years	Centile for weight, height and head circumference
Buckler-Tanner (BT)	Buckler et al. 1997	2 years to 20 years	Weight, height and stage of puberty
UK 1990 (UK90)	Cole et al. 1998	Birth to 23 years	Centile for weight, height, BMI and head circumference
Tanner-Whitehouse (TW)	Tanner et al. 1966	Birth to 19 years	Centile of weight, height and velocity

2.1.2 Method of body fat measurements

The criteria used to measure obesity in children and adolescents varied widely. Among populations, weight is the most common measure of obesity. But in the laboratory and clinic or as a research tool more specific measurements of body fat are used such as under water weighing, Dual Energy X-ray Absorpiometry (DEXA) (Taylor et al., 2002), Computer Tomography (CT) or Magnetic Resonance Imaging (MRI) (Lee and Gallagher, 2008). These are generally not used in routine clinical practice because of high cost and limited access. However, in clinical practice it is

desirable to have an ideal measure which is accurate, precise, accessible, simple and requires minimum time and effort (Burniat et al., 2002).

2.1.2.1 Hydrodensitometry- underwater weighing

This method of measurement involves underwater weighing of subjects, wearing bathing suits and submerging in a water tank, once under water the weight is recorded. This requires a significant co-operation and can frighten the children, it is also time consuming and requires expensive equipment, so it is also impractical for use in large group field testing (Bray et al, 2002).

2.1.2.2 Dual Energy X-Ray Absorptiometry– DEXA

DEXA machine scan the whole body with subjects lying in supine position, the scanner determines total fat mass, lean mass and bone mineral content (Taylor et al., 2002). Although the DEXA is well accepted and highly accurate, the accuracy of DEXA as a measurement of fat been highly correlated with intra-abdominal fat measured with CT and MRI (Treuth et al., 1995), due to its cost and low dose radiation, is thought not to be suitable for large population studies (Mei et al., 2002).

2.1.2.3 Bio-Electrical Impedance Analysis - BIA

This method works on the principle that body fat contains no water and therefore it has a high electrical resistance or impedance. The BIA measures the amount of bioreisistence in the body to determine Body Fat percentage (%BF). Bioresistance is an indication of a person's conductivity. Lean tissue is conductive, thereby having low bioresistence, whilst fat tissue is less conductive due to its low water content. For this reason, a person with low bioresistence (for their height, weight and gender) will therefore have a low %BF. The Electrodes are placed on the

extremities, usually the hands and feet and passing a low, safe electrical current through subject's body to measure impedance between electrodes. BIA has been supported by some researchers (Boot et al., 1997, Casanova Roman et al., 2004), whilst others have found it less accurate in comparison to other methods such as DEXA or anthropometry (Eisenmann et al., 2004, Bray et al., 2002).

Casanova and colleagues tested the reliability of BIA device and anthropometry in 365 healthy children aged 6 to 14.9 years and found that fat-free mass estimated using BIA and anthropometric variables was highly correlated with interclass correlation coefficients, 0.948 in boys, and 0.945 in girls (Casanova Roman et al., 2004). Additional support from Boot and colleagues found high correlation between BIA and DEXA in healthy 403 healthy Caucasian Dutch children (Boot et al., 1997). In contrast, a study of 75 children aged 3 to 8 years old found a low correlation coefficient for BF% estimated by BIA and found that BIA significantly underestimate the body fatness as compared to DEXA (Eisenmann et al., 2004).

2.1.2.4 Anthropometry

Anthropometry is universally applicable, inexpensive and non-invasive method and the most widely used are weight, height, skinfold and waist circumferences. Table 2-2 describes the advantage and limitation of practical methods used in clinical practice to describe body fatness (Kopelman, 2000).

Although, all of the three most simple and commonly used anthropometric tools (BMI, skinfold thickness and waist circumference) are sensitive and specific enough to use in children and adolescents, the recommendation of their use, in terms of using either one method or combination of methods varied widely in the literature (Sarria et al., 2001). For example, Eisenmann et al (2004) suggested that

anthropometry (BMI and Skinfold thickness) is a reasonable representation of the BF% and useful in estimating body composition in children and adolescents, especially during adiposity rebound and wide epidemiological study (Eisenmann et al., 2004). Whilst Lee and colleagues (2006) and Taylor and colleagues (2008) indicated the use of combination of BMI and waist circumference, however Mei and colleagues (2004) and Freeman and co-workers (2007) suggested BMI alone is sufficient and other methods of skinfold and waist circumference do not provide additional information on body fat.

2.1.2.5 Skinfold thickness (SFT)

This method measures subcutaneous fat at different sites of the body. The most popular site are triceps and subscapular area. However, skinfold of trunk could also be used as a predictor of intra-abdominal fat. Several studies supported the use of this method as an accurate predictor of body fat (Eston et al., 2005, Chan et al., 1998, Lohman et al., 1999, Sardinha et al., 1999). For example, among a group of 8 to 12 year old children Magnetic Resonance Imaging (MRI) was used to estimate the total body fat volume and percentage body fat and this was compared with assessment by bioelectrical impedance, skinfold thickness and body mass index (BMI), their result indicated that skinfold measurement gives a reasonably good prediction of total body fat (Chan et al., 1998). It is fairly cheap and simple but there could be error whilst using this technique due to either skinfold site location, skinfold caliper or inter and intra-observer variation (Lohman et al., 2000, Lohman et al., 1999), especially in fat subjects because of the difficulty in measuring SFT, the BF% could easily be underestimated (Eisenmann et al., 2004). Therefore, strict quality control is necessary which increase the overall cost of this technique but once technical errors are minimized through accredited training it is well accepted. In addition, as subject need to be partially undressed,

that can lead to subject refusal, but its mobility and the accuracy of skinfold method it has been used in many studies, makes it a useful method for measuring body fat in field (Eisenmann et al., 2004).

2.1.2.6 Waist circumference

This method is a good predictor of intra-abdominal fat (Taylor et al., 2000), it is cheap and simple with a smaller measurement error compared to skinfold method. Taylor and colleagues stated that to predict health risk associated with obesity in youth (age 8-17 years old) additional waist circumference should be added to BMI percentile (Lee et al., 2006, Taylor et al., 2008).

2.1.2.7 Body Mass Index

Body Mass Index (BMI) is internationally recognized and classified into normal weight, overweight and obese group and it is calculated as weight (kg)/height $(m)^2$. As previously mentioned the cut-off point is age and gender specific ranging from 2 to 18 years old at 6-monthly intervals, which have been developed from pooled data of six representative countries (Cole et al., 2000). It's validation has been reported and significantly correlated to DEXA. Moreover, it has been accepted as the most reasonable measurement for assessing body fat among children and adolescents (Taylor et al., 2002). Although it has some limitation such as inability to recognize the fat mass from muscle mass or oedema, but because of its simplicity of use, and strong association with body fat percentage, it is widely used.

In 1982 Rolland-Cachera and co-workers stated that the W/H^2 (Quetelet Index) was the best and the most suitable technique to use for children in comparison to W/H or W/H^3 (Rohler Index) (Rolland-Cachera et al., 1982, Mei et al., 2002) but

later Rolland-Cachera suggested that in addition to measuring weight and height or body mass index (BMI), triceps skinfold (SF) measurements should be added to BMI among adolescence to predict percent of body fat (Rolland-Cachera, 1993).

A relatively recent survey of 26 countries showed that BMI was the most popular index (Guillaume, 1999a, Guillaume, 1999b) and the precision of body mass index (BMI) was the highest in comparison to waist/hip, waist/thigh circumferences and skinfold thickness (Mueller and Kaplowitz, 1994) and these measurements do not provide additional information on excess of body fat in children and adolescents (Mei et al., 2007, Freedman et al., 2007b).

Table 2-2: Advantage and limitation of different body fat measurement

Methods	Definition	Limitation	Advantage
BMI	Weight in kilograms divided by square of height in meters.	It dose not distinguish fat mass from lean mass.	1)Cheap and simple; 2) BMI correlated strongly with densitometry measurement (such as DEXA and underwater weighing) of fat mass.
Waist circumference	Measured in (cm) at midpoint between lower border of ribs and upper border of the pelvic bone.	Waist circumference and waist to hip ratio to assess upper body fat deposition; neither provide precise estimates of intra-abdominal (viscera) fat.	1) Cheap and simple; 2) Smaller measurement errors compare to skinfold thickness.
Skinfold thickness	Measurement of skinfold thickness in (cm) with callipers. Provides a more precise assessment if taken at multiple sites (most commonly the triceps and subscapular sites).	1) Subject to considerable variation between observers; strict quality control required necessary which increases overall cost; 2) Requires accurate callipers, and does not provide any information on abdominal and intramuscular fat; 3) Subjects need to partially undress. 4) May not apply especially those with abnormal growth.	Cheap and simple.

2.1.3 Prevalence of obesity

The prevalence of overweight and obesity is increasing both in adults and children, this increase in prevalence is already evident in developed countries (Dehghan et al., 2005). For example, in the United States and other higher income countries over the past 15 years the prevalence of obesity among children has increased dramatically because the structure of dietary intake has changed, mainly because of the availability of fast food and processed foods and also an increase in snacking (Popkin and Doak, 1998, Popkin, 2004).

Adair, has stated that more and more children in United States are becoming overweight (Adair, 2008). Odgen and colleagues demonstrated a significant increase in percentage of overweight among children and adolescents in the United States aged 2-19 year old during six year period between 1999-2004, where among both female and male increased from 13.8% and 14% to 16% and 18% respectively, using CDC growth chart (Ogden et al., 2006).

Kain and co-workers (2002) has also demonstrated the trend of overweight and obesity over time among Chilean children over a period of 13 years, using three different criteria of weight for height (WHO), BMI (CDC) and BMI (IOTF). They found that although the trends increased markedly over time, the prevalence varied according to the criteria used. For example, the prevalence of overweight increased from 15% in 1987 to 20% in 2000 for boys and 17.2% to 21.8% for girls using (W-H) weight for height (WHO). With BMI (CDC) the increase was from 13.2% to 19% for boys and 12% to 18.5% for girls.

There is also rising concern over the increase of prevalence of overweight and obesity among children in Great Britain (Jebb et al., 2004). A representative

sample of 4 to 18 years old in 1997 demonstrated the prevalence of obesity and overweight was 4% and 15% respectively based on IOTF cut off points (Jebb et al., 2004). The National Study of Health and Growth of England carried out between 1974- 2003 has shown the prevalence of obesity among children aged 5-10 years old has increased from 1.2% in 1984 to 6% in 2003 in boys and from 1.8% to 6.6% in girls (Stamatakis et al., 2005).

The prevalence of obesity has also increased in developing countries (Dehghan et al., 2005). WHO available data on prevalence of obesity and overweight from 191 countries around the world has illustrated different prevalence rates of overweight and obesity by region with prevalence rate noticeable increased in the Middle East, Central and Eastern Europe, and North America (James et al., 2001).

Arabian Gulf countries, namely Kuwait, Bahrain, Oman, Qatar, Saudi Arabia and United Arab Emirates share similar cultural, social and environmental characteristics and have experienced similar rapid economic development, since the oil boom (1973-1981) (Musaiger, 1985). This economic development has affected the dietary habits and lifestyle of residents of Gulf States (Musaiger, 1993) with an increase in prevalence of obesity among children and adults in this region (Al-Sendi et al., 2003, Al-Mahroos and Al-Roomi, 1999, Al-Rukban, 2003).

There have only been limited studies conducted in UAE, Al-Haddad and colleagues reported the prevalence of obesity and overweight amongst children aged 6-16 years resident in the Ras-Alkhaima Emirate by measuring BMI using US Reference criteria, 8.5% for boys and 9.3% for girls were found to be overweight and 7.9% for both sex were obese, in this sample of schoolchildren

they were 1.8 times more obese than US children of the same age (Al-Haddad et al., 2000). The National Survey of UAE (1998/1999) which was carried out in all seven emirates, Abu Dhabi, Al-Ain, Dubai, Sharjah, Ajman, Um Al-Qwain, Fujairah and Ras Al-Khaimah on 16,391 UAE nationals showed that prevalence of obesity among UAE youths age 4 to 18 years old was two to three times more than International childhood BMI standard (IOTF), children below 9 were found to be below the IOTF standard for obesity and overweight, whilst there was an increase from nine until the age of 18. For example, the prevalence of overweight increased from 16.4% at age of 10 to 29% at age of 18 years, and obesity from 6.1% at 10 years to 18% at 18 years old among males. Similarly, 22.8% of female were found to be overweight at 10 year old and reach to 27% by age of 18 years whereas 7.8% were obese at 10 and 9.8% at 18 years old (Al-Haddad et al., 2005).

Since the previous study covered only UAE national, Malik and Bakir, conducted another study among 5 to 17 year old children and adolescents which represented the whole UAE population. In addition, they covered both urban and rural areas as they considered there might be a difference in the lifestyle of urban and those living in rural areas, where nutrition transition is more obvious in contrast to those living in rural areas that follow the Bedouin lifestyle and were more likely to maintain a traditional eating behaviour. Therefore, a sample was collected from Abu Dhabi representing rural area, City of Al-Ain representing inland area, and Hatta, Al-Awir and Khwanij within Dubai representing rural area. Using IOTF cut-off points, the prevalence of both obesity and overweight was higher among girls as compared to boys, increased in the 11-13 years old and lowest among the age 5-7 years old. The overall prevalence of overweight was 21.5% and obesity 13.7%, in general more girls were overweight than boys and non-citizen girls were

more likely to be obese than UAE girls and boys from rural area who had a lower rate of both obesity and overweight (Malik and Bakir, 2007). Table 2-3 summarizes the data available on prevalence as recorded by percentage for both obesity and overweight in different populations using different methods, which inevitably makes the comparison between countries difficult.

Table 2-3: Prevalence of obesity in children and adolescents in Arabian Gulf and several European countries

Authors	Country	Reference	Age	Sex	
				Boys	Girls
Amin et al. 2008	Saudi Arabia: Al Hassa	Tim Cole's Cut-off table	10-14	14.2% * 9.7% **	
Al-Rukban Mo 2003	Saudi Arabia: Riyadh	BMI age specific percentile	12-20	13.8% ≥ 85th * 20.5% ≥ 95th **	
El-Hazmi and Warsy, 2002	Saudi Arabia: East & South Province		1-18	10.68% * 5.98% **	12.68% * 6.74% **
Al-Nuaim et al. 1996	Saudi Arabia: Riyadh & Southern Region	CDC reference	6-18	11.7% * 15.8% **	
Al-Isa, 2004	Kuwait	BMI ≥ 85th * BMI ≥ 95th **	11-14	30% * 14.7% **	31.8% * 13.1% **
Al-Isa and Moussa, 2000	Kuwait	CDC reference	6-10	15.7% **	13.8% **
Al-Sendi et al. 2003	Bahrain		12-17	15% **	18% **
Malik & Bakir 2007	UAE	IOTF Criteria	5-17	Overall (both sexes) 21.5% * 13.7% **	
Al-Haddad et al 2005	UAE	Tim Cole's Cut-off table	4- 18	They were 2 to 3 times more than IOTF	
Al-Hourani et al. 2003	UAE	NHANES Ref. Data	11-18		14% ≥ 85th † 9% ≥ 95th *
Al- Haddad et al. 2000	UAE	US Ref. Data	6-16	16.5% ≥ 85th * 8% ≥ 95th **	16.9% * 8% **
Ogden et al 2006	USA	NHANES Ref. Data	2-19	14% (1999) ≥ 95th * 18.2% (2006) ≥ 95th *	13.8% ≥ 95th * 16% ≥ 95th *
Sanigorski et al. 2007	Australia	IOTF Criteria	4-12	19.3% ± 0.08% * 7.6% ± 0.6% **	
Stamatakis et al 2005	UK	UK Ref Data	5-10	1.2% (1974) 1.8% (2003)	6% 6.6%
Moreno et al. 2002	Spain	IOTF Criteria	6-7	21% (1985-86) ** 34% (1995-96) **	25% ** 36% **
			13-14	13% (1985-86) ** 21% (1995-96) **	16% ** 21% **

† (at risk of overweight), *(Overweight), ** (Obese)

2.1.4 Risk factors/etiology of obesity

Obesity is a multifactorial disease. Several factors have been highlighted as a “risk factors” for the development of obesity.

2.1.4.1 Genetic versus environment factors

The genetic role in relation to development of obesity has been highlighted in adoption, twin and family studies (Stunkard et al., 1986b, Stunkard et al., 1986a, Bouchard et al., 1990). The adoption study of Stunkard and co-workers (1986) among 540 Danish adoptees showed the children had BMI closer to their biological mother than the adopted parents (Stunkard et al 1986a). In addition, a longitudinal study of 5,884 monozygotic twins and 7,492 dizygotic pairs, in which weight and height were measured at 20 years old, after 25 years follow-up showed that identical twins had similar BMI whether raised together or apart. This was a first step in identifying genetic influence in humans that suggested a strong genetic influence on human fatness and obesity (Stunkard et al 1986 b). Furthermore, long term overfeeding of identical twins (monozygotic twins) suggested a genetic influence on susceptibility of an individual to gain weight (Bouchard et al.1990).

Bouchard (2009) in a brief review on the role of genetics in childhood obesity, stated that parental obesity increases the risk of childhood obesity (Bouchard, 2009). However, the rapid increase in prevalence of obesity worldwide suggests the importance of environmental change rather than the genetic background of obesity (Duncan et al., 2009, Lee, 2009).

2.1.4.2 Environmental factors

In search for the cause of obesity it is widely agreed that the increase of prevalence of obesity is so rapid that it cannot be blamed primarily on genetic factors, because our genes have not changed substantially during the past two decades, therefore non-genetic factors such as current environment and behavioural issues play a major role and promote high energy intake and low energy expenditure (Hill and Peters, 1998).

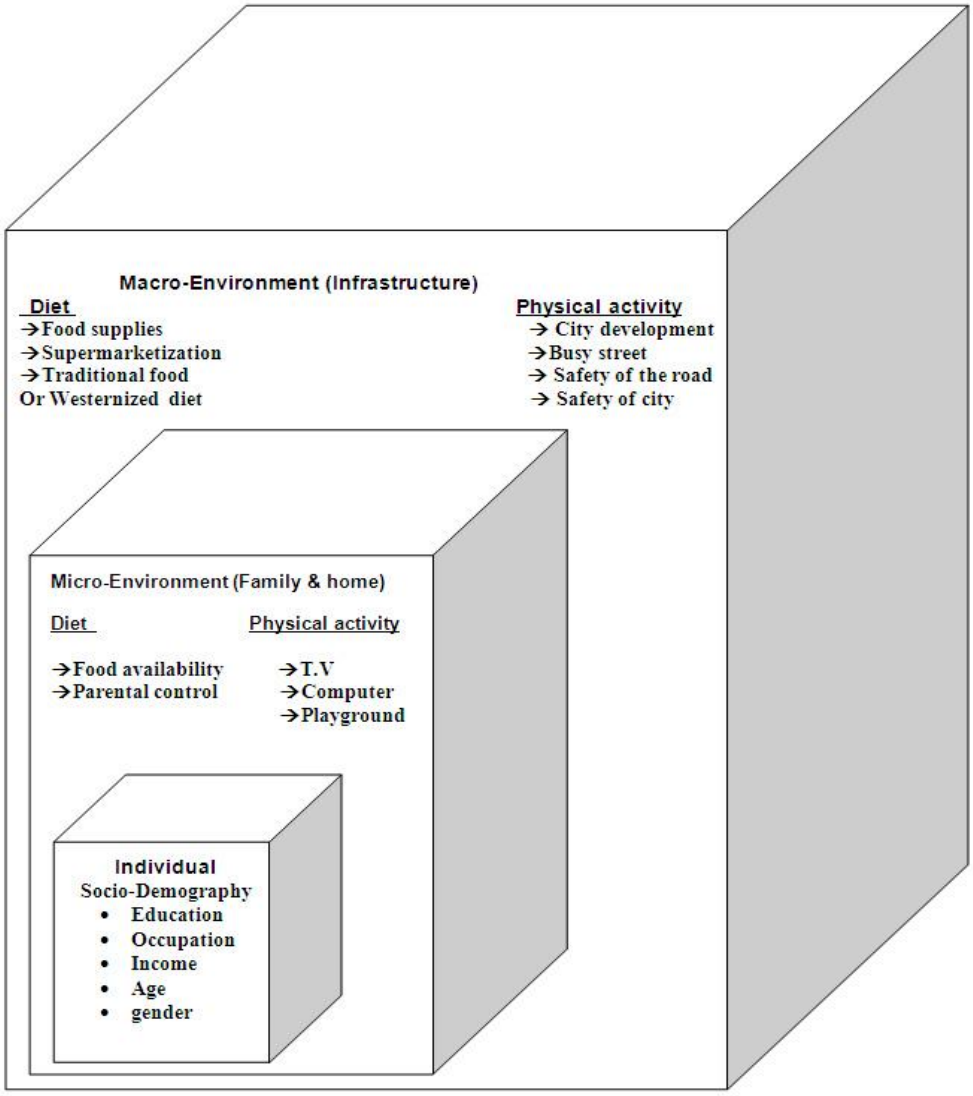
Weight gain and obesity results when there is an imbalance between energy intake and expenditure, by which energy intake exceeds expenditure resulting in the deposition of fat, therefore dietary and physical activity behaviour are identified as key factors. Although obesity has both genetic and environmental origins, the majority is caused by environmental factors (Sorensen, 1995, Kopelman, 2000).
According to the World Health Organization (2003) a potential contributor to obesity development was identified and mainly blamed on dietary habits and eating behaviour including snacking, eating frequency and extensive consumption of high fat, high sugar foods and a concomitant reduction in physical activity (WHO, 2003).

Moreover, behaviour is influenced by the environment, the eating habits of people have changed gradually and become more sedentary due to the gradual change of environment in which people live (Saarloos et al., 2009).

The environmental factors can be divided into micro- environment such as home, school, work or macro-environment which include broader infrastructure that may support or hinder health behaviour such as city development, town planning,

urbanization, transport system, technological change and supermarketization (Saarloos et al., 2009). Besides environmental factors, individuals are also different in their behaviour based on their socio-demographic characteristics, beliefs, attitude and culture (Figure 2-1).

Figure 2-1: Factors related to obesity



2.1.4.3 Behavioural factors

This section reviews the literature of behaviours relevant to obesity. These include dietary behaviours and physical activities. The review of the literature with regard to dietary habits includes the food intake in both children and adults revealed a

wide variety in the pattern of eating, such as daily number of meals (Toschke et al., 2009), home environment, parental influence (Utter et al., 2008), availability, selection of food, snacking and role of breakfast, that influenced body weight (Burniat et al., 2002).

2.1.4.3.1 Number of meals per day

A recent study among 4,642 children aged 5 to 6 years in Germany revealed that the prevalence of obesity decreased by the number of daily meals. The study concluded, “high meal frequency was inversely associated with childhood obesity” (Toschke, 2009).

2.1.4.3.2 Family meal versus away from home meal

The family and home environment influence adolescents’ nutrition due to many factors such as parental modeling, accessibility of healthy or unhealthy food, supervision of healthy eating and parental influence on eating behaviour (Utter et al., 2008). Furthermore, age was negatively associated with frequency of family meals. Adolescents eating with the family had a lower BMI, those who reported having family meals also consumed more fruit, vegetables and did not skipping breakfast, had less soft drink and fast food (Utter et al., 2008). The restaurant meals are typically high in calories and fat and lower in valuable nutrients than meals prepared at home (Sallis and Glanz, 2006).

The negative effect of food intake away from home was also confirmed in a cross sectional study conducted by Gillis and Bar-Or (2003). Their study compared dietary habits of 90 obese and non-obese children aged 4-16 years old and showed that although the diet of both the obese and non-obese was low in fruit, vegetables and milk and it was high in meat, and they did not meet the nutrition

recommendation. Obese children consumed significantly more away from home, more meat, sugar sweetened drinks and fat in the form of potato chips compared to non-obese (Gillis and Bar-Or, 2003).

Adair and Popkin's study suggests the dietary pattern of children has transformed globally, especially in countries that are undergoing nutritional transition. The 24 hour dietary record of children aged 2 to 19 years old was used to investigate snacking behaviour, eating away from home, soft drinks and fast food consumption from nationally representative data worldwide, such as United State, Russia, China and Cebu (Philipines). These countries represented different levels of modernization (Adair and Popkin, 2005). In all age groups, children from US and Cebu consumed more food away from home. There were also age differences in all countries. For example in US, preschoolers consumed less food away from home than older children. The extent of snacking was also different across four countries, in the Philippines and US snacking was prevalent and mainly processed or fast food. Whilst Chinese consumed less food away from home, their snacking was typically nuts, fruits or biscuits. Eating in restaurants was rare for Chinese families and similarly for Russians. Fast-food played a more dominant role in the American diet including consumption of soft drinks with their fast food. Fast food remained relatively expensive in the Philippines, Russia and China in comparison to their local traditional meal purchased at a street vendor and there was a limited invasion of fast food and soft drink.

The major shift in eating behaviour has been observed across all age groups in US population from 1977 to 1996, in that energy intake from food eaten at home has been replaced substantially by fast food and restaurants. Also a large

proportion of snacking and daily meals are consumed with soft drinks. The consumption of milk and meat products has decreased substantially. Therefore this shift in eating behaviour should not be looked at in isolation, but include the environmental change that has encouraged people to make unhealthy choices of food (Adair and Popkin, 2005).

2.1.4.3.3 Food preference

Food preference has been shown to predict what children eat. Several studies have shown that food preference is related to age or gender (Lytle et al., 2000, Cooke and Wardle, 2005). For example, Lytle and co-workers (2000) have reported that the diet quality especially consumption of fruit and vegetables and milk decreased by age, whilst soft drinks increased (Lytle et al., 2000). Moreover, an investigation of food preference among a large sample of 1,291 British school children, 4 to 16 years old in three primary and three secondary schools in West London, children preferred fatty and sugary food, whilst vegetable and fruit had the lowest rating. This pattern of food preference was significantly increased by age and boys had less healthy food than girls (Cooke and Wardle, 2005).

2.1.4.3.4 Skipping breakfast / skipping meals

The effect of skipping meals and specifically breakfast has been investigated widely. Breakfast consumption among children and adolescents has many benefits for their health, such as improving their cognition and school performance and achievement (Gajre et al., 2008), due to increase in level of blood glucose (Benton and Parker, 1998, Pollitt and Mathews, 1998) as well as reducing snacking frequencies later in a day (Brugman et al , 1998). Moreover, several studies support the association between skipping meals and especially breakfast with obesity (Cho et al., 2003, Vanelli et al., 2005, Rashidi et al, 2007, Croezen et

al., 2009), mainly due to imbalance of eating (Cho et al., 2003) and frequent snacking latter in the day (Vanelli et al., 2005).

The percentage of skipping breakfast was more often among low parental education and also among older children and girls due to dieting and body image concern and those with single parents due to lack of time to prepare breakfast among 4-15 year old Dutch children (Brugman et al , 1998).

Breakfast consumption pattern and trend between 1965 and 1991 in the United States was also investigated based on large sample of children and adolescents from Nationwide Food Consumption Survey (NFCS). These data showed that breakfast consumption had declined dramatically related to behavioural changes and a shift in population characteristics such as increased female education status, and changes in the pattern of employment of women as a head of household. This has parallels with the decline in consumption of breakfast in all age groups, but significantly amongst adolescents where the greatest decline was observed among the girls (Siega-Riz et al., 1998). It was thought that the most common reason for skipping breakfast is due to poor time management, preventing children having breakfast and the mother from preparing breakfast (Fernandez Morales et al., 2008, Vanelli et al., 2005). Skipping breakfast as already indicated is associated with lack of time to prepare during the week, the opposite is true at the weekends, in that breakfast was more frequent as children and parents are not in such a hurry or indeed stressed to reach work and school on time (Vanelli et al., 2005).

In a study among 35,000 Dutch adolescents in grade 2 (13-14 year of age) and grade 4 (15-16 year of age), skipping breakfast was identified as the most important risk factor for overweight and obesity (Croezen et al., 2009).

2.1.4.3.5 Soft drink

During the past decade, consumption of beverages has significantly changed (French et al., 2001). It is important to investigate the beverage consumption among children because of the potential impact on their health. Soft drinks are also believed to increase energy due to the sugar content (Giammattei et al., 2003). Increased consumption of soft drinks and fruit drinks has also been linked to an increase in the risk of dental decay (Marshall et al., 2007), bone fracture (Wyshak and Frisch, 1994) and also associated with a decreased intake of calcium because of milk replacement by soft drinks (Vartanian et al, 2007). Therefore, this reduction in calcium intake is a risk factor for the development of obesity as calcium regulates lipogenesis and lipolysis in lipocyte (Striegel-Moore et al., 2006, Parikh and Yanovski, 2003).

Increase in consumption of soft drinks in the past decade is also paralleled to the increase in obesity. French and colleagues have shown among 6-17 year old children between 1977/1978 to 1994/1998 that the mean consumption of soft drinks per day among school-aged children has more than doubled. The overall prevalence of soft drink consumption increased from 37% to 58% respectively and this increase tended to be greatest among boys, and the home environment was the largest source, whilst other sources such as restaurants, fast food and vending machines were also found to be responsible (French et al., 2001).

Further studies support the possibility of increased soft drink consumption as one of the causal factors in the obesity epidemic. A systematic review between “1966 to 2005” which included a total of 30 studies, 15 cross sectional, 10 prospective and 5 experimental, demonstrated a positive association between soft drinks with weight gain and obesity in children and adolescents. This review found a positive association in most of the cross sectional studies and four of the prospective studies (Malik et al., 2006, Wolff and Dansinger, 2008).

In another recent prospective study of 51,603 women, Schulze and colleagues demonstrated that the consumption of sweetened beverage was associated with overweight after adjustment for lifestyle and dietary factors after an eight years follow-up (Schulze et al., 2004). In addition, in a cluster-randomised control trial in school children (age 7-11 years), James and coworkers found that reducing consumption of soft drinks was associated with a reduction in prevalence of obesity and overweight after 12 months (James et al., 2004). The positive association between soft drink consumption with weight gain and obesity in children and adolescents, especially male adolescents has resulted in a dramatic increase in the consumption of soft drink (Kassem and Lee, 2004).

In a large cohort study of 2379 Black and White girls aged 9 -19, Striegel-Moore and colleagues found that beverage intake changed considerably with time and was different between those two groups. Black girls consumed less milk than white, but overall the consumption of milk decreased over time in both groups. Overall consumption of soft drinks increased by three fold over 10 years and was positively associated with BMI (Striegel-Moore et al., 2006). In contrast O’Connor

and co-workers (2006), did not show any association between beverage intake and BMI among preschool children aged 2 to 5 years old (O'Connor et al., 2006).

2.1.4.3.6 Physical activity

The Australian physical activity guideline recommends that adolescents aged 12-18 year old need daily exercise for at least 60 minutes and to restrict sedentary activities such as TV, games, computer to not more than two hours to keep them healthy (Spinks et al., 2007). Similarly, the American physical activity guideline (Donnelly et al., 2009), American Association of Pediatrics (American Academy of Pediatrics, 1992), WHO (2004) and IOTF (www.iotf.org) have recommended at least 30 minutes (adults) and 60 minutes (children) of moderate physical activity daily and reducing the time spent in sedentary activity (T.V, Video game) to less than 2 hours to prevent weight gain.

The “Built environment” which is defined as neighborhoods, roads, buildings, food source and facilities in which people live, work, educate, eat and play can affect children’s weight by shaping both their eating habits and their physical activity (Sallis and Glanz, 2006). Over the past decade the environmental change (obesogenic environment) has reduced opportunities for physical activity (Swinburn et al., 1999). For example, the lack of sidewalks, long distances to school, busy streets discourage walking and biking to school, and indeed other forms of outdoor activity among children and adolescents (Sallis and Glanz, 2006).

Physical activity of children and adolescents has been shown to be affected at the macro-environmental level such as transport system, safety of the road and city and access to public parks (Hill and Peters, 1998), and at the micro-environmental

level by access and availability of Television, electronic games, computers in the home environment which has increased the time in sedentary activity. Although children and adolescents spend a large amount of their time away from home such as at school, the family and home environment remain the most important place which affects both their diet and physical activity (Spurrier et al., 2008).

2.1.4.3.7 Sedentary activity and the impact of Television

Since a sedentary lifestyle has been linked to many chronic diseases such as hypertension, diabetes mellitus and obesity. the Committee of Sport Medicine and Fitness of American Academy of Pediatrics (AAPD) has promoted physical activity in early childhood as an important step in the development of health behvaiour to prevent chronic illness (American Academy of Pediatrics, 1992).

The American Academy of Pediatric has described viewing TV, movies, music, video games as a significant risk factor for development of number of negative health outcome such as aggressive behaviour, social problems, night mares, decreased school performance, sexual activity and obesity among children and adolescents. (American Academy of Pediatrics, 2001) .

Children today spend more hours in front of television than in past decades. Following introduction of TV to the community, sport has also declined significantly. There is evidence that physical activity among children and adolescents is dramatically displaced by time spent in front of TV, video, DVDs and games (American Academy Of Pediatrics, 1992). The guideline for TV viewing recommended by American Academy of Paediatrics for children aged 2 and older is up to 2 hours per day, however in developed countries 40% of adolescents spent more than 3 to 4 hours a day.

There are two mechanisms by which television viewing contributes to the development of obesity; first reducing energy expenditure and physical activity, secondly by increase in energy intake especially unhealthy food choice and snacking (Boynton-Jarrett et al., 2003).

The relationship between obesity and sedentary activity was observed in several studies (Dietz and Gortmaker, 1984, Gortmaker et al., 1996, Robinson, 1999, Boynton- Jarrett et al. 2003, Kuriyan et al., 2007).

William Dietz and Gortmaker have looked at the relationship between obesity and factors within physical environment such as season, region and population density on the prevalence of obesity among children 6 to 11 years old in US. They observed that the prevalence of obesity was lowest in summer as a result of increased outdoor activity and reduction of time at home and also alteration of diet or combination of factors (Dietz and Gortmaker, 1984).

Gortmaker et al (1996) observed a strong association between prevalence of overweight and hours of TV viewing in a nationally representative cohort sample of 746 youths aged 10 to 15 years old in the United States. Those youth viewing TV for ≥5 hours a day were nearly four times more likely to be overweight as compared to those watching 0-2 hours (Gortmaker et al., 1996).

Robinson and co-workers (1999) tested the role of TV, video games on development of body fat as well on dietary habits and physical activity among students aged 8 to 9 years. Children that were randomly allocated to the intervention group reducing the TV viewing had significantly decreased BMI,

triceps skin fold thickness and waist circumference and waist to hip ratio compared to control group (Robinson, 1999).

A further cross sectional study of 598 Indian adolescents aged 6-16 years showed that the duration of TV viewing and sleep hours were significantly associated with being overweight, increased television viewing was significantly associated with overweight (Kuriyan et al., 2007).

The family environment plays an important role in the development of health behaviour among children, as the parents are the key source of influence. Early childhood exposure to TV is found to persist into adulthood. Therefore, effort in reducing TV viewing among adolescents will need a changing in family viewing practice. Hardy and colleagues (2006) concluded in their cross sectional study of Australian adolescents aged 12-13 that the home environment and TV viewing was significantly associated with parents and sibling watching TV (Hardy et al., 2006).

Viner and Cole (2005) investigated 16,567 babies from 1970 British Cohort at 5, 10 and 30 years old. Data on TV viewing were available for 8,158 subjects and showed the higher the duration of TV watching was significantly associated with increased BMI at 10 and 30 years old (Viner and Cole, 2005). Furthermore, TV viewing was inversely associated with intake of fruit and vegetables as a result of high fat food replacement while watching TV (Boynton-Jarrett et al., 2003).

2.1.4.4 Socio-economic status in relation to obesity

The definition of Socio Economic Status (SES) is complex and is usually measured by indicators of human capital such as income, education and

occupation (Krieger et al., 1997). Children's socioeconomic status is determined by their parents' characteristics such as education and income (Wang and Zhang, 2006).

The relationship between SES and incidence and prevalence of diseases is well established. The review of the literature showed that the rate of mortality and morbidity from cardiovascular diseases, diabetes and cancer is different across different socioeconomic groups (Kaplan and Lynch, 1999). SES in addition influences dental caries and obesity (Ahn et al., 2008, Baltrus et al., 2005). For example, a cohort study of over 2500 women (1375) and men (1186) aged between 17 and 40 years in Alameda County, California found racial differences in weight gain. Black men and women tended to be heavier throughout their life than White. They concluded that this was largely due to lower socio-economic position of Black compared to Whites (Baltrus et al., 2005). A similar finding is reported by Ahn and colleagues where increased body weight was found to be associated with lower SES among 4010 adolescents in California aged 12-17 years (Ahn et al., 2008).

SES also influences food choice and dietary habits. Dietary habits have been identified as a potential contributor to the development of obesity (Ricciuto et al., 2006, Turrell and Kavanagh, 2006). Higher socio-economic status was noted as a predictor for purchasing better quality and healthier food (van der Horst et al., 2007).

A prospective birth cohort study in four German cities among 2,637 children aged two years old, between 1999 to 2001 found an association between SES using

three indicators of education, occupation and income of their parents and food intake. The key finding was the impact of SES on food intake among children. Low parental education and low income was associated with low intake of fresh fruit, cooked vegetables and milk (Sausenthaler et al., 2007).

2.1.4.5 Demographic factors

Although researchers are concerned with SES as one of the risk factors for obesity and overweight, there are other factors such as demographic characteristics (age, gender, and ethnicity) that contribute to the prevalence of overweight and obesity. In other words, the association between obesity and SES may vary by gender, age or race (Ahn et al., 2008, Zhang and Wang, 2004).

For example, a significant difference was observed among 4010 California adolescents in the United States with mean age of 14.5 years according to age, gender, ethnicity and SES group in prevalence of overweight. Apart from lower parental education, boys, older age children and American Indian were more likely to be overweight due to their biological and behavioural characteristics (Ahn et al., 2008).

National Health and Nutrition Examination Surveys (NHANES) data between 1971 and 2002 for children and adolescents age 2 to 18 years old illustrated, the prevalence of overweight was different according to SES, gender, age and race. However, they stated that not all low SES groups were at increased risk of being overweight, but that considerable racial, gender and age differences also exist whilst considering overweight. For example, among low SES, White children were associated with being overweight, whilst in contrast high SES Black children were more overweight. Therefore, although White children with low SES might be at risk

of overweight and need more attention, the higher SES Black group should also be targeted (Zhang and Wang, 2004). Similarly, lower SES strata were identified at greater risk of obesity among UK population (Jebb et al., 2004, Stamatakis et al., 2005).

A longitudinal study of 6,928 adults over 34 years resident in Almada county in California showed a racial difference in weight gain, Black adults tended to be heavier throughout life than White, African American women and men weighed 4.96 kg ($p<0.001$) and 2.41 kg ($p=0.006$) more than White women and Black men respectively (Baltrus et al., 2005). Further, a significant difference in percentages of obese people was observed amongst different ethnic groups in a nationally representative US population between 2003-2004. Approximately 30% of Non-Hispanic White were obese compared to 45% Black and 36.8% Mexican American (Ogden et al., 2006). Similarly, Asian 4-18 year olds were four times more likely to be obese compared to White children of a similar age amongst a nationally representative sample resident in UK (Jebb et al., 2004).

The quality of diet was found to be different according to race and age, reported from the National Health and Examination Survey (NHES) 1999-2002 taking into account 1,521 American preschoolers aged 2-5 years old. Essentially overall diet quality significantly decreased with increased age ($p<0.001$) and improved with family income ($p<0.001$). However, certain ethnic groups had better diet quality than others related to their cultural background. Mexican American children from lower income families, had significantly better diet because their traditional diet consisted of a large proportion of fruit and high fiber vegetables compared to non-Hispanic White children (Kranz et al., 2008).

2.1.4.6 Stage of country development

The link between socio-economic status (SES) and obesity is also highly dependent on stage of industrial development of the country (Sobal and Stunkard, 1989). Generally, in industrized countries, low SES individuals are more likely to be obese than high SES (Klein-Platat et al., 2003), whilst in developing countries high SES are at increased risk of developing obesity (Sobal and Stunkard, 1989, Wang, 2001, Wang and Beydoun, 2007, Wang and Zhang, 2006). For example, among US adolescents there was a statistically significant reverse association between family income and overweight (Wang and Zhang, 2006), whilst in urban Tanzanians the obesity was positively associated with socioeconomic status (Villamor et al., 2006).

Modernization and economic growth can help to improve living standards but also contributes to changes in dietary pattern and increases the risk of diet related disease such as diabetes, cardiovascular disease and obesity. Many transition countries are recipients of considerable direct investment, this investment can benefit economic growth and result in better living conditions but at the same time contribute to nutrition transition, for example “supermarketization” of food resulting in dramatic shift from traditional diets to diets rich in refined carbohydrate, animal fat and processed food, fast food and confectionary and sweet beverages (Knai et al., 2007).

The WHO has identified poor dietary habits and eating behaviour including snacking, eating frequency and extensive consumption of high fat, high sugar foods and reduction in physical activity, as the potential contributors to obesity development (WHO, 2003).

2.1.4.7 Changing food price and availability

Changing food price has encouraged poor nutrition, for example the price of fresh fruit and vegetables had increased whilst the price of sugar, sweets, fat and oil have decreased. The biggest change in diet structure involves the increased consumption of fat and sugar simply because they are a cheap source of dietary energy available (Drewnowski, 2003, Drewnowski and Darmon, 2005b, Drewnowski and Darmon, 2005a, Drewnowski et al., 2004, Drewnowski and Popkin, 1997).

In summary, all over the world there is rapid development and urban growth with decline in agricultural employment and families moving to urban areas. More women are working to maintain their family's income, therefore preparation of traditional food, homemade food and having family meals in a traditional family environment has largely declined due to lack of time and costs and replaced by greater consumption of prepared ready meals from refrigerators which are high in fat, sugar and salt. In addition, due to economic growth, city development, and a fear of children's safely playing in public areas or outdoor parks, children spend more time in front of TV and have a sedentary lifestyle. This in turns gives easy access to snacking, confectionary and soft drinks whilst watching TV or playing video games. As a result the down side of this has led children to engage in sedentary activity as well as poor eating habits due to exposure to food advertising (Burniat et al., 2002).

2.1.4.8 Critical period of growth

Although obesity is associated with many factors such as socio-demographic, behaviour and genetic susceptibility, there is a critical period in childhood that

relates to development and persistence of obesity in later years (Dietz, 1994, Whitaker et al., 1998, Dietz, 1997).

A critical period refers to stage in which physiological alteration increases the risk of later disease. For example, intrauterine exposure of the fetus to rubella in the first trimester of pregnancy leads to blindness and deafenses, whilst at a later time there is no adverse effect (Dietz, 1994).

Body fat consists of fat cells or adipocytes. They either change in number or in size. In infancy, fat mass gain is mainly through adipocyte enlargement while after infancy fat mass gain is mainly through cell proliferation (Burniat et al., 2002). The body fat goes through several stages of physiological development, during the first year of life there is a rapid increase in size of adipocytes and therefore BMI increases, which then remains stable or even declines for several years until 5-6 years of age. The second phase of increase in fat mass and period of rapid growth in body fat in both number and size of adipocytes starts at 6 years old, this referred to as adipocity rebound (Knittle et al., 1979).

Rolland Cachera et al observed that an early adipocyte rebound in children is associated with a high risk of development and persistence of obesity. Adolescence is the final critical period for development of obesity due to significant physiological and behavioural change taking part at that time (Rolland-Cachera et al., 1984). Therefore, obesity that begins during these three periods appears to increase the risk of persistent obesity. In other words severity and age of onset affect the likehood of persistence of obesity.

Therefore, for development and persistence of obesity there are at least three critical or sensitive periods: The prenatal period, the period of adiposity rebound (AR) and adolescence.

- Prenatal period gestation or early infancy

Several large studies have confirmed the persistence of obesity in adulthood is due to early infancy fatness. For example, infants born of a diabetic mother (Pima Indean mother) were fatter at birth and also at later stage than non-diabetic mothers (Pettit, et al., 1983). In contrast, the 1944 Dutch famine was a natural experiment post Second World War, and through follow up studies of infants exposure to famine in the prenatal period, or in utero, or early infancy were compared to age matched controls that were exposed to famine in the first trimester. The prevalence of obesity was lowest among men exposed to famine in last the trimester of pregnancy or immediately postnatal than men who were exposed to famine in utero in first trimester (Ravelli et al., 1976).

- Adiposity rebound (AR)

The time of adiposity rebound has significant effect on weight in later life, illustrated by a longitudinal observation of a small cohort of 151 French children followed over a period from one month to 16 years. Children that had early adiposity rebound were found to be at greater risk of persistent obesity and fatness in adolescence and adulthood (Rolland-Cachera et al, 1984). A retrospective cohort study of Whitaker and colleagues showed that risk of adult obesity was highest in those who had early AR and also those who were heavy at AR, and was lowest in those who had late AR or were lean at AR (Whitaker et al., 1998). Children undergoing early rebound gain fat at a significantly faster rate and

tend to be taller and heavier with greater fat mass than children with late rebound (Taylor et al., 2004).

- Adolescence

Adolescence is the final period for the development of obesity (Dietz, 1997). A large national cohort study conducted in England, Wales and Scotland on individuals from birth to 36 years showed that among obese women at age of 36 years, 24% were overweight and 30% were obese at age 11 (Braddon et al., 1986). In addition, the Third Harvard Growth Study (1922- 1935) among 508 overweight adolescents aged 13 to 18 years old, a 55 year follow up showed morbidity and mortality was higher among both men and women if they were obese or overweight during high school and the adolescents age (Must et al,1992).

2.2 Definition of dental caries

Dental caries is a disease that is caused by three main factors: teeth, cariogenic bacteria and fermentable sugar, processed by exposure to acid produced during bacterial fermentation of carbohydrate (Rugg-Gunn and Nunn, 1999). Therefore, it is a chronic dietomacrobial, site specific disease caused by shift from protective factors favoring tooth remineralization to destructive factors leading to demineralization (Zero et al., 2009).

Dental caries is now well recognized to be a complex and multifactorial disease where many other factors have also been identified to be contributory (Rodrigues and Sheiham, 2000, Sayegh et al., 2002, Dye et al., 2004), such as host salivary and tooth structure, genetic factors, microorganism and dietary factors. In addition

other factors such as socio-economic status, ethnic origin, age, gender have also been identified to have an effect on caries development.

The dmf/DMF index used to report the amount of dental caries is the count of number of teeth (dmft/DMFT) or surfaces (dmfs/DMFS) in a individual's mouth that are decayed, missed or filled as a result of caries in either primary (dmf) or permanent dentition (DMF) (WHO, 2003).

2.2.1 Etiology of dental caries

2.2.1.1 Genetic factors and host oral environment

Although genetic factors such as tooth morphology, position, occlusion, tooth eruption time, salivary composition and salivary flow rate are important in caries development, the environmental factors such as diet especially carbohydrate and microbial plaque (oral hygiene) are the main contributors to dental caries (Hassell and Harris, 1995, Konig, 1995) .

2.2.1.2 Microbial etiology

Willoughby Miller (1902) together with William Black (1898) were the early researchers who established our knowledge of dental caries aetiology that bacteria in the presence of fermentable carbohydrate produce acid that can dissolve tooth structure (Zero, 2009) and that *Streptococcus mutans* is the main cariogenic organism despite the presence of more than 500 species found in oral cavity (Paster et al., 2001, Orland et al., 1954, Fitzgerald and Keyes, 1960). Studies by Orland and Fitzgerald demonstrated that dental caries will not occur in the absence of microorganism, animals that were fed high carbohydrate diet in a germ free environment did not develop caries (Orland et al., 1954, Fitzgerald and Keyes, 1960)

2.2.1.3 Dietary factors

Diet affects oral health in many ways, such as alcohol consumption and oral cancer (Garavello et al., 2009), excessive ingestion of fluoride and enamel fluorosis (Rugg-Gunn and Nunn, 1999), erosion and excessive consumption of acidic drinks and foods (Jarvinen et al., 1991), severe vitamin C deficiency and periodontal disease and (Pussinen et al., 2003). However, the focus of this review is predominantly on dental caries.

2.2.1.3.1 Sugars

The term “Sugars” refer to sucrose, glucose, fructose, maltose, lactose and galactose. However, sucrose is the most commonly associated with dental caries. A sucrose rich diet increase the growth rate of many oral bacteria and subsequently the composition of the oral microflora changes (Rugg-Gunn and Nunn, 1999). The term sugar in this report refers mainly to non-milk extrinsic sugars (added sugar).

It is generally agreed that sugar consists primarily of “empty calories” that provide large numbers of calories in small volume. Excessive sugar replaces more nutritious food which is beneficial to health such as vitamins, minerals, protein and fiber. Sugar has many adverse effects on health and considered to be a risk factor for diabetes mellitus, obesity and dental caries (Gaby, 2005).

Dental caries is a biofilm dependent oral disease and fermentable dietary carbohydrates are the key environmental factors involved in its initiation and development. In the absence of dietary sugar dental caries does not occur. Dental

caries was not a problem before wide spread production and consumption of sugar (Moynihan, 2003).

Increase in sugar availability and consumption has occured in parallel with the increase in DMFT (Sreebny, 1982). Stephan (1940) first demonstrated the relationship between caries and sugar and promoted “acidogenicity theory of caries aetiology” (Stephan, 1940). Since then many studies have reported the role of sugar in the aetiology of dental caries. For example, in Europe reduced sugar availability during the Second World War resulted in a reduction in dental caries and subsequent increase of dental caries after the war (Sognnaes, 1948), and reduction in dental caries level among children living in Hopwood House Children’s home in Australia who followed a strict lacto vegetarian diet that was low in sugar and refined flour (Harris, 1963). In addition, a link between sugar intake and higher caries level was also observed in those who work in an environment where there is potential for high sugar consumption such as Danish chocolate factory workers (Petersen, 1983) and biscuit factory workers in Finland (Masalin et al., 1990).

Moreover, frequency of sugar intake is also an important factor in caries development. The relationship between meal frequency and snacking of sweets or sugary snacks in between meals and dental caries was reported in Vipeholm study in Sweden (Gustafsson et al., 1954, Weiss and Trithart, 1960). The 1991 Committe on Medical Aspects of Food Policy (COMA) reported that caries experience was positively associated with both amount and frequency of non-milk extrinsic sugar in diet. According to Sheiham, 2001 “Sugars, particularly sucrose , are the most important dietary aetiological cause of caries, and in order to reduce

the level of dental caries, both the frequency of consumption and total amount of sugars intake should be reduced" (Sheiham, 2001).

Rodrigus and Sheiham (2000) reported a longitudinal study in North-Eastern Brazil where 510, three year old children attending low socio-economic nursery adopting a guideline of sugar reduction showed a significantly ($p<0.001$) lower caries increment compared to those attending non-guideline nurseries. Children attending nurseries not adopting a guideline on sugar had 4.8 times higher caries increment (Rodrigues and Sheiham, 2000).

2.2.1.3.2 Missing meals

Missing meals especially breakfast has direct influence on snacking during the day which are usually rich in carbohydrates and indirectly lead to increase consumption of sugar (Brugman et. al, 1998).

A study by Bruce Dye and his co workers (2004) on 4,236 US children aged 2 through 5 years, included in the Third National Health and Nutrition Examination Survey (NHANES III) from 1988 to 1994, examining eating practice and dental caries in children, showed that caries experience was significantly associated ($p<0.05$) with skipping breakfast (Dye et al., 2004).

2.2.1.3.3 Soft drink consumption

Sugar containing beverages and sugar sweetened soft drinks have been linked to adverse nutritional and health consequences such as dental caries (Shenkin et al., 2003, Heller et al., 2001, Sorvari and Rytomaa, 1991), potential enamel erosion (Amato et al., 1997), displacement of milk consumption, (Sorvari and Rytomaa, 1991) resulting in calcium deficiency with an increase risk of osteoporosis and

fractures and obesity (Bray et al., 2004). Soft drink consumption, has the potential to increase tooth destruction for two reasons, firstly the low pH leads to erosion of enamel surface and secondly the sugar is fermented by plaque organisms and produces acid which demineralizes the enamel (Tahmassebi et al., 2006) .

Lee and Messer (2010) showed that consumption of sweetened drinks is an additional source of sugar in children's diet and was significantly associated with caries ($p=0.004$) among 100 primary school children in Melbourne, Australia (Lee and Messer, 2010). Marshall has also suggested that the increased rate of soft drink consumption over time was associated with an increased rate of dental caries in a cohort study among 427 US children 4.5-6.9 years of age. He measured their height and weight and caries status of the primary dentition at 4.5-6.9 years and again at 7.6-10.9 years. 'Overweight' children had less educated fathers ($p<0.05$). Children 'at risk' of being overweight had higher caries rates than 'normal' or 'overweight' children ($p< 0.05$). In Stepwise logistic regression models to predict caries experience, mother's education had the strongest effect in the final model (Marshall et al., 2007).

Sayegh's and co-workers study, among 1,140 Jordanian children aged 4-5 years showed that the consumption of tea with sugar and fruit squashes was significantly associated ($p<0.05$) with caries severity (dmft ≥ 4.) (Sayegh et al. , 2002). A cohort study of 369 children, aged 3 to 5 years old, children who changed from being low consumers of soft drinks at baseline to high consumers after two years resulted in 1.75 times higher mean dmfs compared with low consumers of soft drinks at age 3-5 years old and again two years later (Lim et al., 2008).

Sohn et al, reported data from NHANES III (1988-94) concerning 2-10 year olds children from United States. Approximately 13% of children consumed high volume of carbonated soft drinks and displayed significantly more dental caries in their primary teeth than did children with other fluid consumption such as milk, water and juice (Sohn et al., 2006).

2.2.1.3.4 Protective diet

Apart from dietary products without added sugars which are considered to be safe, there are some dietary components which have a protective effect against dental caries. Milk is cariostatic, as it contains calcium, phosphorus and casein, which inhibit caries (Bibby et al., 1980). Cheese also has cariostatic properties by raising plaque calcium concentration which aids remineralisation (Moynihan et al., 1999), Xylitol containing sugar free chewing gum (Isokangas et al., 1988) or food that requires mastication and thereby stimulated salivary flow such as whole grain food and peanuts are also known to have a protective effect against dental caries (Moynihan, 2003).

2.2.1.4 Socio-demographic factors

These include demographic factors (Age, gender and ethnicity) and socio-economic factors.

As for age, the longer the teeth stay in the oral cavity; oral health status is more likely to be affected. This may be due to longer and more frequent exposure to plaque, therefore, over time both prevalence and incidence of dental caries increases (Savara and Suher, 1955, Peressini et al., 2004). Weddell and Klein (1981) showed a trend towards higher caries frequency among 441 children,

where the prevalence of dental caries among 12 to 17 month olds was (4%), whilst 20% among 24 to 29 month olds and 36% in those 30 to 36 months of age (Weddell and Klein, 1981). Tang and co-workers performed dental examination among 5171 preschoolers in Arizona, the prevalence of dental caries was approximately 35% and 49 % with mean dmft of 0.70, 1.35 and 2.36 respectively for 2, 3 and 4 year olds (Tang et al., 1997). Age and dental caries were also shown to be positively associated ($p<0.05$) among 650 children, 1- 6 years of age in Portland, Oregon (Savara and Suher, 1955). Similarly, Peressini and co-workers reported the prevalence of dental caries and mean DMFT(± sd) was 95% and 0.8 (±1.1) compared to 97%, 4.1 (±2.6) respectively among 7 and 13 year old adolescents (Peressini et al., 2004). Bajomo and colleagues reported doubling of mean DMFT from 12 year olds to 15 year olds among 519 South African school children, where the mean DMFT (sd) of 12 and 15 year old adolescents was 0.6 (± 1.50) and 1.26 (± 2.18) respectively (Bajomo et al., 2004).

With respect of gender a survey of dental caries among children aged 7 and 13 years old from Manitoulin showed that, boys in both age groups had significantly higher mean DMFT scores. The mean DMFT (±sd) for 7 years old was 1.0 (± 1.4) and 0.6(± 0.9) for boys and girls and for 13 year old was 4.7 (± 2.6) and 3.8 (± 2.6) for boys and girls respectively (Peressini et al., 2004).

As for the role of ethnicity, Perkins (1981) investigated the caries prevalence in 9-14 years old children in three ethnic groups, Caucasian, Asian and Negroid living in North-West London and reported significantly higher caries prevalence in the Asian group compared with the other ethnic groups (Perkins, 1981). Five years later Perkins investigated further the ethnic differences in caries prevalence of 5

year olds resident in North-West London and found significantly higher caries prevalence in Asian children as well as a higher proportion of untreated disease compared to the others. There were no significant difference found between Whites and Afro-Caribbean (Perkins and Sweetman, 1986). Bradnock and colleagues (1988) also reported on dental health of school children of similar SES but dissimilar ethnic origin in west Birmingham, children of Asian origin had a higher caries experience (Bradnock et al., 1988).

Dye et al (2004) studied 4,236 US children from third National Health and Nutrition Examination Survey (NHANES III) from 1988 to 1994 and demonstrated that caries experience was significantly ($p<0.05$) higher among non-Hispanic Black and non-Hispanic White children. In addition, untreated decay was significantly ($p<0.05$) associated higher among non-Hispanic black or Mexican American (Dye et al, 2004). Reidy et al (2001) reported that apart from parental belief, attitudes and health behaviour is important to understand the larger area of culture and environment in which individuals exist. Therefore, there are two main factors which can affect the oral health of children and adolescents: System level factors which include social, environmental and cultural as well as oral health care system and community water fluoridation programs, individual level factors which Include socio-economic, health beliefs, attitude, knowledge and oral health behaviour (Riedy et al., 2001).

The relationship between socio-economic status (SES) and general health as well the incidence and prevalence of diseases is well established (Marmot et al., 1991, Marmot et al., 1987). Dental caries is also similar to most chronic diseases in that it is strongly associated to SES (Rorigus & Shieham, 2000).

The study of Peres and collegues (2004) among 2,704, Brazilian adolescents aged 18 years showed that subjects from families with low parental education level, especially in mothers had significantly poorer dental health (Peres et al., 2005).

In another study of Peres and collegues (2007), among 888 adolescents aged 15 years old, adolescents from low income families, had worse pattern of dental caries (dental caries index). In addition, worse oral behaviour such as lower frequency of tooth brushing and attendance at dental service (Peres et al., 2007). In contrast, dental caries survey on 2,445 Mexican children aged 6-15 years old showed that DMFT and DMFS score increased by socio-economic level, which indicated more dental care, especially among girls, higher socio-economic level had 3 times more missing and also increase in restored teeth , which explain higer dental care compared to boys (de la Rosa, 1978)

2.2.1.5 Oral hygiene practice

The role of Fluoride in caries prevention has been studied since the early part of the 20th century when McKay found the positive correlation between motled teeth and reduction of dental caries in his practice. Later Trendley Dean conducted several studies in the United States between 1930 and 1940 linking dental fluorosis and fluoride in drinking water and experience of dental caries (Dean and McKay, 1939, Arnold et al., 1953) .

Daily tooth brushing with fluoride toothpaste is thought to be the primary reason for the caries decline that has been observed since 1970. Fluoride has a well documented effect in caries prevention primarily associated with its topical effect

of fluoride. Fluoride toothpaste is by far the most widely used method of applying fluoride to the teeth (Rugg-Gunn and Nunn, 1999). Studies have shown that the frequency of tooth brushing has significant association with caries prevalence (Pita-Fernandez et al., 2010, Kuusela et al., 1997b)

With regard to oral health behaviour, tooth brushing is the most effective method, and the recommendation is to brush twice a day (Sheiham, 1979). Despite considerable emphasis on additional tooth cleaning aids, such as flossing, dental floss is not commonly used (Honkala et al., 2007), therefore individual tooth cleaning consists mainly of tooth brushing. This was also confirmed by Kuusela et al (1997) investigating the oral hygiene habits (tooth brushing and flossing) of 11 year old school children in 22 European countries and Canada. Thirteen hundred school children represented each country, and demonstrated that dental flossing was rare, especially amongst boys, and brushing more than once a day was uncommon. Tooth brushing was less frequent among boys than girls ($p \leq 0.001$) in all countries except in France, where 61% of both boys and girls brushed twice daily. Family economy was not associated with brushing frequency in some countries (Denmark, Norway, Sweden, and France) whilst infrequent brushing and poor family economy was significantly associated in other countries such as Austria, Estonia, Wales and Greenland (Kuusela et al., 1997a).

Assessing oral hygiene habits among Finish, Norwegian and Swedish school children Rise and colleagues (1991) found a higher percentage of girls brushed their teeth more than once a day compared to boys and among girls the proportion increased by age (Rise et al., 1991). Furthermore, the survey on oral hygiene habits of schoolchildren in 22 European countries and Canada as

outlined above showed that in general tooth brushing was less frequent among boys (Kuusela et al., 1997a).

2.2.2 Prevalence and trends of dental caries

Although dental caries is a preventable disease, it is still a major health problem in many countries, with considerable variation in prevalence between and within countries, region, areas and ethnic groups. In spite of the dramatic decline of dental caries and improvement in dental health since 1970 in most industrialized countries, caries experience is still high among socially deprived communities and ethnic minorities where the minority of children (20%) have the majority of disease (80%). WHO Global Oral Health Data taken from1986-96 on Oral Health Surveys of 12 year old children demonstrated a trend towards a reduction of prevalence of dental decay in many developed (industrialized) countries (Appendix II-A).

There are limited data on the prevalence of dental caries, in the neighbouring region of United Arab Emirates and Gulf countries. However, high caries prevalence has been reported in the region. For example, in Kingdom of Saudi Arabia the overall caries prevalence among 789 pre-school children from Riyadh with a mean age of 4.7 years was 74.8% with mean dmft of 6.1 ±sd 3.9 with highest caries prevalence in mandibular second primary molars (54.3%) (Wyne, 2008). A recent study comprising 300 randomly sampled, 6-7 year-olds Bedouin children from military school in Jeddah City , dentally examined using BASCD criteria, showed only 4% were caries free and mean dmft was 8.08 ± sd4.04 , primary second molars were the most affected (83.35%) (Al-Malik and Rehbini, 2006).

Al-Dosari et al (2004) reported the caries prevalence and severity among 1,104 children from primary (6-7 year olds) and intermediate (12-13 year olds) school in Riyadh and Qaseem Regions in Saudi Arabia, utilising the WHO criteria for diagnosis of dental caries. Ninety one percent of the children from primary schools in Riyadh and Qaseem while 92.3% and 87.9% respectively attending Intermediate school for Riyadh and for Qaseem area demonstrated caries experience (Al Dosari et al., 2004).

Another study was conducted by Alamoudi, among 1522 children aged 6-9 years in Jeddah, Saudi Arabia found only 26% of the children were caries free, with mean dmft of 5.71 (Alamoudi et al., 1996). However, in 1982 Younes and El-Angbawi reported low level of dental caries experience amongst Saudi children aged 13 to 15 and attributed this to the type of food eaten, that is mainly traditional fare which is low in sugar (Younes and El-Angbawi, 1982). Appendix II-B demonstrates the trend towards an increase in dental caries.

A national epidemiologic survey of four and a half thousand, 5 to14 year old Kuwaiti schoolchildren, using WHO criteria to examine dental caries, found only 12.6% and 14.4% respectively were caries free with mean dft/dfs of 4.6/9.7 and 4.6/9.9 for 5 and 6 year-oldsrespectively. In the permanent dentition 26.4% and 21.7% were caries free, with a corresponding mean DMFT/DFS of 2.6/3.4 and 3.9/4.2 for 12 and 14 year-olds respectively. Dental caries experience in this sample population was similar to those in neighboring and other Middle East countries (Al-Mutawa et al., 2006).

A random sample of 450 aged 3 to 7year-old children drawn from the students in Kindergarten and Primary from the Salwa District of Kuwait found only 39% were caries free. Molars and maxillary incisors were most often affected by caries (Murtomaa et al., 1995).

The prevalence of dental caries in United Arab Emirates is not well documented; few studies which report high prevalence among pre-school children in different Emirate region. Al-Mughary and co-worker (1991) reported from Emirate of Abu-Dhabi among 1210 children aged 5 year old attending city and rural schools and demonstrated that despite considerable expenditure on dental health care, only 28% of 5 years old Abu-Dhabi children were caries free (Al Mughery et al., 1991).

The study of Al-Hosani and Rugg-Gunn (1998) in the Emirate of Abu-Dhabi, Al-Ain, and the Western Region among children aged 2, 4, 5 years old, reported prevalence at 94%, 90%, and 82% in the three region respectively with an overall dmft of 7.1. In their study, the occurrence of caries was related to parental education and parental income. The better educated parents knew and practised the principles of caries prevention (tooth brushing with fluoride toothpaste, restricting sugar consumption) better than the less educated parents (Al-Hosani and Rugg-Gunn, 1998). High sugar food and drinks were more freely purchased and given to children by the parents with larger incomes and with poor education. Moreover, Hashim et al's study showed a high prevalence of dental caries (76%) and average of 10.2 dmfs and 4.4 (sd 4.3) dmft among children aged 5 and 6 years old from the Emirate of Ajman. Caries severity was significantly ($p < 0.05$) greater among Emirati (local) children, males ($p < 0.05$) and children from low maternal education ($p<0.01$) (Hashim et al., 2006).

2.3 Studies that link Obesity and Oral Health

The assumption that obesity could be associated with dental caries is based on a principle that both diseases are caused by common risk factors. This concept has motivated researchers to investigate the relationship between obesity and dental caries.

The association between obesity and many systemic chronic diseases such as coronary heart disease, stroke, hypertension, diabetes mellitus and cerebrovascular diseases are well established (Kopelman, 2000), whilst association between obesity and dental caries among children has been investigated less often but has occured in several countries, and with conflicting results (Willershausen et al., 2007) .

Several studies have identified a positive association between these two conditions and have suggested that obesity is a risk factor for developing dental caries (Larsson et al, 1995, Willershausen et al., 2004, Hilgers et al., 2006, Willerhausen et al., 2007, Marshall et al., 2007, Bailleul-Forestier et al., 2007, Gerdin et al., 2008).

For example, in a population based cross-sectional study of all the 15 year old adolescents (181 subjects, 94 boys and 87 girls) living in a small urban community in Northern Sweden between 1987 to 1989 were investigated to determine whether high dental caries could be a risk factor for the development of Cardio Vascular Disease (CVD). A significant positive association was found between Decayed and Filled Surfaces (DFS-Score) and BMI not only in univariate association (r=0.23, 95% CI 0.09-0.39) but also in a forward stepwise multiple

regression. BMI was the only variable that contributed significantly (p=0.002) to explain variation in caries score. Therefore, it was stated that high caries score could be an indicator of risk for CVD by the covariate of BMI, and it was stated that dietary counseling may help not only in the reduction of caries risk but also risk for development of CVD in adolescents who are obese (Larsson et al, 1995). This study was done on a relatively small population and other confounders such as SES and dietary habit were not taken into account.

Further, an association between increased weight and caries frequency in both the primary and permanent dentition was also observed in a cross sectional study of elementary schools in Germany (Willerhausen et al., 2007, Willershausen et al., 2004). This relationship between dental caries frequency and BMI was investigated in 2071 elementary school children, aged 6 to 10 yeas old in Mainz-Germany. A significant positive association ($p<0.001$) between dental caries and BMI was found regardless of gender and after adjusting for age. The mean df-t + DF-T was 2.5 for normal weight, whilst the mean df-t + DF-T for overweight and obese was 2.6 and 2.7 ($p=0.004$) respectively. In addition, the prevalence of a caries-free dentition was also higher among normal weight (47.4%) compared to obese (38.3%) children (Willershausen et al., 2007). Similarly this study did not consider other confounder such as dietary habits and SES

Marshall and colleagues have suggested that neither obesity nor caries increase the risk of each other; they believed that it is more realistic that common risk factors such as dietary habits and socio-economic status increase the likehood of both diseases. In their cross-sectional study assessing SES and self reporting food and beverage intake , children at risk of being overweight had a higher caries

rate than normal weight peers. In addition, caries in the primary dentition and obesity coexisted in children aged 4.5-7 years old of low socioeconomic status in United States, indicating an association between caries, obesity and socioeconomic status as evidenced through parental education and family income.Their investigation suggested that both being overweight and having soda pop were predictive of caries in a multivariate model. However, measure of SES especially mother education was strongest predictor of caries (Marshall et al., 2007).

Elevated BMI has been shown also to be associated with an increased incidence of permanent molar caries in cross-sectional study of 178 US children, aged 8 to 11 years of age after adjusting for age and gender. Subjects with low BMI differed significantly in their mean permanent caries average of 0.08 sd± 0.06 from those with high BMI 0.51 sd± 0.09 (p=0.004) or with normal weight 0.19 sd± 0.05 (p=0.05) (Hilgers et al., 2006). In this study dental hygiene and deitary habit were not evaluated.

Bailleul-Forestier and colleagues (2007) compared the DMFT of a group of 41 severely obese and 41 non-obese adolescents matched by age, gender and parental socio-occupational categories, and showed that the severely obese adolescents had a significantly (p= 0.002) higher mean DMFT (6.9, ± 4.1) than non-obese (4.3, ± 3.5) adolescents (Bailleul-Forestier et al., 2007).

A study among 15 year old Swedish adolescents showed that those who were overweight and obese had more proximal caries than normal weight individuals (Alm et al., 2008). In another recent cohort study among 2,303 Swedish children

investigating the association between dental caries and BMI by their socioeconomic status, showed that those who were overweight or obese at the age of 4 and remained overweight or obese at age of 5, 7 and 10 had significantly more proximal surface caries (DFS) than children with normal weight at age of 5,7 and 10 years of age (Gerdin et al., 2008).

However, there are studies which have reported no association between dental caries and obesity (Tuomi, 1989, Chen et al., 1998, Pinto et al., 2007, Hong et al., 2008, Granville-Garcia et al., 2008). Tuomi (1989) used weight to predict caries experience in a cross-sectional study among 516 Finish children 5 to 18 years of age, but found that obesity alone was not a predictor of dental caries, however when predicting caries in permanent first molars both earlier obesity and earlier caries experience were the predictors but not obesity alone (Tuomi ,1989). In this study criteria used for obesity were based on standards used in Finland but the growth table was outdated. The caries data was taken from the local health center file which may not be representative of whole population.

Chen after investigating the association between obesity and dental caries among 3 year old children in Taipei showed no significant difference ($p=0.25$) in decay among different BMI groups (Chen et al, 1998). In this study the result could be deviated, in that at this particular age there is still major parental control over diet and oral hygiene, beside other risk factor could be more important and associated with dental caries such as nursing bottle caries.

Moreover, Pinto and colleagues evaluated the association between BMI and dental caries in a random prospective cohort of small sample of 135 children aged

8-9 years old in an African-American group with similar socioeconomic status background; they did not find any association between dental decay in obese and non- obese children after adjusting for age, gender and BMI (Pinto et al., 2007).

Further, in a recent cross-sectional study, investigating the relationship between obesity and dental caries among 2,651 Brazilian pre-school children aged 1-5 years old attending both private and public school showed no relationship between dental caries and obesity in spite of a high prevalence of obesity (9%) and dental caries (15%) (Granville-Garcia et al., 2008). This study looked only at DMFT index and anthropometric measurements without considering other risk factors such as socio-demographic characteristics, diet or oral hygiene habits of the study population. In another recent cross-sectional study among 1,507 children aged 2-6 from the 1999-2002 national survey (NHANES), both overweight children and those “at risk” of being overweight had higher decayed and filled teeth, but this was not statistically significant, a multivariate logistic regression model the predictors of caries was found to be family income and age (Hong, 2008). Although this study was conducted on a large national sample, it had some limitations, the cross-sectional nature of the study could not establish the causal relationship; as some of the demographic and health related behaviour data was self-reported and thus subject to recall bias. Furthermore missing teeth were excluded from the analysis, this may have excluded teeth lost due to caries.

Moreover, some studies have also reported a negative association (Macek and Mitola, 2006, Kopycka-Kedzierawski et al., 2008). In 2006 Macek and Mitola investigated the relationship between BMI and dental caries among 2-17 year old US children in a cross-sectional study, again utilising data from the 1999-2002

NHNES survey. Regarding the primary dentition, overweight children had higher prevalence of caries experience (36%, sd± 6.4) than did normal weight (28%, sd±1.8), and in the permanent dentition, overweight had a slightly higher caries prevalence (38.8, sd±1.7) than did normal weight children (37.8, sd±1.4). However, these differences were not statistically significant in either primary or permanent dentition. Using a multiple linear regression model and controlling for age, gender, ethnicity (non-Hispanic White, non-Hispanic Black, Mexican and others) and poverty also showed that there was no statistically significant association between BMI and dental caries in either the primary (p=0.95) or permanent (p=0.54) dentitions. There was however, a statistically significant association between BMI and caries severity, where overweight children had a significantly (p=0.05) lower mean DMFT in multiple regression model after controlling for age, gender, ethnicity and poverty (Macek and Mitola, 2006).

Later Kopycka-Kedzierawski and colleagues (2008) examined the relationship between dental caries in both primary and permanent dentitions and BMI from nationally representative data of NHANES III in 1988-1994 and NHANES 1999-2002 among 2-18 year olds in a cross-sectional study. Their result suggested that being overweight was associated with a decreased rate of dental caries in older children of aged 6-11 in the primary dentition and 12-18 year olds in their permanent dentition after adjusting for sex, age, race, poverty, level of education and last dental visit, and for children 2-5 years of age, ther was no difference in having caries experience among normal or overweight children (Kopycka-Kedzierawski et al., 2008).

It is worth noting that in a systematic review between 1984-2004 investigating the relationship between obesity in childhood and adolescence and prevalence of dental caries, the reviewers stated that only three studies; Willerhousen et al (2004), Chen et al (1998) and Tuomi et al (1989) had high level of evidence and even these three studies had conflicting results and contradictory conclusions. Only Willerhousen et al 2004 showed direct association between obesity and dental caries in both primary and permanent dentition, while Chen et al and Tuomi et al did not find any association. Therefore, in view of these findings the authors had suggested that further studies are needed to demonstrate the relationship between dental caries and obesity in order to draw a clear conclusion (Kantovitz et al., 2006).

2.4 Self-esteem

Self-esteem is used both in popular language as well in psychology. It refers to an individual's sense of his or her value or worth. Self-esteem was originally described by Rosenberg (1965) and measured by the Rosenberg Self-Esteem Scale to determine general psychological well-being. It includes 10 items, five items are phrased as positive and five as negative statements that are scored using a four point Likert response ranging from strongly disagree to strongly agree. This yields an overall score between 0 to 30, 30 being the highest score possible. Other scoring options are possible for example if assessing the value of 1-4 rather than 0-3; the score will range from 10-40. There are no discrete cut-off points to indicate high and low self-esteem. The higher the score, the higher the self-esteem and this will be based on specific population to determine the norms of that population. The scale comprises a series of short sentences, which are easy and fast to administer. Most of Rosenberg's work has been carried out with

adolescents. The original sample for which the scale was developed consisted of 5,024 high school juniors from 10 randomly selected schools in New York State. Rosenberg reported a reproducibility of 0.92 and scalability of 0.72 in his sample (Rosenberg, 1965). Further, McCarthy & Hodge (1982), conducted a further study among 1,852 adolescents from grade seven to twelve to investigate the validity of Rosenberg scale, in their study the RSE scale produced an alpha value between 0.74 to 0.77 (Mcarthy & Hodge,1982, Hodge and McCarthy, 1984).

Rosenberg's questionnaire has been translated and adopted to various languages such as Persian (Shapurian et al., 1987), Spanish (Martin-Albo et al., 2007) and Arabic which has also been tested for validity and reliability (Cronbach's Alpha=0.87) among a Saudi Arabia population on 165 first and fourth year nursing students (Suliman and Halabi, 2007).

However, there are other measurements of self-esteem available, such as Coopersmith Self-Esteem inventory (1967/1981) which was developed shortly after the Rosenberg Self-Esteem test by Stanley Coopersmith and the Self-Perception Profile for Children (SPPC) which was developed by Harter (1982).

The Coopersmith Inventory is a standardized scale to measure self-esteem among children, it consists of two versions of questionnaire (adolescents and adults), and the questions cover a variety of topics and ask subjects whether they rate someone as similar or dissimilar to themselves. The adolescents' version of Coopersmith Self-Esteem Inventory (age 8-15) is a fifty-eight item questionnaire which is completed by checking either "like me" or "unlike me" next to each item. These items comprise four subscales: general self esteem (e.g. things usually

don't bother me), social self esteem (e.g. I'm popular with kids my own age), home self esteem (e.g. my parents usually consider my feelings) and school self esteem (e.g. I am proud of my school work) (Marriage and Cummins, 2004). The adult version of Coopersmith Self-Esteem Inventory is a twenty five item questionnaire.

According to Harter (1982), Self-Perception Profile for Children (SPPC) is a 36 item scale that comprises five domain-specific subscales (scholastic competence, athletic competence, physical appearance, peer acceptance, and behavioral conduct) together with measure of self-worth. The questions are presented in a "structured alternative format" as described in (Harter, 1985, p.7) (Shevlin et al ,2003), each subscale is measured by six items and the items on each question are scored from one to four, 1 and 2 indicating low perceived competence and 3 and 4 reflecting high-perceived competence (Harter, 1985). It's validity and reliability has been confirmed (Cronbach's alpha 0.86 to 0.92) among 8 to 16 year old children in United Arab Emirates (Eapen et al., 2000).

Self-esteem has also been shown to be related to various aspects of health and health related behaviour such as tobacco and alcohol use (Murphy and Price, 1988), physical activity (Schmalz, et al, 2007 Kristjansson, et al, 2008), tooth-brushing (Regis et al., 1994, Macgregor and Balding, 1991) and obesity (Strauss, 2000, Franklin et al., 2006, French et al, 1995b, Stern et al., 2007, Kristjansson, et al, 2008).

2.4.1 Self-Esteem and obesity

Obesity and being overweight have a significant impact on both physical and psychological health (Dehghan et al., 2005). The association between being overweight and physical health such as cardiovascular disease, diabetes and hypertension has been much more consistently demonstrated (Freedman et al.,

2007a), whereas the relationship between obesity and psychological well-being is controversial.

Recently Swallen and colleagues (2005) and other researchers have documented the relationship between obesity and psychological aspects of health (Swallen et al., 2005) such as depression (Erickson et al., 2000), Health Related Quality of Life (HRQOL) (Swallen et al., 2005, Fallon et al., 2005), socialization (Strauss and Pollack, 2003), body image (Skemp-Arlt et al, 2006) and increased level of loneliness, sadness, nervousness, self-worth or self-esteem (Franklin et al., 2006, Strauss, 2000, French et al, 1995b). Data of 17,557 high school adolescents enrolled in the National Longitudinal Study of Adolescents Health (1994) in the United States, showed that overweight adolescents were more likely to be socially isolated (Strauss, 2003).

Several studies have shown a strong correlation between obesity and self-esteem and revealed decreased level of self-esteem in obese children (French et al., 1995, Strauss 2000, Franklin et al., 2006, Stern et al., 2007, Kristjansson et al, 2008). Whereas other studies have not found any association between BMI and self-esteem and reported normal level of self-esteem among obese children (Ozmen et al., 2007).

Strauss (2000) has also investigated the association between obesity and self-esteem using Self Perception Profile for Children (SPPC) on a large sample of 1,520 American children aged 9-10 from the National Longitudinal Survey of Youth (NLSY) and followed up over a four year period until 13 to 14 years of age. There was no difference detected in self-esteem between obese and non-obese children

among pre-adolescents (age 9-10). However, there was a significant reduction of self-esteem over four year period among the 13-14 years old, especially among obese Hispanic girls and obese White girls (Strauss, 2000). It has been concluded that early adolescence is a critical period for development of self-esteem and the importance of psychosocial consequence of childhood and adolescent obesity should be emphasized (Strauss, 2000). It is a period with major psychological changes, especially at early adolescence stage (11-14 years of age) where they mainly focus on body change, body image and appearance (Joffe, 1994).

Body image dissatisfaction can also be common in pre-adolescent children. For example, children as young as 6 to 7 year olds preferred a body figure thinner than they were (Collins, 1991), and as Franklin who reported the impact of obesity on self-esteem among 2,813 Australian Children as young as 11 years old (Franklin et al., 2006).

Although the above studies have supported a correlation between obesity and low self-esteem, there have been studies that reported no relationship between obesity and self-esteem. For example, Ozmen and co-workers, reported that being overweight did not have a significant effect ($p=0.075$) on depression and self-esteem ($p=0.708$) among 2,444 Turkish adolescents aged 15-18 years old (Ozmen et al., 2007). In addition, Mendelson and White stated that self-esteem was not significantly different among normal and obese elementary school children age 7 years old (Mendelson and White, 1982). These various findings could be due to differences in age, race and gender, therefore the effect of body mass on psychological well-being can vary by socio-demographic characteristics (Huang et al., 2007, Strauss, 2000). For instance, overweight girls ($r= 0.32$, $p<0.001$) but not

boys (r=0.001, p< 0.78) were more depressed, among a school-based sample of 868 pre-adolescent children, where the mean age was 8.4 years attending public elementary school in Northern California (Erickson, 2000). A similar result was obtained by Strauss (2000), where obese girls had significantly lower self-esteem compared to boys (Strauss, 2000). Moreover, overweight adolescents and particularly overweight girls documented greater body dissatisfaction, lower self-esteem and lower body image compared to boys among 657 US adolescents aged 12 to 14 years old (Huang et al, 2007). In addition, physical attractiveness was found to be important in relation to their sense of self-worth among 8-16 year old girls in United Arab Emirates while boys' sense of self-worth was mainly determined by their behaviour (Eapen et al, 2000).

Body Mass Index (BMI) and psychosocial outcomes may also vary by race and ethnicity, for instance White female adolescents were more likely to view themselves overweight and had lower self-esteem than Black female adolescents (Strauss, 2000, Fallon, 2005). Further, low self-esteem was not a characteristic of obese African-America inner city children in grades 4 to 12 when exploring the relationship between obesity and self-esteem. Neither age nor gender affected the relationship between obesity and self-esteem in these children (Kaplan and Wadden, 1986).

Adverse psychosocial consequences of being overweight and obesity could be related to age and developmental stage as well. For example, obesity was not associated with psychological outcome among pre-school children (Klesges et al., 1992), while body image dissatisfaction seems to become more prominent during

early adolescence (Skemp-Arlt, et al, 2006), as overweight adolescents express more dissatisfaction with their weight and figure (Wadden et al., 1989).

2.4.2 Self esteem and oral health

Oral disease is a common problem affecting many people throughout the world. It is not generally life threatening and the mortality rate associated with dental disease is low (WHO, 2003) (Nuca et al, 2007). However, the consequence of oral disease such as dental caries and periodontal disease not only disrupts physical functionality (oral function, difficulty in chewing, oral pain, difficulty in eating) but also affects other aspects of life such as economic, social role, changes of behaviour and psychological wellbeing including social relationships, appearance, smiling, laughing and communication (Naito et al, 2006).

These consequences have lead to development of several measures to assess how oral disease and disorder can affect daily function and the psychosocial aspect of health (Locker et al, 2000). These include the “Oral Health Related Quality Of Life” (Kressin et al,1996), “Oral Health Impact Profile” (Slade and Spencer, 1994), Oral Impact on Daily Performances” (Adulyanon et al., 1996) “Child Oral Health Quality Of Life Questionnaire” (Jokovic et al., 2006) and “Child Oral Impact on Daily Performance” (Gherunpong et al., 2004). However, each of these tools has differences in their technical characteristics (administration methods, the answer possibilities and final scoring) and evaluating domains (functional, psychological, and social).

The other aspect of psychosocial health is self-esteem, which is also a measure of psychosocial wellbeing. The association between self-esteem and oral health is relatively new, in that aesthetic problems such as abnormalities of shape, size, color and structure of the teeth can affect psychosocial health among children and

adolescents (Bryan and Welbury, 2003, Bryan and Welbury, 2006). Furthermore Necodemo and co-workers (2008), compared the Rosenberg Self-Esteem score and level of depression before and after orthognatic surgery, and showed a significant improvement in both self-esteem score and depression level after surgery especially amongst women. This underlines the importance of human appearance on social interaction and personality characteristics (Nicodemo et al., 2008). In addition, some studies have reported the affect of tooth loss, discoloration and appearance on psychological factors particularly on socialization and self-image (Teo, 1989, Welbury and Shaw, 1990).

Recently Locker (2009) reported the association between psychosocial factors (depression, life stress, sense of cohesion and Self-esteem using Rosenberg's scale), and oral health among 2,754 adults aged 20 and above. He showed that of all psychosocial variables, self-esteem had the strongest independent effect in association with self-reported oral health (Locker, 2009, Locker et al., 2000). Whereas, previously among children and adolescents existing evidence mainly focused on possible correlations between oral health practice such as frequency of tooth brushing and flossing rather than oral health status in association to self-esteem (Macgregor and Balding, 1991, Regis et al, 1994).

For example, Macgregor and Balding (1991), stated that self-esteem has a potential for predicting dental health behaviour in adolescents, Regis and co-workers (1994) conducted a further survey of 7,770 school children from 131 secondary school in England and demonstrated that tooth-brushing frequency among 14-15 years old increased with increased self-esteem (Regis et al, 1994).

In 1997 Macgregor et al reported significant positive correlation between tooth brushing frequency and self-esteem for both male and female among 41,142 adolescents age 12-16 years old who completed a questionnaire about health related behaviour, such as tooth brushing, dental flossing and dental attendance (Macgregor et al., 1997, Macgregor and Balding, 1991).

2.5 Summary of the literature

- The definition of obesity varied widely due to various cut-off points and various methods of body fat measurement.
- Various cut-off points to define obesity and being overweight have been published based on either national reference population or adopted for international use such as (CDC growth chart or IOTF cut-off points)
- Different methods have been used to measure body fat (DEXA, MRI, BIA, under water weighing, anthropometry). Anthropometry including Skin fold, BMI and waist circumference are the most widely used, universally and non-invasive method. However, BMI was the most popular, practical and simple method for use among children and adolescents.
- The prevalence of obesity has increased in the past decade among adult and children in both developed and developing countries, especially noticeable in Middle East, Central Europe and North America. Similarly, in the Arabian Gulf a high prevalence of obesity due to rapid economic development that was affected the dietary habits and lifestyle has been reported.
- High prevalence of obesity and being overweight was reported in the UAE which varied from 9% to 29% for being overweight and 8% to 18% for obesity. In neighborhood region (Gulf countries), this varied from 11% to

14% for being overweight and from 6% to 32% for obesity. It was difficult to make a direct comparison due to study design, criteria and cut-off point, age range, country or regions with in the country.

- Most studies suggested higher prevalence of obesity and being overweight among female than male, although this gender difference was reversed in some studies.
- Obesity is a multifactorial disease, it has both genetic and environmental origin, which is primarily blamed on current environmental changes such as urbanization and modernization (Obesogenic environment) that has changed dietary habits and behaviour and city development and technology that affected physical activity. In addition, other factors such as socio-demographic characteristics have also been identified as risk factors.
- With regard to dietary habits, the review of literature identified patterns of eating such as meal frequency, snacking, fast food, processed food skipping meals, role of breakfast and soft drink which influence body weight, and concerning physical activity city development and modern technology such as TV, games, computer which has led to sedentary lifestyle.
- There are three critical periods that have been identified as critical or sensitive that increase the prevalence and persistence of obesity, prenatal and infancy (first year of life), adiposity rebound period (at 6 year of age) and adolescence (age 11-19).
- Dental caries is multifactorial disease, caused mainly by three main factors of bacteria, fermentable sugar and teeth. Beside genetic factors environmental factors such as, sugars, frequency of meals, soft drink consumption and oral hygiene (frequency of tooth-brushing) played

important role. In addition, other factors such as socio-demographic characteristics were also identified to affect caries development.

- High prevalence of dental caries was reported in the UAE which varied from 72% to 94% and in the region (Gulf countries) varied from 61% to 92%. It was difficult to make a direct comparison due to study design, criteria used for detecting caries, age range, country or regions with in the country.
- The reported relationship between obesity and oral health was discrepant. Some researchers concluded a significant positive association between being overweight or obese and dental caries in both primary and permanent dentition, whilst other failed to establish the significance. Some studies adjusted for age, gender, ethnicity, socio-economic status and dietary habit, whilst majority looked univariately and the above factors were not regarded.
- Several studies revealed a decreased level of self-esteem in obese children, whereas other studies reported no relationship between obesity and self-esteem. Association between oral health and self-esteem was mainly focused on an aesthetic point of view or in relation to oral health behaviour rather than dental caries.

Chapter 3. Aims, Objectives and Theoretical Framework

3.1 Aims and Objectives

Aim 1: The first aim is to investigate the relationship between obesity and oral health in adolescents aged 11-17 years old attending Public and Private Schools in Sharjah City, United Arab Emirates.

Objectives were:

1. To assess socio-demographic characteristics of adolescents aged 11-17 years in Sharjah City.
2. To assess health behaviour and lifestyle including dietary habits, physical activity and oral hygiene habits amongst adolescents aged 11-17 years in Sharjah City.
3. To determine the prevalence and severity of dental caries in 11-17 years old adolescents in Sharjah City.
4. To determine the prevalence of obesity and being over-weight of 11-17 years old adolescents in Sharjah City.
5. To investigate the relation between socio-demographic factors and the development of obesity and oral health in adolescents aged 11-17 years of Sharjah City.
6. To investigate the effect of health behaviour and lifestyle choices including dietary habits, physical activity and oral hygiene habits on the development of obesity and poor oral health in adolescents aged 11-17 years in Sharjah City.
7. To investigate association between dental caries and oral hygiene (cleanliness) and obesity.

Aim 2: The second aim is to explore the psychological consequences (self-esteem) of poor oral health and obesity of 11-17 year old adolescents.

Objectives were:

1. To investigate the relationship between socio-demographic characteristics and psychological status (self-esteem) in adolescents aged 11-17.
2. To investigate psychological status (self-esteem) in relation to obesity and poor oral health in a 11-17 year old adolescent population.

The Null Hypotheses:

1. There is no difference between oral status (DMFT and oral cleanliness) of obese and non obese adolescents.
2. There is no difference in level of self-esteem in relation to obesity.
3. There is no difference in level of self-esteem in relation to poor oral health.

3.2 Theortical framework

In order to achieve the aims and objectives of our study, the general hypothesis of this study proposed an association between socio-demographic, health behaviour and health outcomes. The theoretical foundation of the study was based on two well-established models of health (Saarloos et al., 2009), shown in Figure 2-1 and the Petersen, et al. (2005) models.

These models were selected because they take a broader view the role of individual and interpersonal characteristics, and take into account the multilayer network of interactions that can affect individual health behaviour and subsequent health outcome (Saarloos et al., 2009). According to Peterson and co-workers (2005), disease has its roots in a complex combination of environmental,

behavioural and socio-economic factors. They say “proximal factors act directly or almost directly on an adverse health outcome, while distal factors are further back in the causal chain and act via a number of intermediate causes” (Petersen, et al., 2005)

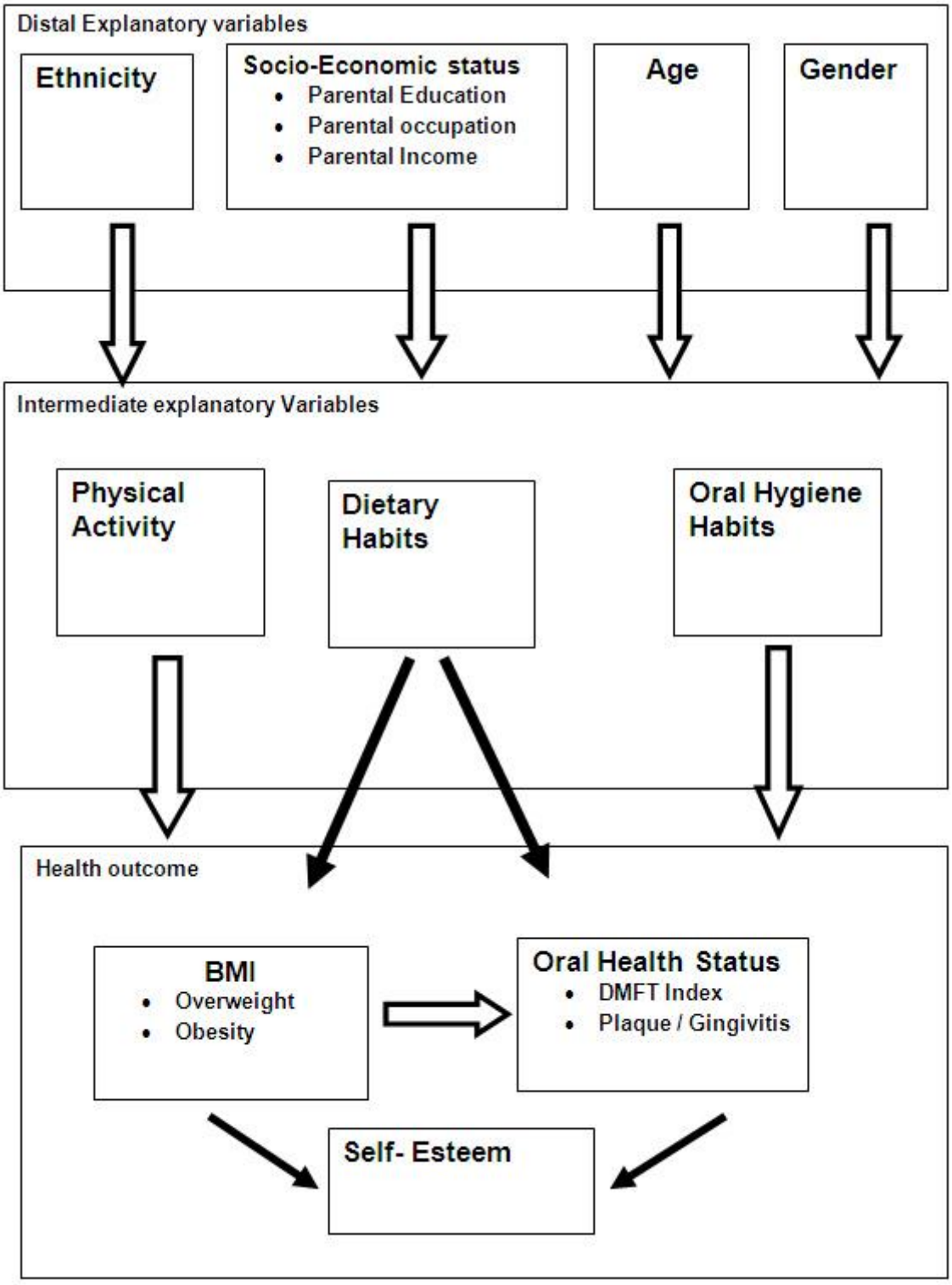
Therefore, this research examines the relation between distal explanatory variables (socio-demographic characteristics), an intermediate explanatory variable (health behaviour) and adolescents’ health outcomes (oral health status, BMI and their self-esteem) as demonstrated in Figure 3-1.

The socio-demographic characteristics chosen in the present study were age, gender, socio-economic status and ethnicity. This model considers that the person’s socio-demographic background can influence their lifestyle and health behaviour. For example, the lower social class is less physically active, has worse oral hygiene and dietary habits. Lifestyle and health behaviour tend to be different between males and females, different age groups and ethnicity (Jebb et al., 2004, Baltrus et al., 2005, Ahn et al., 2008). In addition it has previously shown that those from lower socio-economic status have a lower self-esteem (Macgregor et al, 1997), and evidence suggests that those from a lower socio-economic group experience more psychological impact (Locker, 2009). Self-esteem tends to change with age according to Macgregor (1997) there is a general improvement of self-esteem from adolescents through early adulthood. Therefore, socio-demographic characteristics are an important distal predictor that could affect adolescent’s health outcome.

The health behaviours considered and selected as intermediate predictors in the model were dietary habits, physical activity and oral hygiene habits. This model hypothesized that health behaviour factors namely dietary habits, physical activity and oral hygiene habits can affect the adolescent's health outcomes, such as oral health status (Rugg-Gunn and Nunn, 1999, Moynihan, 2003, Dye et al., 2004), BMI (Gillis and Bar-Or, 2003, Adair and Popkin, 2005, Cho et al., 2003, Vanelli et al., 2005, Rashidi et al, 2007, Croezen et al., 2009). Several studies have demonstrated a strong correlation between obesity and self-esteem where obese children had low self-esteem (French et al., 1995, Strauss 2000, Franklin et al., 2006, Stern et al., 2007, Kristjansson et al, 2008). With regard to aesthetic problems such as abnormalities of shape, size, color and structure of the teeth this has been shown to affect the psychosocial health among children and adolescents (Bryan and Welbury, 2003, Bryan and Welbury, 2006) socialization and self-image is also affected by tooth loss, discoloration and appearance on psychological factors particularly on socialization and self-image (Teo, 1989, Welbury and Shaw, 1990). This therefore underlines the importance of oral health status on self-esteem.

Therefore, this study has been designed to test the interaction between socio-demographic characteristics, the health behaviour or lifestyle of individual and health outcome (obesity, dental caries and self-esteem). The study was also designed to test the interaction and relationship between each of three health outcomes namely obesity, oral health status and self-esteem, by exploring the association between obesity and oral health and also the relationship between obesity and poor oral health on the self-esteem of this particular population.

Figure 3-1: Theoretical framework of the present study



Chapter 4. Methodology

4.1 Introduction

This chapter describes the study design, study population, geographic location of the study, ethical approval, consent and confidentiality, sample size calculation, sample collection, the procedure of data collection, and lastly data cleaning, preparation including statistical analysis of study are described in detail.

4.2 Study design

This is a cross sectional study, investigating the relationship between obesity and oral health among adolescents in Sharjah City, United Arab Emirates.

4.3 Study population

The study population consisted of 11-17 year old adolescents, who were recruited from Secondary or Intermediate schools Grade 6 to Grade 9 of both genders attending Private and Public schools in Sharjah City, UAE. According to the education system in UAE, secondary levels of education is from grade 6 to 9 and classified to be for the age of 11 to 14 year olds as the children start grade one at the age of 6-7 years old. The total adolescent population in intermediate stages in both Private and Public schools in Sharjah City was 24,187 in January 2008.

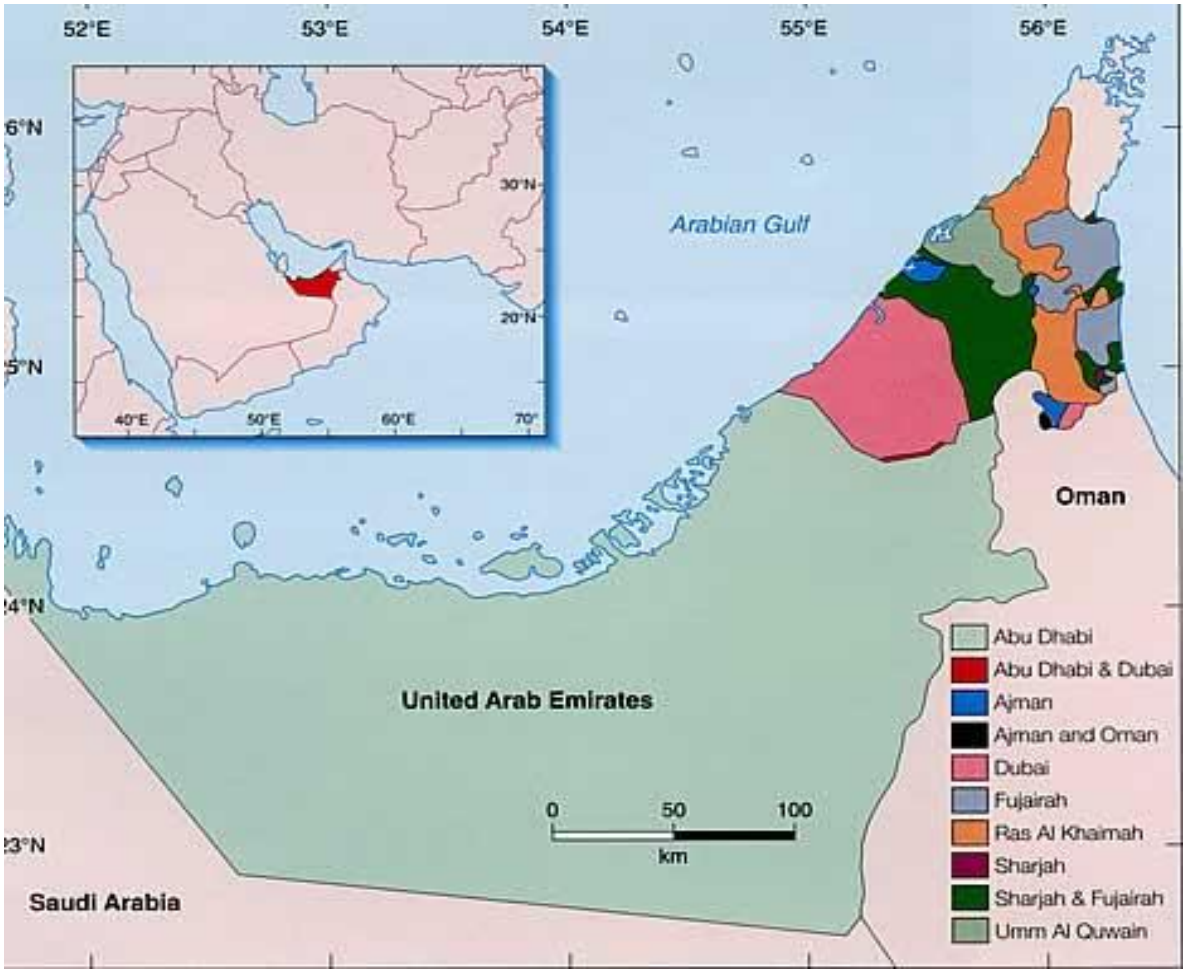
4.4 Study location-United Arab Emirates

The UAE covers 83,000 square km, of which Abu Dhabi represents over 80% of the total. It is located in the northeastern part of the Arabian Peninsula, bordered to the south and west by Saudi Arabia and to the north and east by Oman.

The Federation was formed in December 1971 and comprises the sheikhdoms of Abu Dhabi, Dubai, Sharjah, Ras Al Khaimah, Fujairah, Umm Al Quwain and Ajman, as shown in Figure 4.1. Sharjah is the third largest of the seven Emirates,

which constitute the United Arab Emirates (UAE). The population of the UAE is estimated at 4 million (Ministry of Planning 2003). Only 15-16% of the total U.A.E population are citizens. The rest include significant numbers of other Arabs Palestinians, Egyptians, Jordanians, Yemenis, Omanis as well as many Indians, Pakistanis, Bangladeshis, Iranians, Afghans, Pilipino, and Europeans. According to 2003 census estimate the population of Sharjah was 519,000 which contribute 16% of the total UAE population.

Figure 4-1: Map of United Arab Emirates



www.panda.org/.../united_arab_emirates/about/

4.5 Permission and ethical approval

The procedures used in the study required ethical approval from the following sources

- Queen Mary University of London Research Ethics Committee on 28th January 2008 (Reference Number: QMREC2007/60) (Appendix III).
- Subsequently permission was obtained from both the Ministry of Health and Ministry of Education in UAE to conduct the study (Appendix IV).
- They provided a letter to access selected schools.
- In addition letters via Ministry of Education were sent to all selected schools asking for permission, to conduct the study.
- Each selected school was contacted individually by FK to obtain permission from the Head teachers, to clarify the aims of studies, to check school facilities prior to school visit.

4.6 Arabic translation of the questionnaires

Forward and backward translation from English to Arabic of the questionnaires was carried out by the Department of English Language and Literature in University of Sharjah (Appendix V and VI). The forward translation was completed by the Head of the Literature Department and backward translation was carried out again by a qualified person from the same Department. The clarity of the questionnaires was tested in a pilot study.

4.7 Sample size calculation

To determine the sample size of the study the prevalence both of obesity and dental caries was taken into consideration. According to a national survey on prevalence of obesity for children age 4 to 18 years old in the United Arab

Emirates, (Al-Haddad et al., 2005) and the study of Malik and Bakir among the children age 5 to 17 years old the prevalence of obesity was approximated to 10% (Malik and Bakir, 2007). Accordingly, the sample size was calculated, using STATA 9, to observe a difference of 0.5 sd in mean DMFT between obese and non obese (Hilgers et al., 2006) using an alpha level of 0.05 (2- sided) and power of 90% . A total of 650 subjects were required, these numbers would be sufficient to provide reasonably small confidence intervals for the different outcomes. However to compensate for the non-response and refusal, and because it is no more time-consuming to do dental examinations on all the consenting children in a class rather than a sample, and because there is no ethical problem in having more children in the sample, the final sample was larger than the 650 that was originally envisaged, therefore, 1094 subjects were recruited into the study. Resulting sd DMFT turned to be 2.97 in our study, so there was power to detect a difference of 0.3 sd DMFT between the obese and non-obese or 99% power to detect a difference of 0.5 sd in mean DMFT.

4.8 Selection criteria

Inclusion: Intermediate schools adolescents aged 11–17 years old and resident in Sharjah City were selected for this study.

Exclusion: Adolescents who were obese or overweight caused by a medical condition such as hormonal or metabolic disorder or use of medication (e.g. steroid) were excluded.

4.9 Sample selection

We aimed to obtain a representative sample of all secondary / intermediate school children.

The lists of all schools located in Sharjah City were obtained from the Statistics and Planning Department of Ministry of Education. According to Ministry of Education's data, there were approximately 24,187 students in Intermediate schools attending in a total of 53 Intermediate/Secondary schools in Sharjah City, (17 Public and 36 Private schools) with an average of 27 students in each classroom and in each school at the time of study.

The sampling frame included both Private and Public schools. A total of 10 schools were selected randomly (6 Private and 4 Public) using random digit table. Since Private schools were categorized into three categories two schools were selected from each category considering proportional allocation while four Public schools (2 boys' and 2 girls' schools) were selected (Figure 4-2).

However, the selected schools preferred that individual classes were randomly sampled rather than individual adolescents, therefore one section of each class was further randomly selected from each grade and all the students from the selected section were included in the study. The number of adolescents in each selected class/section ranged from 17 and up to 38 students.

Selected class list of participant's name was obtained from the school administration. To protect the confidentiality of participant, their name, all questionnaires and the clinical examination forms were coded and stored securely. Data collection was carried out over a period of five months starting February 2008 to June 2008.

4.10 Education system

Expatriate children will often go to private school, according to nationality and qualification preference. Almost all UAE government schools educate students in Arabic and offer local UAE qualifications which do not have much value if applying for English-speaking Universities outside the UAE. There are different curriculums available in UAE, such as American, British as well as, Arabic, French, German, Indian, Iranian, Japanese, and Russian etc. Age and equivalent grade can very little. Some school have year 13 as the final year, whilst most of school will call grade 12 as the final year. Moreover, term used in reference to school level can also vary, based on the school's curriculum. For instance, according to US term, elementary school is for student aged about 4-12 years, or some school High School is considered for students aged 11 to 17 years. In this study we used our national terminology for school level (Table 4-1).

Table 4-1: Terms often used in reference to school levels

UAE National School Level		Kindergarten			Primary					Intermediate / Secondary				High School		
US School Level		Elementary / Primary School														
										High / Secondary School						
System	Age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
American	Grade		KG1	KG2	1	2	3	4	5	6	7	8	9	10	11	12
British	Year	FS1	FS2	1	2	3	4	5	6	7	8	9	10	11	12	13
National Curriculum (UK)		KS0		KS1	KS2				KS3				KS4		KS5	
Indian	Class/Grade				I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Internationl	Grade		KG1	KG2	1	2	3	4	5	6	7	8	9	10	11	12

Figure 4-2: Schools random selection

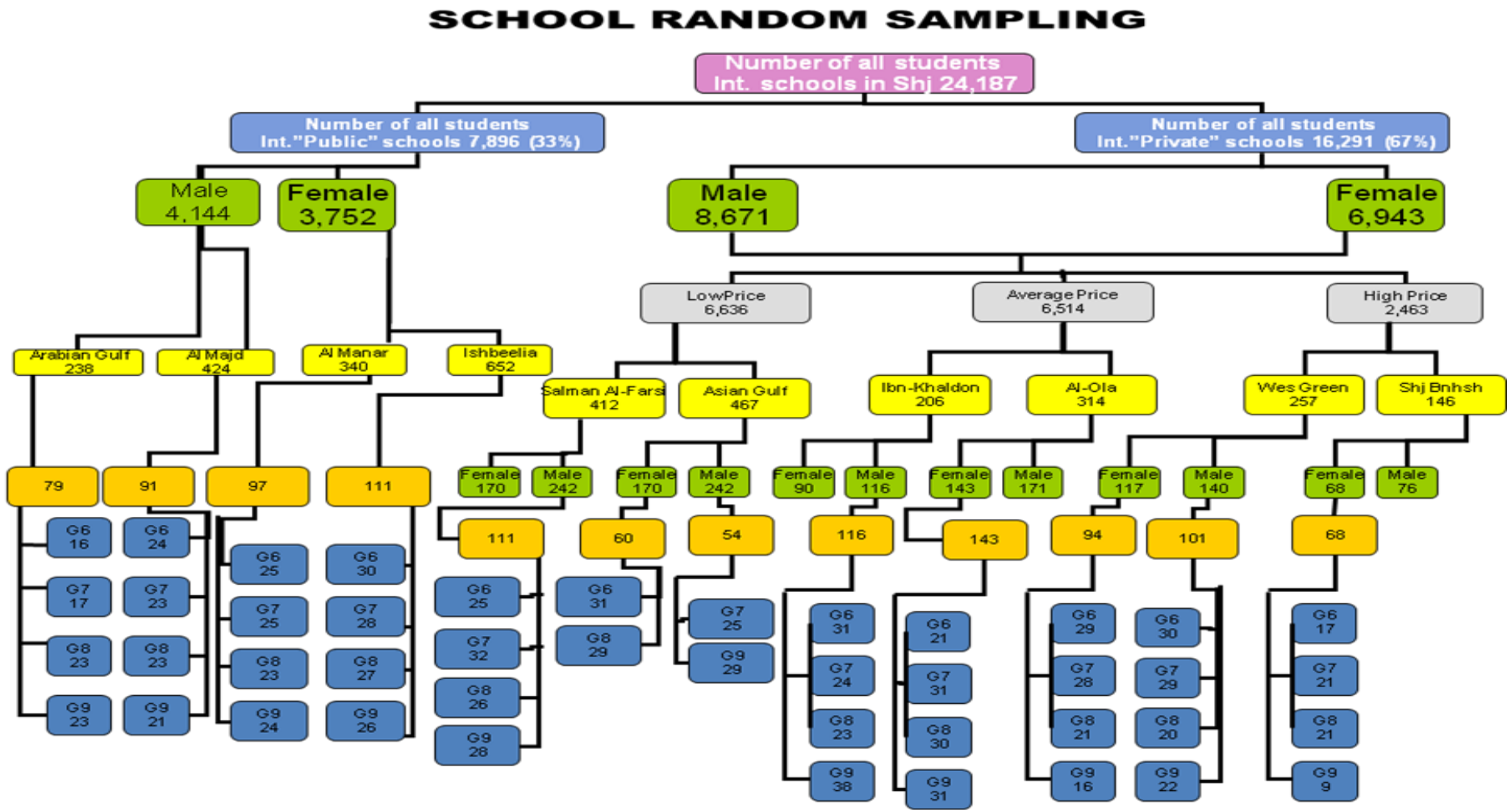


Figure 4-3: Sharjah City map and school location

1. Arabian Gulf school (Al-khan)
2. Al-Ola school (Al-Ghaphia)
3. Ibn-Khaldoon school (Al-Ghaphia)
4. Sharjah-British school (School area)
5. Wes Green school (School area)
6. Salman al-Faresi school (Al-Quadesia)
7. Al-Majd school (Al-Izra)
8. Asian Gulf school (School area)
9. Al-Manar school (Al-Izra)
10. Ishbeelia school (Al-Jazat)

4.11 Pilot study

A pilot study was conducted prior to the main study. The research instruments and the questionnaires used in the main study were first tested to examine:

1- The practicality and feasibility of the research instruments.
2- To check the content and language of the questionnaires.
3- To check the procedure of clinical examination and management of the questionnaires.
4- To measure the time required for both the clinical examination and administration of the questionnaire.

The pilot study took place in one of the Public school (Arabian Gulf). A total of 20 subjects were invited to participate in the study. Height and weight were measured in addition to clinical examination. The order, understanding and time they needed to fill in the questionnaire were tested. FK recorded any difficulties in understanding the content of questions. Based on these findings a few changes were made to the questionnaires and their management. The final versions of questionnaires used in the main study are shown in Appendices VII and VIII. No other amendments were made to the protocol for collection of data in the study.

4.12 The main study parts

The main study consisted of two parts: questionnaire and clinical examination.

4.12.1 Questionnaire

The questionnaire was developed to obtain wide variety of variables from both adolescents and their guardians.

1- Adolescent questionnaire: To assess the demographic characteristics, dietary habits, physical activity, oral health behaviours and psychological status (Appendix VII).

2- Guardian questionnaire: To evaluate socioeconomic status (SES) and medical history (Appendix VIII).

4.12.2 Clinical examination

Two clinical examinations were performed: An oral examination and an anthropometric measurement.

1- Oral health examination: Oral examination was performed to assess two aspects of oral health: dental caries and oral cleanliness (Appendix IX).

2- Anthropometric measurement: Anthropometric measures were carried out to record height and weight (Appendix IX).

4.13 Measures of study

4.13.1 Non clinical data (Questionnaire)

These include demographic, socioeconomic status, Medical history / General Health, Dietary habit, Physical activity, Oral health behaviour and Psychological status.

4.13.1.1 Demographic variables

Demographic variables which were investigated in our study were age (in years and month), gender, nationality and school type.

- The age was calculated as the difference between the date of school visit and the date of birth which was recorded on the questionnaire form. Participant age ranged between 11-17 years old.

- Both genders were included in the study: male and female, this was recorded in a tick box on the questionnaire form.
- Information on adolescents' ethnicity was taken by asking the participants about their nationality in an open-ended question and they were categorized into four categories of Emirati (those who hold UAE nationality), other Arabs (those from other Arab country such as Egypt, Jordan, Lebanon, Palestine, Iraq, Syria), Indian sub-continent (those from India, Pakistan and Srilanka) and others, which included Asian (Afghani, Iranian and Philippines) and Western (American and European).
- Schools were categorized into two types, Public and Private school. Public schools are only accessible to the Emirati (those who hold UAE nationality) which offer a free education. Whilst Private schools are accessible for all nationalities including UAE nationals and these are generally profit-based educational institutions, their annual fees ranging from 2,000 Dhs up to 30,0000 Dhs. The private schools were again categorized based on their annual fees into three categories of low price (below 5,000 Dhs), average (5,000 to 10,000 Dhs) and high price (above 10,000 Dhs). The public schools are segregated by gender whilst Private schools are co-educational.

4.13.1.2 Socio-economic variables

Reviewing the literature related to socio-economic background of individual, different indicators such as father's education, mother's education, father's occupation, mother's occupation, household income were used either as a single indicator or in combination. However, generally parental education and income were the most often used (Krieger et al., 1997).

Similarly, in this study the adolescents were required to provide information about level of parental education and occupation and household income. Moreover, additional information such as number of adults and children in household and existence of helper/housemaid was also included in order to supplement the information taken from study population.

Socioeconomic status of the participant in this study was explored using the following social indicators: Household income, father's and mother's education and respective occupation.

- Mother's and father's education was categorized into four levels: no education/primary school, secondary school, high school and university /college level.
- Parental occupation was assessed using an open–ended question and classified according to Standard Occupational *Classification 2000 Volume* 1 (www.statistics.gov.uk/methods_quality/ns_sec/downloads/SOC2000_Vol1_V5.pdf)
- The household income was measured based on monthly salary and was categorized into three levels. The first category ranged from 1,000 – 3,000 Dhs per month, the second ranged from 3,000 – 7,000 Dhs per month and the last category was more than 7,000 Dhs per month. This categorization was based on the study of Hashim and colleagues (Hashim et al., 2006).

4.13.1.3 Medical history

Criteria to assess the general health of adolescents were obtained based on presence and absence of adolescents' medical condition and the use of any medication based on information obtained from their parents. In addition, information on history of obesity in the family was obtained from parents.

4.13.1.4 Dietary habits

Dietary habits were assessed using a self-administered questionnaire previously validated by Hashim and coworkers among preschool children in the UAE (Hashim et al., 2006). This questionnaire assessed eating pattern, in term of regularity of main meal and skipping meals, frequency of foods, drinks and snacks at home using a scale that ranged from 1-2 times per day (coded as 1) to 11+ times per day (coded as 6). Adolescents were asked to indicate their food preference (Vegetarian, meat products, traditional food and sweets/carbohydrates). Frequency of consumption of certain sweets was also measured using a scale in which never (coded 0) and 5 times (coded 6). Information on eating while watching TV was also obtained. Frequency of consumption of fruit and vegetables using scale ranged from 0 to 3 times per day (Appendix X). In addition, information on frequency of food, snacks and drinks purchased from the school's canteen was included in the questionnaire. (Neumark-Sztainer et al., 2005).

4.13.1.5 Physical activity

Physical activity was assessed using the items from previously developed and validated questionnaire (Singh et al., 2006) and consisted of eight questions for gathering information on frequency and duration of physical activity (such as number of days per week they participated in sports, walking to school and biking etc.), transport to school such as whether walking or utilizing bus or car and sedentary activities such as time spent in front of T.V, games and computers.

4.13.1.6 Oral health behaviour

Oral hygiene practice, whether they brushed or not, frequency and time of tooth brushing was assessed using items from Hashim's study of (Hashim et al., 2006). Information about dental visits during the last 12 months was obtained. Information

related to fluoride use such fluoridated toothpaste and fluoride tablets, as well as access to either fluoridated or non fluoridated water was ascertained using open ended questions by asking the type and name of bottled water.

4.13.1.7 Psychological status

The Rosenberg Self-Esteem Scale (1965) was used to measure adolescents' global feeling of self-worth or self-acceptance. It is the most widely used measure of self-esteem and has been validated to be used amongst adolescents (Swallen et al., 2005). It includes ten items, rated from 0 (strongly agree), to 3 (strongly disagree) and the final score was determined by summing up the ratings. The higher scores indicated the higher self-esteem. Rosenberg Self-Esteem Scale was previously translated into Arabic language and tested for validity and reliability in Saudi Arabia by Sulliman and Halabi (Suliman and Halabi, 2007).

4.13.2 Clinical data (Clinical Examination)

4.13.2.1 Anthropometric measurement

In order to calculate the Body Mass Index (BMI), weight and height were measured using a Seca digital scale,and stadiometer respectively as illustrated in Figure 4-4, according to Food and Nutrition Anthropometric Indicators Measurement Guide (Cogill, 2003). BMI was calculated as: BMI= Weight (Kg)/ Height (m^2).

Adolescents were classified into three groups of normal, overweight and obese according to the International Obesity Task Force cut-off point age and gender matched table reference as illustrated in (Appendix I).

As for weight, it was measured in a standard manner. The subject in their school uniforms and all contents removed from their pockets, without shoes stepped onto

the Seca digital floor scale with a capacity of 200 kg in graduations of 100 gr. This was chosen because of its wide, low platform and non-slip dimpled mat, and its ease and safety to stand on. The scale has a stable integrated steel frame, ideal for weighing very heavy individuals. The step-off function meant that the scale did not have to be switched on separately before use. It has a precise and automatic zero adjustment, which takes into account any changes in the environment specially when changing location, for example temperature or flooring.

With respect of height, it was measured using portable Seca Stadiometer. Subjects stand erect with heels together, without shoes, head placed in the Frankfurt plane and with occiputs, scapula, buttock and heel touching the wall, and eyes looking straight. This stadiometer was chosen because of its suitability for mobile use specially for measuring adolescents in schools. It could be dismantled into several pieces for ease of transport and set up anywhere. A stable floor plate provides stability and the measuring rod is graduated in 1mm, scale between 20-207 cm on both sides making reading the scale easier. The measurement of height and weight and registering in the form following standard guideline (Cogill, 2003).

Figure 4-4: Seca digital and Stadiometer

Seca digital scale

Seca stadiometer

http://www.scalesgalore.com/seca_scales.htm

4.13.2.2 Oral health status

Oral health outcomes of the study were dental caries and oral cleanliness.

1- Dental caries: was assessed using DMFT index according to WHO coding and criteria (WHO, 1997a). Dental caries was recorded at the cavitation level and catching of blunt probe under slight pressure for fissure. All necessary steps were taken for infection control. The examination was carried out using plain disposable sterile mirror and probe and disposable gloves. The teeth were examined in a standardized manner from upper right, middle and left then lower left, middle and right. The examination for dental caries was carried out followed by the scoring of the presence of plaque and gingival condition. The subject sat on a static chair situated in the room where the light would aid illumination. The tooth was not cleaned of debris, nor was compressed air used, but where visibility was obscured by excess debris or moisture this was removed with gauze or cotton wool rolls. No radiographs were used in this study.

2- Oral cleanliness: was measured using BASCD criteria (Pitts et al., 1997) to examine the presence/absence of gingival inflammation and the presence /absence of visible plaque without using a probe or disclosing tablet. The time taken to examine each subject was five to seven minutes.

4.14 Study procedure

4.14.1 Parental consent and confidentiality

Permission from parents was obtained before recruiting the students and prior to the school visit. An Information sheet and consent letter was sent in advance informing the parents about the aims of the study, procedure of clinical

examination and assuring confidentiality of any information collected (Appendix XI). The parents were informed that the questionnaire and clinical examination measuring height and weight and dental check-up would be carried out during the school hours. Negative consent from parents/guardian was adopted. In addition, each student was consented before starting the clinical examination, at the same time reassurance was given to them in relation to confidentiality. All sections of the clinical examination forms and questionnaire were pre-coded and the original files containing the identification of the participant were kept by principal investigator (FK) in a securely locked filing system.

4.14.2 Approaching staffs

Before data collection started, the Ministry of Education in UAE was contacted and letters were sent to all selected schools seeking for permission and explaining the study design. In addition, the Ministry of Education in UAE provided FK with a letter to access selected schools. Later a meeting was organized between FK and the head teaches or representatives of the school authorities. The purpose of this meeting was to present the research design and objectives. Information on total number of classes and the number of students per class was confirmed. The school clinic to be allocated for the clinical examination was wieved.

An appointment was made with the teachers of the selected classes; the selected period of either art or PE was identified as most of the school did not want to interrupt the important period such as science or maths. A date for FK to visit the school was agreed.

4.14.3 Approaching students

The researcher (FK) was introduced to the students by the school staff. Then a brief explanation of the project was given to the students by FK in the class room and the students were allowed to ask for the help of researcher (FK) to clarify the questions, where necessary.

4.14.4 Management of questionnaires

Students' questionnaire was distributed and completed in each selected classroom. A clear explanation about the objectives of the study and instruction on how to answer the questions was also given. The confidentiality of their personal information and results was stressed. The time taken to carry out the questionnaire varied between 30 to 40 minutes for each class. After completing the questionnaire in the classroom the individual questionnaires were reviewed to ensure that all the questions had been answered, the subjects were asked to answer any missing items before leaving the classroom. Further, after completing the questionnaires, the clinical examination followed in the designated school clinics and during school hours.

4.14.5 Clinical examination

On the day of clinical examination, the health station previously reserved was organized with a suitable chair and instruments. At each participating school, the location and structure of the examination room slightly varied, but the characteristics of artificial light and basic layout of the furniture used were strictly maintained. Daily disinfection of furniture such as chairs, tables, weight and height scales was adopted. Disposable diagnostic kits were used for each student. The examiner (FK) maintained personal protection in terms of wearing disposable gloves, mask and white coat. For the examination, the student sat on a straight

back chair and faced the examiner (FK). Two assessment forms were used to collect clinical data. These forms were:

1-Anthropometric form (Appendix IX).

2-Oral Examination form (Appendix IX).

Oral health status was measured by FK using the DMFT index according to WHO criteria and gingival condition using BSCAD criteria. Oral health status was recorded in the clinical examination form (Appendix VIII). Overall, a school's cooperation varied widely depending on their administration. Some schools were very cooperative and therefore the actual time scale and the predicted time scale was the same, whilst others were not. However, the time spent in clinical examination and questionnaire remained the same. All the participants were informed about their oral condition and were referred to the dental center if any treatment was needed. Oral hygiene instruction was given to all participants. In addition, the participants were rewarded with Oral-B tooth-brush, toothpaste and dental floss after completing the full set of data.

The Rosenberg Self-Esteem Scale was used in this study was previously translated into Arabic language and tested for validity and reliability in Saudi Arabia by Sulliman and Halabi (Suliman and Halabi, 2007). We investigated to see whether it is suitable for this particular population. Studies in Western Societies in school children have shown that it is a reliable instrument, with Cronbach's alpha around 0.7 (Hodge and McCarthy, 1984).

In this population however Cronbach's alpha is low, overall 0.58. By ethnicity it is 0.55, 0.63, 0.61, and 0.63 for Arabs, Emiratis, Indian sub-continent and others respectively. For these students either overall or by ethnicity background, a factor analysis showed that the strongest factor (three times the effect of the other factor)

was one where all the factors in the scale were positively correlated with the overall score and the second factor showed that there was a smaller but probably real association with a tendency to agree with all the questions. Whether this is because these children answered that way because they wanted to agree with people in the authority or whether they did not give their full attention to the questions or whether they did not really understand the question or indeed whether there is some other reason for answering in this way is not known.

4.15 Data analysis

This section describes data processing and data analysis. During the survey, the clinical examination forms and questionnaires were checked for errors and omission and were corrected as necessary. Before entering the data into SPSS all the variables in the questionnaire was abbreviated and each response was assigned a numerical code, a summery of coding all the variables are illustrated in Appendix X. Data were entered manually by the researcher (FK), using the Statistic Package for Social Sciences (SPSS for window, Version 18). A sample of data was entered twice to check for any differences in data entry. When looking for data error a column of data was selected and was scaned for error. The data entry was range checked in the system as apart of checking once the data was on the computer (eg, age should be between 10 and 17) or for categorical if only five categories then make sure not to enter 6.

Before data analysis, descriptive statistics, frequency table and scatter plots were used to check for errors, outliers and missing data. Missing values, errors or value that fell outside the range, were replaced and corrected by checking the subject's record, where applicable. A further descriptive analysis was performed testing the distribution of BMI and DMFT using histogram and normal curve. Although the

data was not normally distributed (positively skewed) as shown in Figure 5-2, provided that the data set was large, non-normality of the data does not preclude accurate assessment of differences in means and their confidence intervals. Although there is thought to be an advantage in transforming the data to make it more normal, this often means that the interpretation of the results is made more difficult. Since the sample size was large (803) and because the raw data or log transformed data gave similar results, we have used the raw data in this study and therefore used the parametric test.

Overall two steps were used to analyse the data. Firstly, the descriptive analysis and reporting prevalence. Secondly, the association between study's independent variables and study's health outcomes. As the outcome variables were measured on a continuous scale univariate relationships between explanatory variables and each outcome separately were explored, using simple linear regression, ANOVA or t-Tests. Later multivariate analysis methods were used to determine the independent effect of each variable on dependent variable, using standard multiple regression.The stages of data analysis performed in this study were as follows.

The first stage (Part I) was a descriptive analysis, performing frequency distribution for both categorical and numerical variables describing the characteristics of the sample. Categorical variables were summarized by the number and percentage of adolescents in each category, whilst continuous variables were summarized by mean and standard deviation. This stage included categorizing or dichotomizing some of the variables. Weight groups were grouped into three categories: Normal weight, overweight and obese based on the IOTF cut-off point. Dental caries was dichotomized into caries and caries free.

The second stage (Part II) of data analysis to analyze the association between the study's independent variables (Socio-demographic, dietary habits, physical exercise and oral hygiene habits) and study's health outcomes (BMI, DMFT and self-esteem) using a simple linear regression, if the independent variables were continuous, whilst ANOVA and t-test were used if the independent variables were categorical. For example, association between dietary habits and oral hygiene habits with DMFT and decay were investigated using univariate linear regression. The pattern of dietary habits and physical activity was investigated across weight group using (χ^2) test and also across BMI treating it as a continuous variable using univariate linear regression. One way analysis of variance (ANOVA) and t-Test was also performed to investigate the difference in mean BMI and DMFT across socio-demographic details.

Multivariate significant variables were established for each of the categories, socio-economic status, oral hygiene and dietary habits, to identify potential risk factor in relation to BMI, DMFT and (D) decay in each category. The final stage of data analysis, included a multivariate analysis (multivariate linear regression) to identify a model to show the potential risk factors which best explained in relation to BMI, DMFT and decay. This multivariate model was constructed using stepwise procedure with all the significance variables from multivariate models for each category. In order to check whether the results observed in multivariate regression model would persist in the final model, all other explanatory variables that were not significant (socio-demographic variables, dietary habits and oral hygiene variables) including BMI were added into the model one at a time, to confirm the significance of predictors or risk factors, those variables demonstrating statistically significant association at the 5% level ($p< 0.05$) in the final model were identified as risk factors.

4.16 Summary of the methodology

- A randomized cross-sectional study was conducted in Sharjah City, UAE. The population included adolescents aged 11-17 years old from secondary stage attending Public and Private school. The numbers of participants were 1,094.
- The sampling frame included two stages, first selecting the schools using random digit table, then selecting one class from each grade including all the students from that selected section.
- The study was conducted by firstly approaching health and education authorities, secondly, approaching staff and parents and thirdly approaching students.
- Two sets of questionnaires were used. Adolescent's questionnaire was used to collect data on demographic characteristics, dietary habits, physical activity, oral hygiene habits and psychological status. Guardian questionnaire was used to collect data on socio-economic status and medical history.
- A clinical examination, measurement of height and weight and oral examination for each participant was conducted.
- The feasibility of the study was tested in a pilot study.
- Data analysis was performed in two stages. In the first stage, descriptive analysis of the sample was performed. The second stage, employed univariate relationship between explanatory variables and each outcome, then multivariate analysis method to determine the joint effect of independent variables on dependent variables.

Chapter 5. Results

5.1 Introduction

The aims of this chapter are, to demonstrate response rate and final sample size, to present the results in two subdivisions: Part I the descriptive overview of the sample, Part II reports the univariate and multivariate analysis.

Section 5.2 shows the response rate and final sample size. Section 5.3 shows a description of the sample and Section 5.4 presents the results of univariate linear regression analysis between each of the current study independent variables and dependent variables and finally a multivariate regression between independent and dependent variables.

5.2 Response rate and final sample size analysed

The survey was conducted from Feb 2008 until Jun 2008. All the selected schools (4 public and 6 private schools) agreed to participate and contributed 1,094 students from 44 classes. Eighty students refused to participate giving an initial response rate of 92.6%.

One hundred and seventy five (17.3%) students were absent during data collection either the day of distributing the questionnaires or the day of clinical examination. Thirty six (4.3%) students failed to return the consent form. Reappointing these students failed due to their busy time tables. Hence, a total of 803 adolescents were included in this study.

5.3 Part I: Descriptive overview of the sample

In this section, the demographic characteristics of both adolescents and the parents, the dietary habits, physical activity and oral hygiene habits of adolescents, the prevalence of obesity and finally the oral health status of the adolescents including prevalence of dental caries, gingivitis and visible plaque will be described.

5.3.1 Demographic characteristics of the adolescents

The sample included 803 participants, of whom 406 (51%) were male. The distribution of gender showed similar result when looking by the school type, 50% of adolescents attending Private school and 51% of adolescents from Public were male. The adolescents were aged between 10 to 17 years old, as represented in Table 1. The majority 714 (88%) were in the age range of 11 to 14 years old, with mean age of 12.8 (sd ±1.04), with fewer in the 10, 15, 16 and 17 years old groups (Table 5-1).

Because of the diverse ethnic background, the adolescents were placed into four major groups: namely Emiratis (UAE national) 352 (41%), other Arabs 278 (34.6%), Indian Sub-continent 135 (16.8%) and others 65 (8%). Of the above population 269 (34%) attended Public school but the majority 534 (66%) were at Private School. Majority of Emiratis (72%) attended Public school, vice versa amongst Arabs nationality majority (87%) attended Private school, whilst Indians and others were all in Private school.

The majority of the study population 744 (93%) were healthy, however 59 (7%) had a medical condition such as asthma, eczema or anemia. A small percentage

(less than 1%) had other conditions such as congenital heart disease, epilepsy and diabetes. Overall only 29 (50%) of the adolescents with medical condition were on medication relevant to their disease.

Table 5-1: Demographic details of adolescents

Variables	Number (%)
Age	
Mean (sd)	12.8 (1.4)
Median	13
Age (Years)	
10	17 (2.1%)
11	146 (18.2%)
12	169 (21%)
13	223 (27.8%)
14	176 (21.9%)
15	46 (5.7%)
16	20 (2.5%)
17	6 (0.7%)
Gender	
Male	406 (50.5%)
Female	396 (49.4%)
Nationality	
Emiratis	325 (40.5%)
Other Arabs	278 (34.6%)
Indians	135 (16.8%)
Others	65 (8.1%)
School type	
Public	269 (33.5%)
Private	534 (66.5%)

5.3.2 Demographic characteristics of the parents

The parents' demographic characteristics are presented in Table 5-2. The fathers' age in the sample population ranged from 32 to 68 year olds with a mean age of 45 (sd± 6) and mothers' age ranged from 25 to 66 year with mean age of 39 (sd± 5). Fifty five percent of the fathers and 45% of the mothers had an education up to college. The occupation of the parents was classified using Standard Occupational Classification 2001 Vol.1.Three quarter of the mothers were housewives, 20% worked in administrative and educational profession and a few (5%) worked in

either a professional occupation or as a manager. Whilst the fathers had a wider range of occupation, only 6% were un-employed, the rest were manager (8%), professional job (14%), and business (self-employed) (17%), administrative and secretarial (34%), teacher (5%), military and police (11%) and few had elementary occupation (3%).

Although two thirds of the study population had a family income of above 7000 Dhs per month, more Emiratis (78%) reported a salary of >7000Dhs compared to other nationalities. On the other hand the lowest salary income (1000-3000 Dhs) was more reported by Arabs (43%) compared to 34% of Emiratis, 9% of Indian sub-continent and 11% of the others. The household income increased significantly ($p<0.001$) by the level of parental education.

Almost half of the study population had household servant, however this was significantly different across nationalities, among the Emiratis the majority (84%) had household servants while among the Arabs and those from the Indian sub-continent 80% did not have any household servants.

Table 5-2: Demographic details of parents

Variables	Father N (%)	Mother N (%)
Age (years)		
Mean (sd)	44.69 (6)	38.92 (5.2)
Range	32–68	25–66
Median	44	38
Education		
No education	24 (3%)	34 (4%)
Primary	66 (9%)	87 (11%)
Secondary	77 (10%)	99 (12%)
High School	186 (24%)	218 (27%)
College / university	426 (55%)	360 (45%)
Occupation		
Manager	60 (7.5%)	12 (1.5%)
Professional Job	111 (13.8)	23 (2.9%)
Business/Self-employed	139 (17.3%)	4 (0.5%)
Administrative	272 (33.9%)	76 (9.5%)
Education professional	43 (5.4%)	79 (9.8%)
Military/Police	84 (10.5%)	2 (0.2%)
Elementary/Non-skilled job	24 (3%)	1 (0.1%)
Unemployed/Housewife	46 (5.7%)	601 (74.8%)
Deceased	24 (3%)	5 (0.6%)
Income		
1000-3000 Dhs	85 (11%)	
3000-7000 Dhs	222 (28%)	
More than 7000 Dhs	496 (62%)	

5.3.3 Description of adolescents' behaviour by socio-demographic factors

The characteristics of adolescents' behaviour namely dietary habits, physical activity and oral hygiene habits in association with their socio-demographic details are summarized in Appendix XII, while the variables that were found to be statistically significant are presented in the following sections.

5.3.3.1 Dietary habits

The characteristics of the adolescents' dietary habits included food and drinks frequency and preference. A summary for all 803 pupils is given in Appendix XII.

Overall, the majority (59%) reported they had their main meals regularly. The data showed that 87% skipped breakfast, while 51% reported to have all three meals, which presumably included breakfast. Therefore, 291 (36.2%) did not have either

breakfast or all the three meals, 490 (61%) skipped lunch and 660 (82.2%) skipped dinner. However, girls consumed both lunch 186 (46%) and dinner 87 (21.9%) more frequently in comparison to boys 130 (32%) and 56 (13.8%) respectively and this difference was statistically significant ($p<0.001$) (Table 5-3).

The pattern of snacking is shown in Appendix XII-A. The majority 67% of the study population snacked once or twice a day, a slightly higher percentage of boys (18%) reported snacking more than three times a day in comparison to girls (13%). Overall, the majority of the participants reported consumption of fast food and processed food once a week 362 (45%) and 277 (35%) respectively (Appendix XII-A).

Observation related to frequency of intake of fast food and processed food showed no significant difference between genders. Preference of various foods was investigated among the adolescents. An overall positive response in all food categories was higher among boys except for sweets and carbohydrates, where the girls 135 (34%) reported slightly higher than boys 129 (31%) (Appendix XII-B).

Daily consumption of fruit and vegetables is illustrated in Appendix XII-B. Significant gender influence was observed in daily fruit consumption ($p=0.001$) (Table 5-3). Forty seven percent of the girls had fruit once a day in comparison to boys (37%). However, more boys 228 (56%) reported consumption of fruit two to three times a day than girls 176 (45%) as shown in Table 5-3. Gender was the main determinant of difference in drinking frequency and choice. The boys consumed soft drinks, natural fruit juices, milk and tea with sugar more often than the girls ($p<0.001$) as shown in Table 5-3.

Table 5-3: Chi-Square test analysis of dietary habits by gender

Diet	Gender		P-value
	Male N (%)	Female N (%)	
Have lunch every day			
Yes	130 (32%)	183 (46.1%)	
No	276 (68%)	214 (53.9%)	<0.001
Have dinner every day			
Yes	56 (13.8%)	87 (21.9%)	
No	350 (86.2%)	310 (78.1%)	0.003
Fruit/day			
None	26 (6.4%)	35 (8.8%)	
1x	152 (37.4%)	186 (46.9%)	
2x	118 (29.1%)	113 (28.5%)	0.001
3X	110 (27.1%)	63 (15.9%)	
Soft drinks			
Never	25 (8.6%)	29 (7.3%)	
1-2 times/week	107 (26.4%)	163 (41.1%)	
3-4 times/week	55 (13.5%)	52 (13.1%)	
1-2 times/day	128 (31.5%)	10 (27.7%)	<0.001
3-4 times/day	47 (11.6%)	26 (6.5%)	
5+ times/day	34 (8.4%)	17 (4.3%)	
Natural fruit juice			
Never	44 (10.8%)	75 (18.9%)	
1-2 times/week	107 (26.4%)	122 (30.7%)	
3-4 times/week	71 (17.5%)	53 (13.4%)	
1-2 times/day	112 (27.6%)	111 (28%)	<0.001
3-4 times/day	43 (10.6%)	23 (5.8%)	
5+ times/day	29 (7.1%)	13 (3.3%)	
Milk			
Never	54 (13.3%)	113 (28.5%)	
1-2 times/week	72 (17.7%)	89 (22.4%)	
3-4 times/week	49 (12.1%)	31 (7.8%)	
1-2 times/day	140 (34.5%)	119 (28%)	<0.001
3-4 times/day	45 (11.1%)	29 (7.3%)	
5+ times/day	46 (11.3%)	24 (6%)	
Tea &Sugar			
Never	99 (24.4%)	164 (41.3%)	
1-2 times/week	92 (22.7%)	97 (24.4%)	
3-4 times/week	42 (10.3%)	31 (7.8%)	
1-2 times/day	108 (26.6%)	79 (19.9%)	<0.001
3-4 times/day	36 (8.9%)	17 (4.3%)	
5+ times/day	29 (7.1%)	9 (2.3%)	

The frequency food consumption was also assessed by school type. Table 5-4 demonstrates adolescents from Public school had significantly ($p<0.001$) less regular main meals as compared to those attending Private school 348 (65%). In

addition the adolescents from Public school skipped more meals and significantly missed dinner more often ($p<0.001$) as illustrated in Appendix XII-A.

Both Public and Private school had similar pattern of snacking. However, pupils from Public school significantly ($p<0.001$) consumed fast food and processed food more than three times per week than those in Private schools (Table 5-4).

There was variation between the two school types in food preference, for example fast food and carbohydrates were preferred among Public school adolescents 134 (50%), 112 (42%) respectively compared to Private school 197 (37%) and 152 (29%) ($p<0.001$) (Table 5-4). Moreover, consumption of fruit two to three times a day was higher among Private school 296 (56%) in comparison to Public school 108 (40%). A similar result for daily consumption of vegetables was found to be significantly ($p<0.001$) higher in Private schools (Table 5-4).

Table 5-4: Chi-Square test analysis of dietary habits by school type

Diet	School type		P-value
	Public N (%)	Private N (%)	
Have main meal regularly			
Yes	127 (47.2%)	348 (65.2%)	
No	142 (52.8%)	186 (34.8%)	<0.001
Fast food / week			
None	41 (15.2%)	106 (19.9%)	
1X	109 (40.5%)	253 (47.4%)	
2X	52 (19.3%)	112 (21%)	<0.001
3X	36 (13.4%)	32 (6%)	
>3	31 (11.5%)	31 (5.8%)	
Processed food /week			
None	22 (8.2%)	76 (14.2%)	
1X	78 (29%)	199 (37.3%)	
2X	69 (25.7%)	140 (26.2%)	<0.001
3X	44 (16.4%)	62 (11.6%)	
>3	56 (20.8%)	57 (10.7%)	
Fast food			
Yes	134 (49.8%)	197 (36.9%)	
No	135 (50.2%)	337 (63.1%)	<0.001
Sweet & carbohydrate			
Yes	112 (41.6%)	152 (28.5%)	
No	157 (58.4%)	382 (71.5%)	<0.001
Fruits/day			
None	30 (11.2%)	31 (5.8%)	
1x	131 (48.7%)	207 (38.8%)	<0.001
2x	56 (20.8%)	175 (32.8%)	
3X	52 (19.3%)	121 (22.7%)	
Vegetables/day			
None	60 (22.3%)	69 (12.9%)	
1x	122 (45.4%)	210 (39.3%)	<0.001
2x	60 (22.3%)	171 (32%)	
3X	27 (10%)	84 (15.7%)	
TV while eating			
Yes	229 (85.1%)	403 (75.5%)	
No	40 (14.9%)	131 (24.5%)	0.002
Soft drinks			
Never	17 (6.3%)	47 (8.8%)	
1-2 times/week	71 (26.4%)	199 (37.3%)	
3-4 times/week	35 (13%)	72 (13.5%)	
1-2 times/day	88 (32.7%)	150 (28.1%)	0.001
3-4 times/day	37 (13.8%)	36 (6.7%)	
5+ times/day	21 (7.8%)	30 (5.6%)	

Association between food intake and level of parental education was also investigated; Appendix XII shows the proportion of the adolescents' food frequency by level of parental education. Overall, parental education did not seem to be significantly associated with either food frequency or food and drink preference. For example, 85% skipped breakfast which was almost equal, irrespective of level of parental education. However, skipping lunch was reported slightly more often amongst those adolescents whos parent had no education (75%) than for those whose parents were educated up to college level (59%) (Appendix XII-A). Further, the percentage of adolescents snacking more than three times a day was positively associated with level of parental education. For example, snacking ≥3 times was reported more than twice as often in the group of highly educated mothers (41%) than for those whose mothers had no education (18%) (Appendix XII-A). Adolescents with high parental education were less likely to eat fast food three times a week (6%) as compared to adolescents with no parental education (29%), a similar pattern of association with level of parental education was observed for the processed food, however these were not statistically significant (Appendix XI-A).

Association between food and drinks frequency and preference by household income was also assessed among subjects, slightly more adolescents from higher income families reported having their main meal regularly 294 (59%) in comparison to lower income 43 (50%). Although large numbers of adolescents skipped breakfast in all three categories of household income (Appendix XII-A), adolescents from low income families reported more often skipping breakfast 77 (91%) in comparison to higher income 428 (86%) but these were not statistically significant. Positive relationship emerged between income and weekly fast food

intake (p=0.001) (Appendix XII-A). Nationality was significantly associated with dietary habits. Over 80% of Indians and others, reported having their main meals regularly, compared to 50% of Emiratis and other Arabs (p<0.001) as shown in Table 5-5. The meals most often skipped amongst Indian and others were breakfast and especifically lunch (p<0.001). Moreover, skipping dinner was least among Emiratis, although 246 (76%) Emiratis did not have dinner in comparison to the other nationalities (p<0.001) (Table 5-5).

Pattern of snacking was not significantly associated with nationalities. However, frequency of fast food and processed food was least popular among Indians sub-continent and Arabs, whilst approximately half of Arabs 134 (48%) and Indians sub-continent 64 (47%) had once a week fast food while large number of them did not eat fast food at all in comparison to Emiratis and others. Furthermore, significantly more Emiratis consumed more than three times a week both fast food and processed food compared to other nationalities (Table 5-5).

Food preference was significantly different across nationalities. Emiratis were more likely to report that they preferred fast food 161 (50%), sweets and carbohydrates 134 (41%) in comparison to other nationalities (p<0.001). Consumption of fruit and vegetables were also significantly different among nationalities (p<0.001). A greater proportion of Emiratis reported not eating fruit 37 (11%) and vegetables 69 (21%) during a day compared to other nationality, overall the majority of Emiratis (48%, 47%) and Arabs (41%, 40%) consumed fruit and vegetables once a day while Indians sub-continent (41%, 41%) and others (40%, 35%) majority of them reported consumption of both fruit and vegetables twice a day (Table 5-5).

Emiratis and Arabs were more likely to watch TV while eating 273 (84%) and 230 (83%) respectively compared to Indians sub-continent 85 (63%) and others 44 (68%) and these found to be statistically significant ($p<0.001$) (Table 5-5).

Frequency of drinking was also investigated by nationality. Consumption of soft drinks and milk were significantly different across the nationalities ($p<0.001$) (Table 5-5). Almost all participants reported that they drank soft drinks, the Indians sub-continent were less likely to drink soft drinks compared to other nationalities. Moreover, 43 (13%) of Emiratis reported that they drank 3-4 times a day and a quarter of Emiratis 79 (23%) and Arabs 74 (27%) reported never drinking milk (Table 5-5).

Age was significantly associated with beverage intake, the consumption of milk reduced significantly ($p<0.001$), while consumption of soft drink increased significantly ($p= 0.011$) by age. Age was also significantly associated with consumption of fruits and vegetables, the frequency of both fruits ($p=0.003$) and vegetables ($p=0.02$) per day significantly reduced by age. Also, the older adolescents had less regular meal and all three meals (Appendix X VII).

Table 5-5: Chi-Square test analysis of dietary habits by nationality

Diet	Nationality				P-value
	Emirati	**Other Arabs**	**Indian** sub-continent	**Others**	
Have main meal regularly					
Yes	168 (51.7%)	145 (52.2%)	109 (80.7%)	53 (81.5%)	
No	157 (48.3%)	133 (47.8%)	26 (19.3%)	12 (18.5%)	<0.001
Have lunch every day					
Yes	135 (41.5%)	123 (44.2%)	35 (25.6%)	20 (30.8%)	
No	190 (58.5%)	155 (55.8%)	100 (74.1%)	45 (69.2%)	0.001
Have dinner every day					
Yes	79 (24.3%)	38 (13.7%)	18 (13.3%)	8 (12.3%)	
No	246 (75.7%)	240 (86.3%)	117 (86.7%)	57 (87.7%)	0.001
Fast food / week					
None	44 (13.5%)	58 (20.9%)	35 (25.9%)	10 (15.4%)	
1X	130 (40%)	134 (48.2%)	64 (47.4%)	34 (52.3%)	
2X	75 (23.1%)	51 (18.3%)	23 (17%)	15 (23.1%)	<0.001
3X	39 (12%)	18 (6.5%)	5 (3.7%)	6 (9.2%)	
>3	37 (11.4%)	17 (6.1%)	8 (5.9%)	0 (0%)	
Processed food /week					
None	20 (6.2%)	48 (17.3%)	27 (20%)	3 (4.6%)	
1X	101 (31.1%)	99 (35.6%)	46 (34.1%)	31 (47.7%)	
2X	85 (26.2%)	69 (24.8%)	37 (27.4%)	18 (27.7%)	<0.001
3X	51 (15.7%)	25 (9%)	20 (14.8%)	10 (15.4%)	
>3	68 (20.9%)	37 (13.3%)	5 (3.7%)	3 (4.6%)	
Fast food					
Yes	161 (49.5%)	109 (39.2%)	43 (31.9%)	18 (27.7%)	
No	164 (50.5%)	169 (60.8%)	92 (68.1%)	47 (72.3%)	<0.001
Sweet & carbohydrate					
Yes	134 (41.2%)	80 (28.8%)	31 (23%)	19 (29.2%)	
No	191 (58.8%)	198 (71.2%)	104 (77%)	46 (70.8%)	<0.001
Fruits/day					
None	37 (11.4%)	19 (6.8%)	3 (2.2%)	2 (3.1%)	
1x	156 (48%)	114 (41%)	52 (38.5%)	16 (24.6%)	<0.001
2x	65 (20%)	85 (30.6%)	55 (40.7%)	26 (40%)	
3X	67 (20.6%)	60 (21.6%)	25 (18.5%)	21 (32.3%)	
Vegetables/day					
None	69 (21.2%)	46 (16.5%)	10 (7.4%)	4 (6.2%)	
1x	152 (46.8%)	111(39.9%)	46 (34.1%)	23 (35.4%)	<0.001
2x	72 (22.2%)	79 (28.4%)	55 (40.7%)	25 (38.5%)	
3X	32 (9.8%)	42 (15.1%)	24 (17.8%)	13 (20%)	
T.V while eating					
Yes	273 (84%)	230 (82.7%)	85 (63%)	44 (67.7%)	
No	52 (16%)	48 (17.3%)	50 (37%)	21 (32.3%)	<0.001
Soft drinks					
Never	19 (5.8%)	20 (7.2%)	19 (14.1%)	6 (9.2%)	
1-2 times/week	87 (26.8%)	99 (35.6%)	58 (43%)	26 (40%)	
3-4 times/week	43 (13.2%)	34 (12.2%)	21 (15.6%)	9 (13.8%)	
1-2 times/day	107 (32.9%)	89 (32%)	25 (18.5%)	17 (26.2%)	<0.001
3-4 times/day	43 (13.2%)	16 (5.8%)	7 (5.2%)	7 (10.8%)	
5+ times/day	26 (8%)	20 (7.2%)	5 (3.7%)	0 (0%)	

5.3.3.2 Physical activity

Physical activity was investigated among adolescents and was compared across age, gender, school type, nationality, parental education and income (Appendix XIII).

Analysis of physical activity by age showed that number of exercise per week significantly reduced by age ($p=0.002$), visa versa the length of sedentary activity increased significantly by age ($p<0.001$).

The reported physical activities showed that the majority of participants 734 (91 %) exercised one to three times a week. However, when the data was analyzed by gender, the result showed significantly differences among boys and girls ($p<0.001$), the majority of boys 268 (66%) exercised on a regular basis whilst most of the girls 243 (61%) reported that they did not do regular exercise (Table 5-6). In addition, the majority of boys 186 (46) exercised at least 3 times a week whilst girls reported exercising mostly once a week ($p<0.001$) as illustrated in (Table 5-6). Overall, only four percent of the adolescents walked to school, the majority used either used bus or car as a means of transportation to school. There was significant ($p<0.001$) different between gender, more number of boys 26 (6%) reported walking to school in comparison to girls 3 (1%) (Table 5-6).

There were no differences between girls and boys in sedentary activities such as watching TV, computer and video games (Appendix XIII), overall only 14% of subjects reported spending less than half an hour in front of TV, computer, video games whilst the majority 477 (59%) spent one to four hours a day in sedentary

lifestyle, this excludes another 27% of the study population who spent more than eight hours in a day in sedentary activities (Appendix XIII).

Table 5-6: Chi-Square test analysis of physical activity by gender

Physical activity	Gender		P-value
	Male	Female	
Number of Exercise/Week			
No	29 (7.1%)	40 (10.1%)	
1X	76 (18.7%)	150 (37.8)	
2X	115 (28.3%)	107 (27%)	<0.001
3X	186 (45.8%)	100 (25.2%)	
Regular Exercise			
Yes	268 (66%)	154 (38.8%)	
No	138 (34%)	243 (61.2%)	<0.001
Transport to school			
Walk	26 (6.4%)	3 (0.8%)	
Bus	229 (56.4%)	242 (61%)	<0.001
Car	151 (37.2%)	152 (38.3%)	

Association between school type and engaging in routine physical workout was found to be statistically significant (p<0.001), over 55% of adolescents from Private school reported exercising on a regular basis, whilst 56% of adolescents from Public school did not exercise regularly as seen in Table 5- 7. Overall, adolescent from Public school spent more hours a day in sedentary activity in comparision to those from Private school (p<0.001) (Table 5-7).

Table 5-7 : Chi-Square test analysis of physical activity by school type

Physical activity	School type		P-value
	Public	Private	
Regular Exercise			
Yes	119 (44.2%)	303 (56.7%)	
No	150 (55.8%)	231 (43.3%)	0.001
Transport to school			
Walk	11 (4.1%)	18 (3.4%)	
Bus	137 (50.9%)	334 (62.5%)	
Car	121 (45%)	182 (34.1%)	0.007
Sedentary Activity			
<1h/Day	26 (9.7%)	84 (15.7%)	
1-2h/Day	70 (26%)	196 (36.7%)	
3-4h/Day	77 (28.6%)	134 (25.1%)	
5-6h/day	39 (14.5%)	59 (11%)	<0.001
7-8h/Day	20 (7.4%)	26 (4.9%)	
>8h/day	37 (13.8%)	35 (6.6%)	

Analysis of physical activity across household income showed that 40% of adolescents belonging to higher family income of greater than 7000 Dhs exercised three times a week in comparison to only a quarter of those from lower household income (Appendix XIII). In addition, regular exercise was more frequent (57%) amongst higher income families (Table 5-8).

Table 5-8: Chi-Square test analysis of physical activity by household income

Physical activity	Income			P-value
	1000-3000 Dhs	3000-7000 Dhs	>7000 Dhs	
Regular Exercise				
Yes	36 (42.4%)	105 (47.3%)	281 (56.7%)	
No	49 (57.6%)	117 (52.7%)	215 (43.3%)	.009
Transport to school				
Walk	2 (2.4%)	10 (4.5%)	17 (3.4%)	
Bus	53 (62.4%)	156 (70.3%)	262 (52.8%)	
Car	30 (35.3%)	56 (25.2%)	217 (43.8%)	<.001

Although the association between physical activity and parental education was not significant, those who did not exercise at all, for the majority their parents had no education (Appendix XIII).

Regular exercise was significantly different across nationalities (p=<0.001), non-local Arabs had the lowest rate of exercise, 55% reported never exercised. More Emiratis reported using the car as a mean of transport whilst other nationalities were more likely to use bus to get to school (Table 5-9).

Looking across nationalities and their sedentary lifestyle, the majority of Indian sub-continent adolescents 86 (64%) spent only between one and two hours a day in sedentary activities whilst Emiratis, non-local Arabs and other nationalities spent mostly 2-6 hours of daily life in sedentary activity. Twelve percent of local Arabs (Emiratis) reported spending more than eight hours of a day viewing TV, computer or being inactive (Table 5-9).

Hours spent in sedentary activities showed similar results among adolescents with parental education up to college or university as compared to those with no school education (Appendix XIII).

Table 5-9: Chi-Square test analysis of physical activity by nationality

Physical activity	Nationality				P-value
	Emirati	Other Arabs	Indian Subcontinent	Others	
Regular Exercise					
Yes	170 (52.3%)	126 (45.3%)	78 (57.8%)	48 (73.8%)	<0.001
No	155 (47.7%)	152 (54.7%)	135 (42.2%)	17 (26.2%)	
Transport to school					
Walk	12 (3.7%)	11 (4%)	2 (1.5%)	4 (6.2%)	
Bus	149 (45.8%)	170 (61.2%)	112 (83%)	40 (61.5%)	<0.001
Car	164 (50.5%)	97 (34.9%)	21 (15.6%)	21 (32.3%)	
Sedentary Activity					
<1h/Day	34 (10.5%)	29 (10.4%)	43 (31.9%)	4 (6.2%)	
1-2h/Day	95 (29.2%)	101 (36.3%)	43 (31.9%)	27 (41.5%)	
3-4h/Day	88 (27.1%)	82 (29.5%)	25 (18.5%)	16 (24.6%)	
5-6h/day	47 (14.5%)	31 (11.2%)	11 (8.1%)	9 (13.8%)	<0.001
7-8h/Day	21 (6.5%)	12 (4.3%)	10 (7.4%)	3 (4.6%)	
>8h/day	40 (12.3%)	23 (8.3%)	3 (2.2%)	6 (9.2%)	

5.3.3.3 Oral hygiene habits

Oral hygiene behaviour such as tooth brushing habits, time and frequency of brushing and also use of Fluoride supplement was investigated and compared among different socio-demographic groups (Appendix XIV).

Overall, the majority 93% of the participants reported brushing their teeth daily and over half claimed to brush twice a day. Chi-square test indicated that tooth brushing and brushing frequency was significantly ($p<0.001$) more commonly practiced among female 98% as compared to male 89% (Table 5-10). Among those adolescents who brushed once a day, the girls brushed mostly in the evening whilst the boys brushed in the morning. The number of dental visits which were reported by either gender did not differ significantly (Appendix XIV).

Table 5-10: Chi-Square test analysis of oral hygiene habits by gender

Oral hygiene	Gender		P-value
	Male N (%)	Female N (%)	
Tooth brushing			
Yes	363 (89.4%)	387 (97.5%)	
No	43 (10.6%)	10 (2.5%)	<0.001
Brushing frequency			
None	34 (8.4%)	6 (1.5%)	
1X	118 (29.1%)	77 (19.4%)	
2X	198 (48.8%)	236 (59.4%)	<0.001
3X	56 (13.8%)	78 (19.6%)	
Brushing time			
None	32 (7.9%)	6 (1.5%)	
Morning	85 (20.9%)	72 (18.1%)	
Evening	45 (11.1%)	12 (29.2%)	<0.001
Morning & evening	244 (60.1%)	305 (76.8%)	

Table 5-11 illustrates oral hygiene habits by Public and Private school. There was no significant association between school type and tooth brushing practice, however a higher percentage of attendees from Public school brushed three times a day (p<0.001). Adolescents attending Public school were more likely visit the dentist than those at Private school, this was not statistically significant (Appendix XIV). The use of Fluoride tablets was significantly higher in Public school 36% in comparison to Private school 13% (p<0.001) (Table 5-11).

Table 5-11: Chi-Square test analysis of oral hygiene habits by school types

Oral hygiene	School type		P-value
	Public N (%)	Private N (%)	
Brushing frequency			
None	13 (4.8%)	27 (5.1%)	
1X	58 (21.6%)	137 (25.7%)	
2X	133 (49.4%)	301 (56.4%)	<0.001
3X	65 (24.2%)	69 (12.9%)	
Fluoride tablet			
Yes	96 (35.7%)	69 (12.9%)	
No	173 (64.3%)	465 (87.1%)	<0.001

Table 5-12 shows that the dental visit increased with household income (p<0.001). Adolescents from families with higher salary income also used more Fluoride tables than lower salary income (p=0.002).

Table 5-12: Chi-Square test analysis of oral hygiene habits by household income

Oral hygiene	Income			P-value
	1000-3000 Dhs N (%)	3000-7000 Dhs N (%)	>7000 Dhs N (%)	
Dental visit last 12 month				
Yes	28 (32.9%)	89 (40.1%)	254 (51.2%)	
No	57 (67.1%)	133 (59.9%)	242 (48.8%)	<0.001
Fluoride tablet				
Yes	15 (17.6%)	29 (13.1%)	121 (24.4%)	
No	70 (82.4%)	193 (86.9%)	375 (75.6%)	<0.002

Although there was no statistically significant association between the level of parental education and adolescents' oral hygiene habits, those adolescents whose mother had no education were less likely to brush their teeth (Appendix XIV).

Oral hygiene habits were investigated among different nationalities. Those adolescents who did not brush at all were mostly Arabs (p<0.001). In addition, brushing frequency was also significant by different nationalities, for example brushing three times a day was greater among Emiratis (23%) as compared to other nationalities (p<0.001) as shown in Table 5-13. Furthermore, majority of the adolescents who brushed once, were brushing in the morning and 31% of Emiratis used Fluoride tablets (Table 5-13). With regard to dental visit, the Indians sub-continent adolescents were less likely to have visited the dentist in last 12 months (p<0.001).

Table 5-13: Chi-Square test analysis of oral hygiene habits by nationality

Variable Oral Hygiene	Nationality				P-value
	Emirati	Other Arabs	Indian Subcontinent	Others	
Tooth brushing					
Yes	307 (94.5%)	248 (89.2%)	133 (98.5%)	62 (95.4%)	
No	18 (5.5%)	30 (10.8%)	2 (1.5%)	3 (4.6%)	0.002
Brushing frequency					
None	13 (4%)	24 (8.6%)	1 (0.7%)	2 (3.1%)	
1X	63 (19.4%)	88 (31.7%)	27 (20%)	17 (26.2%)	
2X	175 (53.8%)	127 (45.7%)	97 (71.9%)	35 (53.8%)	<0.001
3X	74 (22.8%)	39 (14%)	10 (7.4%)	11 (16.9%)	
Brushing time					
None	13 (4%)	22 (7.9%)	1 (0.7%)	2 (3.1%)	
Morning	56 (17.2%)	59 (21.2%)	30 (22.2%)	12 (18.5%)	
Evening	14 (4.3%)	38 (13.7%)	0 (0%)	7 (10.8%)	<0.001
Morning & evening	242 (74.5%)	159 (57.2%)	104 (77%)	44 (67.7%)	
Dental visit last 12 month					
Yes	161 (49.5%)	141 (50.7%)	34 (25.2%)	35 (53.8%)	
No	164 (50.5%)	137 (49.3%)	101 (74.8%)	30 (46.2%)	<0.001
Fluoride tablet					
Yes	100 (30.8%)	47 (16.9%)	11 (8.1%)	7 (10.8%)	
No	225 (69.2%)	231 (83.1%)	124 (91.9%)	58 (89.2%)	<0.001

5.3.3.4 Prevalence of obesity

The average weight, height and BMI of the participant by age are illustrated in Table 5-14. Based upon the study sample of 803 adolescents, the prevalence of obesity among adolescents in Intermediate stage, attending Public and Private school, of Sharjah City was found to be 14.7% (118), whilst the prevalence of overweight was 23.5% (189), with 31% having a family history of obesity. The mean BMI was 21.7 (sd ±5) and ranged from 13 to 38 as illustrated in Figure 5-1. There was a significant difference ($p<0.001$) between the weight groups (normal, overweight and obese) in terms of family history of obesity; the adolescents having family history of obesity were more likely to be overweight and obese as illustrated in Table 5-15.

From the distribution of weight groups according to nationalities, school type, gender, parental education and household income that is shown in Table 5-15, a significant difference (p=0.04) was found in the prevalence of obesity and overweight by nationality. The results showed the prevalence of obesity was 16%, 16.5%, 8.1% and 13.8% for Emiratis, other Arabs, Indian sub-continent and others respectively. The overweight prevalence was 19.1%, 28.1%, 25.9% and 12.5% respectively among the same nationalities.

The prevalence of obesity by school type was slightly higher in Public school (15.2%) than Private school (14.4%). This was not statistically significant. The prevalence of obesity and overweight by gender, was found to be 25.4% of males were overweight as compared to 21.7% of female, and 15% of male were obese versus 14.4% of female. However, this difference was not statistically significant.
The prevalence of obesity and overweight was not significantly different when compared by level of parental education and household income as shown in Table 5-15.

Table 5-14 a: Median, range, 25th and of 75th percentile of BMI by age and gender

Gender	Age	N	BMI (Median)	25 & 75 (Percentile)	Min & Max (Range)
GIRLS	10	4	20.23	(15.40 , 26.42)	14.67, 28.52
	11	66	19.46	(16.60, 22.03)	13.72, 32.39
	12	80	18.66	(16.76, 21.91)	14.38, 32.02
	13	109	20.32	(18.03, 24.11)	12.82, 36.56
	14	101	23.11	(19.13, 26.56)	13.91, 37.58
	15	29	22.66	(19.61, 24.90)	16.23, 35.76
	16	14	21.15	(20.15, 25.91)	18.43, 35.67
	17	3	18.73	(15.06, 20.38)	15.06, 20.38
BOYS	10	13	18.59	(16.84, 20.72)	14.82, 26.16
	11	80	19.30	(17.34, 21.64)	13.77, 37.28
	12	89	20.24	(17.36, 24.30)	13.32, 36.36
	13	114	21.13	(18.77, 25.56)	13.79, 34.72
	14	75	21.75	(19.53, 24.89)	15.03, 34.55
	15	17	23.34	(20.93, 28.38)	17.78, 36.96
	16	6	25.64	(21.63, 30.33)	19.03, 31.64
	17	3	22.43	(21.50, 29.64)	21.50, 29.64

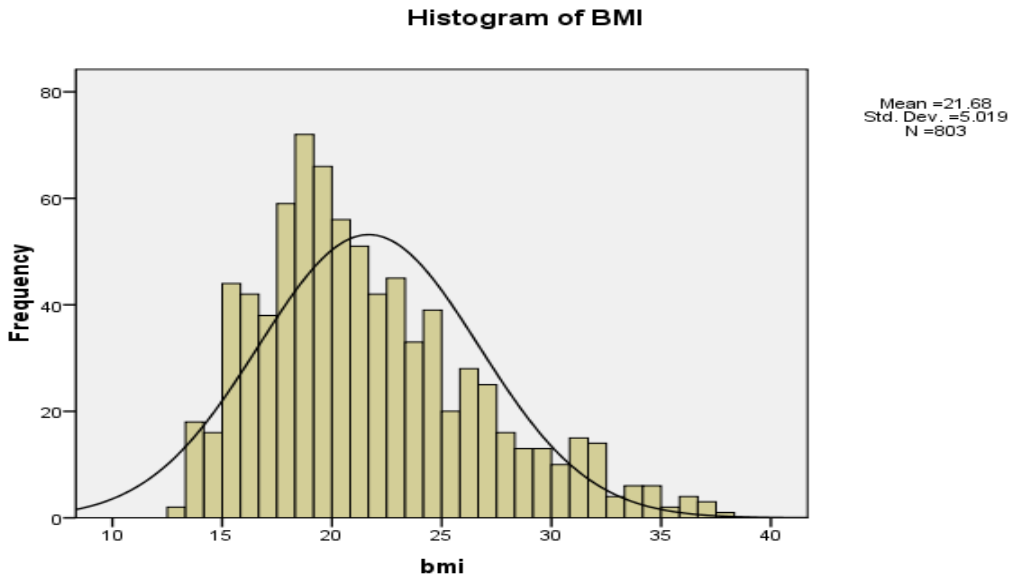
Table 5-14b: Median, range, 25th and of 75th percentile of z-score by age and gender

Gender	Age	N	(Median) Z-Score	25 & 75 (Percentile) Z-Score	Min & Max Z-Score
GIRLS	10	4	1.08	(-0.79, 2.77)	-1.29, 3.07
	11	66	0.99	(-0.30, 1.77)	-2.42, 3.31
	12	80	0.42	(-0.51, 1.53)	-2.19, 3.16
	13	109	0.80	(-0.16, 1.86)	-4.26, 3.45
	14	101	1.43	(0.06, 2.19)	-3.48, 3.47
	15	29	1.09	(-0.01, 1.68)	-1.90, 3.27
	16	14	0.37	(-0.04, 1.75)	-0.86, 3.21
	17	3	-0.97	(-3.576, -0.17)	-3.57, -0.17
BOYS	10	13	0.59	(-0.16, 1.31)	-1.29, 2.54
	11	80	0.60	(-0.20, 1.34)	-2.37, 3.68
	12	89	0.68	(-0.49, 1.80)	-3.14, 3.50
	13	114	0.74	(-0.13, 1.89)	-3.12, 3.25
	14	75	0.73	(-0.06, 1.58)	-2.50, 3.14
	15	17	1.03	(0.27, 2.17)	-1.08, 3.33
	16	6	1.48	(0.35, 2.41)	-0.68, 2.62
	17	3	0.49	(0.17, 2.22)	0.17, 2.22

Table 5-15: Prevalence of obesity and overweight by demographic variables and Chi-Square test analysis of weight group by demographic variables

Variables	Weight Groups			P-value
	Normal N (%)	Overweight N(%)	Obese N (%)	
Total Weight group	496 (61.8%)	118 (14.7%)	189 (23.5%)	-----
Family history of obesity				
Yes	123 (24.8%)	56 (29.6%)	67 (56.8%)	
No	373 (67%)	133 (23.9%)	51 (9.2%)	<0.001
Gender				
Male	242 (59.6%)	103 (25.4%)	61 (15%)	
Female	254 (64%)	86 (21.7%)	57 (14.4%)	0.40
Nationality				
Emirati	211 (64.9%)	62 (19.1%)	52 (16%)	
Other Arabs	154 (55.4%)	78 (28.1%)	6 (16.5%)	
Indian Sub-Con	89 (65.9%)	35 (25.9%)	11 (8.1%)	
Others	42 (64.6%)	14 (21.5%)	9 (13.8%)	0.04
School Type				
Public	176 (65.4%)	52 (19.3%)	41 (15.2%)	
Private	320 (59.9%)	137 (25.7%)	77 (14.4%)	0.14
Mother Education				
No	20 (58.8%)	10 (29.4%)	4 (11.8%)	
Primary	58 (66.7%)	18 (20.7%)	11 (12.6%)	
Secondary	69 (69.7%)	15 (15.2%)	15 (15.2%)	0.49
High School	127 (58.3%)	55 (25.2%)	36 (16.5%)	
College	219 (60.8%)	91 (25.3%)	50 (13.9%)	
Father Education				
No	16 (66.7%)	4 (16.7%)	4 (16.7%)	
Primary	51 (77.3%)	12 (18.2%)	3 (4.5%)	
Secondary	44 (57.1%)	20 (26%)	13 (16.9%)	0.21
High School	121 (65.1%)	41 (22%)	24 (12.9%)	
College	255 (59.9%)	104 (24.4%)	67 (15.7%)	
Income				
1000-3000 Dhs	54 (63.5%)	19 (22.4%)	12 (14.1%)	
3000-7000 Dhs	138 (62.2%)	54 (24.3%)	30 (13.5%)	0.97
>7000 Dhs	304 (61.3%)	116 (23.4%)	76 (15.3%)	

Figure 5-1: The distribution of BMI for all age groups



5.3.4 Oral health status among the study population

5.3.4.1 Prevalence of dental caries

The prevalence of dental caries among adolescents aged 11-17 years old in Sharjah City was 72%, the mean DMFT was 3.19 (sd ±2.9). The number of filled teeth was low, less than 20% had between one to four filled teeth, while 659 (82%) did not have any filled teeth, moreover only 4% of the study population had missing teeth (Table 5-16).

Table 5-16: Prevalence, mean and standard deviation of DMFT, decay, missing and filled teeth

Oral Health Status	N (%)	Mean (95% CI)	Std. Dev (sd)
Total DMFT DMFT = 0 DMFT ≥ 1	 197(24.5%) 606(75.5%)	3.19 (3.00-3.40)	2.97
Total D (Decayed Teeth) D = 0 D ≥ 1	 228 (28.4%) 575 (71.6%)	2.75 (2.56-2.95)	2.76
Total M (Missing Teeth) M = 0 M ≥ 1	 771 (96.0%) 32 (4.0%)	0.05 (0.03-0.07)	0.26
Total F (Filled Teeth) F = 0 F ≥ 1	 659 (82.1%) 144 (17.9%)	0.38 (0.31-0.46)	1.04

The prevalence of dental caries was significantly (p=0.032) higher in Public school (74%) as compared to Private school (70%), and among males 73% (p=0.039). In addition the prevalence of dental decay was significantly (p<0.001) higher among adolescents with lower parental education (Table 5-17).

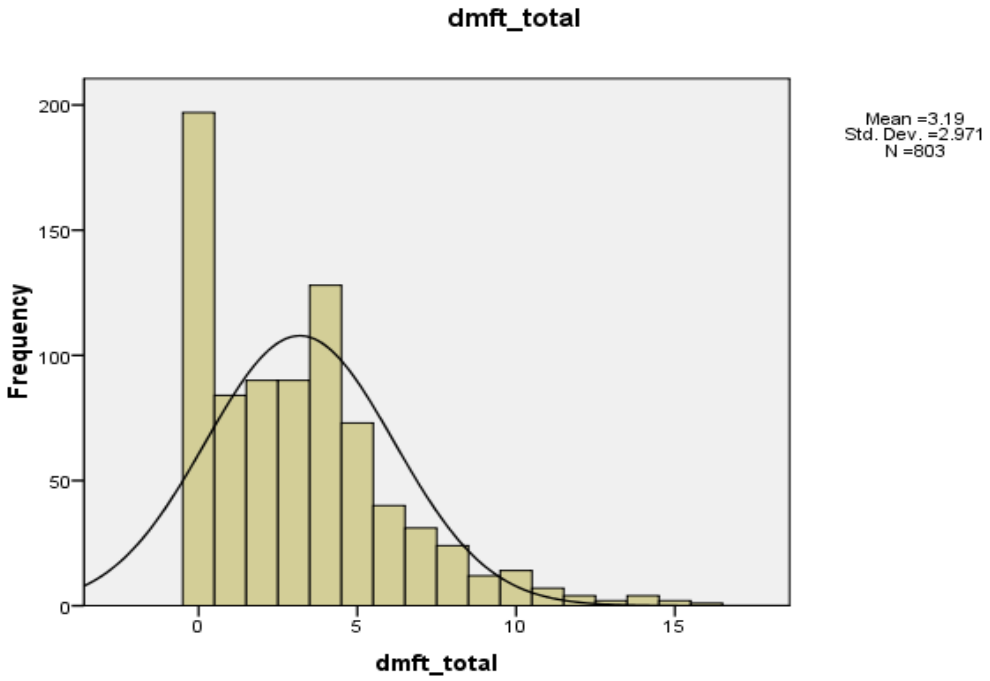
Table 5-17: Prevalence of dental caries by socio-demographic variables and Chi-Square test analysis of socio-demographic variables and caries experience categrories

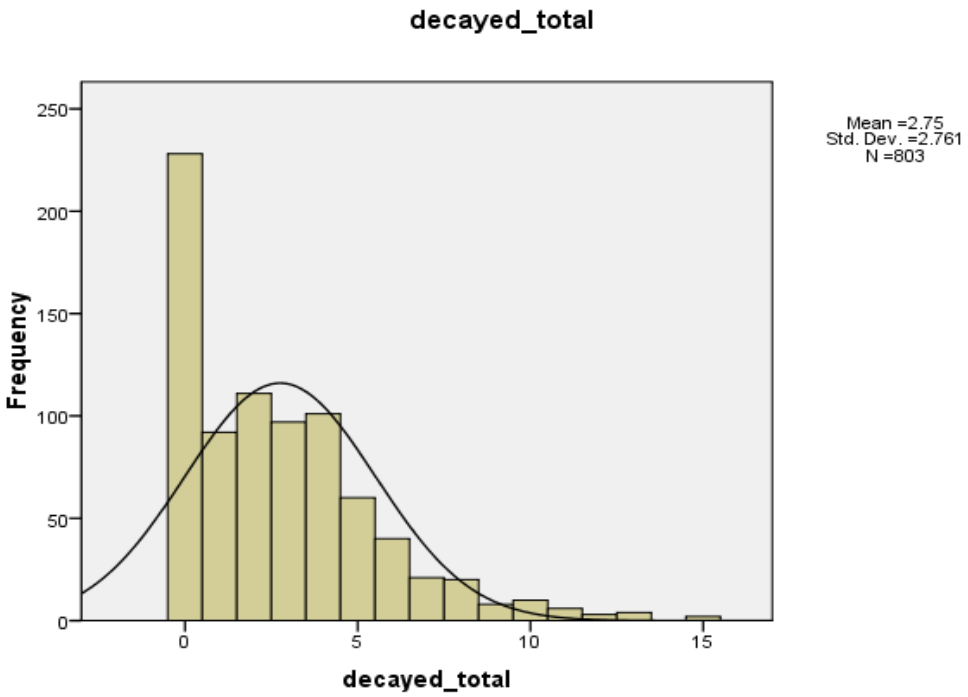
Variables	Caries free	Caries	P-value
Gender			
Male	109 (26.8%)	297 (73.2%)	
Female	119 (30%)	278 (70%)	0.04
Nationality			
Emirati	102 (31.4%)	223 (68.6%)	
Other Arabs	50 (18%)	228 (82%)	0.22
Indian Sub-Con	57 (42.2%)	78 (57.8%)	
Others	19 (29.2%)	46 (70.8%)	
School Type			
Public	69 (25.7%)	200 (74.3%)	
Private	159 (29.8%)	375 (70.2%)	0.03
Mother Education			
None	6 (17.6%)	28 (82.4%)	
Primary	16 (18.4%)	71 (81.6%)	
Secondary	24 (24.2%)	75 (75.8%)	<0.001
High School	54 (23.9%)	164 (75.2%)	
College	126 (55.8%)	234 (65%)	
Father Education			
None	5 (20.8%)	19 (79.2%)	
Primary	12 (18.2%)	54 (81.1%)	
Secondary	17 (22.1%)	60 (77.9%)	<0.001
High School	42 (22.6%)	144 (77.4%)	
College	142 (33.3%)	284 (66.7%)	
Income			
1000-3000 Dhs	42 (28.2%)	61 (71.8%)	
3000-7000 Dhs	55 (24.8%)	167(75.2%)	0.17
>7000 Dhs	149 (30%)	347 (70%)	

5.3.4.2 Distribution of the DMFT indices

Figure 5-2 shows the distribution of DMFT, 25% were caries free (DMFT=0), 58% had the DMFT of 1-5, 16% had DMFT of 6-10 and 1% had DMFT greater than 10.

Figure 5-2: Distribution of DMFT and decay





5.3.4.3 Distribution of dental decay in permanent teeth

This section describes the prevalence of decay and shows which teeth were most likely to be affected. Table 5-18 shows the frequency and percentage of observed dental caries recorded for each tooth in the permanent dentition. The results indicate that the lower anterior teeth (canine to canine) were least affected. Caries was found mainly on the first permanent molars (35% -38%) followed by lower second molars (22%-24%) and upper second molars (10%-12%).

Table 5-18: Percentage of dental caries in each tooth (FDI notation)

18	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**Teeth (Maxilla)**
1	83	281	35	43	0	33	24	20	29	2	52	55	296	94	0	**Frequency (%) of decay teeth**
.1%	10%	35%	4%	5%	0%	4%	3%	3%	4%	.2%	7%	7%	37%	12	0%	
0%	22%	35%	6%	2%	0%	0.1%	0%	0%	.2%	0%	1%	5%	38%	24%	0%	
0	180	283	44	13	0	1	0	0	2	0	9	39	302	192	0	
48	**47**	**46**	**45**	**44**	**43**	**42**	**41**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**Teeth (Mandible)**

5.3.4.4 Prevalence of gingivitis and visible plaque

Table 5-19 shows the number and percentage of adolescents with gingivitis and visible plaque. Ninety percent of adolescents have a score of 1 to 6 indicating that at least one to six regions in the mouth (upper left, upper middle, upper right, lower left, lower middle and lower right) had visible plaque or gingivitis. Only 5% of the 11 to 17 years old adolescents demonstrated healthy gums (Gum=0).

Table 5-19: Prevalence, mean and standard deviation of gingivitis and visible plaque

Variable	Number (%)	Mean	Std. Dev (sd)
Visible plaque			
0 (Healthy Gum/ No Gingivitis)	40 (5%)		
1-5 (Region)	205 (25.5%)	5.04	1.73
6 (All the Region)	558 (69.5%)		
Unhealthy gums/Gingivitis			
0 (No Plaque)	40 (5%)		
1-5 (Region)	210 (26.1%)	5.02	1.74
6 (All the Region)	553 (68.9%)		

5.3.4.5 Tooth brushing

About half of all adolescents reported brushing their teeth twice daily, 24% once daily and 5% never brushed their teeth. Majority reported brushing their teeth morning and evening, 20% reported brushing only in the morning and 7% reported brushing only in the evening. More than half reported that they had not visited dentist in the last 12 months and the majority 80% never used Fluoride tablets (Appendix XIV).

5.4 Part II: Association between explanatory variables & health outcomes

This section describes the association between a set of explanatory variables namely, socio-demographic and behavioural factors (dietary habits, physical activity and oral hygiene) on the following health outcomes and finally reporting the relationship between these three health outcome.

- Body Mass Index
- DMFT
- Self-Esteem

5.4.1 Association between explanatory variables and BMI

5.4.1.1 Association between socio-demography and BMI

One way analysis of variance (ANOVA), t-Tests and univarite linear regression were performed to investigate the difference in mean BMI across socio-demographic variables (Table 5-20).

There was a statistically significant association between BMI and age ($p<0.001$), where the mean BMI increased with age. In addition, there was a significantly difference ($p=0.001$) in the mean BMI across nationalities; where other Arabs had the highest mean BMI. There was no statistically significant different in mean BMI among gender, school type, parental education and income (Table 5-20).

The relationship between BMI and socio-demographic characteristics gave similar results when both BMI and the appropriate socio-demographic characteristics such as age, parental education and income were treated as continuous variables.

Table 5-20: Mean BMI by socio-demography

Variables	Mean BMI (95% CI)	P-value
Age		
10	19.53 (17.44, 21.63)	
11	19.93 (19.17, 20.70)	
12	20.57 (19.85, 21.28)	
13	21.85 (21.21, 22.49)	<0.001*
14	23.30 (22.56, 24.05)	
15	23.92 (22.30, 25.54)	
16	24.24 (21.95, 26.52)	
17	21.29 (16.21, 26.38)	
Gender		
Male	21.62 (21.24, 22.11)	
Female	21.73 (21.13, 22.23)	0.74#
Nationality		
Emiratis	21.26 (20.13, 22.13)	
Other Arabs	22.50 (21.92, 23.09)	0.001**
Indian sub-continent	20.46 (19.70, 21.22)	
Others	21.56 (20.98, 22.38)	
School Type		
Public	21.55 (20.92, 22.19)	
Private	21.74 (21.32, 22.15)	0.63 #
Mother Education		
None	21.63 (21.12, 23.35)	
Primary	21.46 (20.32, 22.60)	
Secondary	21.21 (20.23, 22.13)	0.73**
High School	22.01 (21.32, 22.70)	
College	21.62 (19.90, 22.20)	
Father Education		
None	22.22 (19.99, 24.46)	
Primary	21.73 (19.25, 22.21)	
Secondary	22.18 (21.05, 23.32)	0.11**
High School	21.34 (21.24, 22.04)	
College	20.19 (20.63, 21.13)	
Income		
1000-3000 Dhs	21.78 (20.84, 22.92)	
3000-7000 Dhs	21.37 (20.69, 22.22)	0.56**
>7000 Dhs	21.88 (21.34, 22.05)	

* Univariate linear regression ** ANOVA # t-test

5.4.1.2 Association between dietary habits and BMI

The pattern of dietary habits was investigated across weight group using (χ^2) test (Appendix XV-B) and also across BMI treating it as a continuous variable using univariate regression (Appendix XVI).

The relationship between BMI and soft drinks (p=0.003) and milk (p<0.001) consumption was highly significant when, both drinking and BMI were treated as a continuous variable (Appendix XVI). As soft drinks consumption increased amongst adolescents, there was a significant increase in BMI. When soft drink consumption was treated as a categorical variable (Appendix XV-B), those demonstrating the highest soft drink consumption category were more likely to be obese. Incontrast the higher the milk intake the lower BMI (p<0.001), when milk intake was treated as categorical, milk had a marginal (0.092) protective effect. Those adolescents who had their meals regularly (p=0.026), had all three meals (p<0.001) and drunk butter milk had significantly (p= 0.041) lower BMI. Furthermore, the adolescents that preferred fast food (p=0.06), vegetarian food (p=0.037), sweets and carbohydrate (p<0.001), consumed more date (p=0.024) and sweet biscuit (p=0.002) had significantly lower BMI (Appendix XVI). The rest of dietary items did not show statistically significant association (Appendix XV and XVI).

5.4.1.3 Association between physical activity and BMI

The relationship between obesity and level of physical activity showed that physical inactivity was more prevalent among obese (p=0.026) (Appendix XV-A).

In addition (χ^2) test indicated that regular exercise was a marginal predictor for overweight and obesity (p=0.07), however the relationship between regular exercise and BMI was linear when treated as continuous variable (p=0.006), as BMI increased among adolescents, regular exercise reduced. There was no significant difference (p=0.6) in time spent on sedentary activity between weight groups (Appendix XV-A).

5.4.1.4 Multivariate analysis of BMI and explanatory variables

Multivariate significant variable were established for each of the categories. Socio-demograhic charactristics, oral hygiene and dietary habits and these variables were entered into the final model.

Evaluating the role of each socio-demographic indicators in the multivariate model for BMI showed that adolescents BMI increase with their age ($p<0.001$). With respect to ethnicity, Arabs had marginally ($p=0.085$) higher BMI in comparision to other nationalities. Furthermore, school price showed an important factor in association with BMI, adolescents from Private school with higher fees had higher BMI ($p<0.028$). However, the other socio-demographic factors, such as gender, mother education, parental age, parental occupation and number of adults or children in the house, number of maid, household income and school type were not found to be statistically significant. Three socioeconomic indicators, age, nationality and school price were the most powerful predictors as shown in Table 5-21.

Table 5-21: Multivaritae analysis of BMI and socio-demography

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	8.601	1.674		5.138	.000	5.315	11.887
Age	.968	.128	.265	7.574	.000	.717	1.219
Arab	.652	.379	.062	1.722	.085	-.091	1.395
School price	.353	.160	.079	2.205	.028	.039	.667

a. Dependent Variable: BMI

Evaluating the role of each dietary habit indicators in the multivariate model for BMI showed that consumption of soft drink was significantly associated with an

increase in BMI (p<0.001). Furthermore, the number of soft drinks per day was positively associated with BMI (p<0.001). Whilst, those adolescents who had dinner every day (p=0.035) and all three meals everyday (p<0.001) had lower BMI. In addition, milk had protective effect (p=0.004). Eating more sweets (p=0.001), jelly beans (p=0.03), sweet biscuits (p=0.04) and ice muncher (p<0.001) were negatively associated with BMI. Other dietary habit factors did not show statistical significance (Table 5-22).

Table 5-22: Multivaritae analysis of BMI and dietary habits

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	**Std. Error**	**Beta**			**Lower Bound**	**Upper Bound**
(Constant)	22.383	.553		40.464	.000	21.297	23.469
Has dinner everyday	-1.049	.496	-.080	-2.115	.035	-2.023	-.075
Has all three meals everyday	-1.627	.384	-.162	-4.232	.000	-2.382	-.872
Food preference: traditional food	.794	.346	.079	2.295	.022	.115	1.473
Food preference: sweets & carbs	-1.267	.367	-.119	-3.450	.001	-1.988	-.546
Eating frequency: jelly beans	-.322	.149	-.076	-2.166	.031	-.614	-.030
Eating frequency: sweet biscuits	-.275	.134	-.073	-2.061	.040	-.538	-.013
Eating frequency: ice muncher	-.485	.134	-.131	-3.631	.000	-.748	-.223
No. of times subject drinks per day	.264	.107	.086	2.461	.014	.053	.474
Drinking frequency: soft drinks	.624	.134	.169	4.667	.000	.361	.886
Drinking frequency: milk	-.319	.111	-.100	-2.884	.004	-.536	-.102

a. Dependent Variable: BMI

Evaluating the role of each physical activity indicator in the multivariate model for BMI showed that only regular exercise was significantly (p=0.006) associated with lower BMI.

5.4.1.5 Final model of BMI and explanatory variables

The variables were selected to enter into final multivariate model due to their significance after evaluating for each category. The final model confirmed the positive significant association of predictors; age ($p<0.001$), school price ($p=0.005$) and obesity in family ($p<0.001$) with BMI. In addition, increased consumption of soft drinks ($p=0.004$) was significantly associated with BMI. However, having all three meals ($p=0.007$), frequency of drinking milk ($p=0.026$) had protective effects (Table 5-23).

In order to check whether the results observed in multivariate regression model would persist, the other non-significant explanatory variables were added into model, this included adding socio-demographic variables, dietary habits and oral hygiene variables. This model confirmed the significance of above factors.

Table 5-23: Final multivaritae model of BMI and explanatory variables

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	**Std. Error**	**Beta**			**Lower Bound**	**Upper Bound**
(Constant)	15.770	1.794		8.791	.000	12.249	19.292
Drinking frequency: soft drinks	.364	.126	.099	2.875	.004	.115	.612
Age	.771	.122	.211	6.325	.000	.532	1.010
Has all three meals everyday	-.894	.332	-.089	-2.692	.007	-1.546	-.242
School price scale	.415	.147	.093	2.815	.005	.126	.705
Food preference: traditional food	.757	.328	.075	2.308	.021	.113	1.400
Food preference: sweets & carbs	-1.130	.350	-.106	-3.229	.001	-1.817	-.443
Eating frequency: ice muncher	-.383	.128	-.103	-3.004	.003	-.634	-.133
Drinking frequency: milk	-.234	.105	-.073	-2.225	.026	-.441	-.028
Overweight/obese family member(s)?	-2.365	.356	-.217	-6.651	.000	-3.063	-1.667

a. Dependent Variable: BMI

5.4.2 Association between explanatory variables and DMFT

5.4.2.1 Association between Socio-demographics with dental caries and DMFT

One way analysis of variance (ANOVA), t-Tests and regression were performed to investigate the differences in mean decay, filled teeth and DMFT across socio-demographic details (Table 5-24, Table 5-25). A strong association between nationalities and mean decay and DMFT is evident in Table 5-24 and Table 5-25. The mean decay was significantly higher in the Arabs adolescents than Emiratis ($p=0.002$) and Indian sub-continent ($p<0.001$). In addition, level of parental education was significantly associated with mean decay, the higher the education level, that is college for either parents the lower the mean decay score and this was significant at $p= 0.005$ for the mothers and $p<0.001$ for the fathers. There was no difference in mean decay or DMFT when considering household income, gender and school type as shown in Table 5-24 and Table 5-25.

Furthermore, the difference in mean filled teeth was investigated between socio-demographic variables, there was no statistical significant difference observed among nationalities, parental education, income, gender and school type.

Therefore, overall non-local Arabs nationality and low level of parental education especially father education were found to be significantly associated with higher prevalence of dental caries. Whilst, other socio-demographic variables did not show any significant association (Table 5-24).

Table 5-24: Association between socio-demography and decay

Socio-demographic	N	Mean (95% CI)	ANOVA P-Value	Regression P-Value
Age				
10	17	1.71 (0.68, 2.73)		
11	146	1.83 (1.45,2.20)		
12	169	2.87 (2.43, 3.31)		
13	223	2.77 (2.41, 3.13)	<0.001	<0.001
14	176	3.09 (2.68, 3.50)		
15	46	3.43 (2.46, 4.41)		
16	20	4.40 (3.05, 5.78)		
17	6	3.83 (0.76, 6.90)		
Gender				
Male	406	2.67 (2.70)	0.39	0.39
Female	397	2.84 (2.83)		
Nationality				
Emirate	325	2.62 (2.32-2.93)		
Arab	278	3.26 (2.94-3.59)*	<0.001	-------
Indian	135	2.12 (1.68-2.56)#		
Others	65	2.55 (1.88-3.23)		
School type				
Public	269	2.90 (2.77)	0.29	0.30
Private	534	2.68 (2.76)		
Mother's Education				
None	34	3.5 (2.29-4)		
Primary	87	3.57 (2.87-4.28)**	0.008	0.001
Secondary	99	2.92 (2.35-3.49)		
High-school	219	2.83 (2.47-3.18)		
College	360	2.43 (2.16-2.70)*		
Father's Education				
None	24	3.83 (2.39-5.28)		
Primary	66	3.41 (2.68-4.14)	0.001	<0.001
Secondary	77	3.17 (2.45-3.89)		
High-school	186	2.96 (2.58-3.35)		
College	426	2.38 (2.14-2.62)		
Monthly income				
1000-3000 Dhs	85	2.84 (2.22-3.45)	0.17	0.16
3000-7000 Dhs	222	3.03 (2.65-3.41)		
>7000 Dhs	496	2.62 (2.38-2.85)		

*A significance difference of p=0.002 between Arab &Emirati
#A significance difference of p<0.001 between Arab & Indian
**A Significance of p=0.005 between education of Primary & college

Table 5-25: Association between socio-demography and DMFT

Socio-demographic	N	Mean (95% CI)	ANOVA P-Value	Regression P-Value
Age				
10	17	2.06 (.99, 3.13)		
11	146	2.01 (1.63,2.40)		
12	169	3.18 (2.72, 3.65)		
13	223	3.25 (2.86, 3.63)	<0.001	<0.001
14	176	3.72 (3.27, 4.16)		
15	46	4.04 (3.02, 5.06)		
16	20	5.15 (3.77, 6.53)		
17	6	4.50 (2.72, 3.65)		
Gender				
Male	406	3.08 (2.91)	0.287	0.29
Female	397	3.3 (3.04)		
Nationality				
Emirate	325	3.1 (2.78-3.42		
Arab	278	*3.73 (3.37-4.09)	<0.001	
Indian	135	*2.38 (1.91-2.84)		
Others	65	3 (2.25-3.75)		
School type				
Public	269	3.39 (2.94)	0.166	0.17
Private	534	3.09 (2.98)		
Mother's Education				
None	34	3.79 (2.77-4.82)		
Primary	87	**3.97 (3.25-4.68)	0.013	0.001
Secondary	99	3.29 (2.66-3.92)		
High-school	219	3.31 (2.92-3.69)		
College	360	**2.84 (2.55-3.14)		
Father's Education				
None	24	4.33 (2.93-5.74)		
Primary	66	3.89 (3.08-4.71)	0.004	<0.001
Secondary	77	3.60 (2.84-4.35)		
High-school	186	3.31 (2.90-3.71)		
College	426	2.84 (2.58-3.10)		
Monthly income				
1000-3000 Dhs	85	3.29 (2.64-3.94)	0.542	0.35
3000-7000 Dhs	222	3.35 (2.95-3.76)		
>7000 Dhs	496	3.10 (2.84-3.36)		

*A significance difference of p<0.001 between Arab & Indian
**A Significance of p=0.02 between education of Primary & college

5.4.2.2 Association between dietary habits with dental caries and DMFT

The association between dietary habits and decay were investigated using univariate linear regression including all the key questions on dietary habits as independent variables in association with total decay or DMFT as dependent variable as listed in Table 5-26 and Table 5-27. An inverse relationship was found

between main meal frequency and total decay score, as the adolescents main meal frequency increased, the total decay decreased (p=0.006).

Increase number of fast food frequency per week was also associated with more caries development (p=0.04). In respect to chocolate consumption there was a positive association with dental decay (p=0.003). In addition, the unadjusted regression model also showed that total decay was significantly associated (p=0.009) with watching TV while eating. Moreover, a highly positive relationship (p<0.001) was found between decay teeth and soft drink frequency.

Milk frequency intake had a significant (p=0.006) protective effect against dental caries. The number of decay teeth reduced with increase in frequency of milk consumption. Consumption of tea with sugar was also associated with increase in number of decay (p=0.021).

Table 5-26: Univariate linear regression analysis of dietary habits and decay

Independent variables	Dependent variable (decay)	
	B-Value (95% CI)	P-Value
Eating frequency per day	-0.044 (-0.21 , 0.012)	0.60
Main meal frequency per day	-0.381 (-0.65 , -0.11)	0.01
Main meal regularly	0.317 (-0.07 , 0.71)	0.11
Have breakfast everyday	0.326 (-0.24 , 0.89)	0.26
Have lunch every day	0.329 (-0.063, 0.72)	0.10
Have dinner	0.205 (-0.295,0.705)	0.42
Have all three meals	-0.619 (-0.999, -0.238)	0.01
Number of snack	-0.153 (-0.335, 0.028)	0.10
Fast food frequency per week	0.179 (0.01 , 0.35)	0.04
Processed food frequency per week	-0.065 (-0.22, 0.09)	0.42
Fast food preference	0.166 (-0.22, 0.55)	0.40
Sweet & Carbohydrate preference	-0.001 (-0.41, 0.41)	0.10
Chocolate frequency	0.223 (0.08, 0.37)	0.00
Candy and sweets frequency	0.166 (0.03, 0.3)	0.01
Sweet biscuit frequency	0.008 (-0.14, 0.15)	0.92
Date frequency	0.038 (-0.07, 0.15)	0.50
Watch TV while eating	-0.625 (-1.09, -0.16)	0.01
Fruits per day	-0.085 (-0.3, 0.13)	0.43
Vegetables per day	-0.255 (-0.46, -0.5)	0.02
Soft drink frequency	0.381 (0.24, 0.52)	0.00
Natural fruit juice frequency	-0.014 (-0.15, 0.12)	0.84
Milk frequency	-0.170 (-0.29, -0.05)	0.01
Tea & sugar	0.147 (0.02, 0.27)	0.02

Table 5-27: Univariate linear regression analysis of dietary habits and DMFT

Independent variables	Dependent variable (DMFT)	
	B-Value (95% CI)	P-Value
Eating frequency per day	-0.008 (-0.185, 0.170)	0.93
Main meal frequency per day	-0.258 (-0.548, -0.033)	0.08
Main meal regularly	0.314 (-0.104, 0.732)	0.14
Have breakfast everyday	0.297 (-0.313, 0.908)	0.34
Have lunch every day	0.376 (-0.046, 0.797)	0.08
Have dinner	0.102 (-0.437,0.640)	0.71
Have all three meals	-0.668 (-1.077, -0.254)	0.00
Number of snack	-0.059 (-0.254, 0.136)	0.55
Fast food frequency per week	0.183 (-0.001, 0.367)	0.05
Processed food frequency per week	-0.061 (-0.229, 0.107)	0.48
Fast food preference	0.290 (-0.128, 0.707)	0.17
Sweet & Carbohydrate preference	-0.074 (-0.365, 0.512)	0.74
Chocolate frequency	0.318 (0.162, 0.475)	<0.001
Candy and sweets frequency	0.205 (0.063, 0.347)	0.01
Sweet biscuit frequency	-0.002 (-0.157, 0.152)	0.92
Date frequency	-0.019 (-0.136, 0.099)	0.76
Watch TV while eating	-0.649 (-1.150, -0.148)	0.01
Fruits per day	-0.085 (-0.312, 0.145)	0.47
Vegetables per day	-0.241 (-0.465, 0.017)	0.04
Soft drink frequency	0.406 (0.258, 0.555)	<0.001
Natural fruit juice frequency	-0.006 (-0.153, 0.142)	0.89
Milk frequency	-0.181 (-0.311, -0.051)	0.01
Tea & sugar	0.146 (0.011, 0.281)	0.03

5.4.2.3 Association between oral hygiene habits with dental caries and DMFT

The result of univariate linear regression analysis of adolescents' oral hygiene habits and total decay score showed a weak relationship between tooth brushing frequency, brushing time, dental visit in last 12 months and Fluoride table use. Whilst, tooth brushing showed a positive relationship with decay (p=0.04), subjects that did not brush had more decay (Table 5-28). When considering DMFT, tooth brushing and use of Fluoride tables were marginally significant, (p=0.06) and (p=

0.03) respectively while dental visit showed a strong relationship with DMFT (p=0.002) as shown in Table 5-29.

Table 5-28: Univariate linear regression analysis of oral hygiene habits and decay

Independent variables	Dependent variable (total decay)	
	B-Value (95%CI)	P-Value
Tooth Brushing	0.073 (0.04, 1.58)	0.04
Tooth brushing frequency	-0.034 (-0.376, 0.127)	0.33
Brushing time	-0.035 (-0.3, 0.1)	0.33
Visit the dentist last 12 months	- 0.26 (-0.53, 0.24)	0.46
Use of Fluoride tables	-0.49 (-0.81, 0.14)	0.17

Table 5-29: Univariate linear regression analysis of oral hygiene habits and DMFT

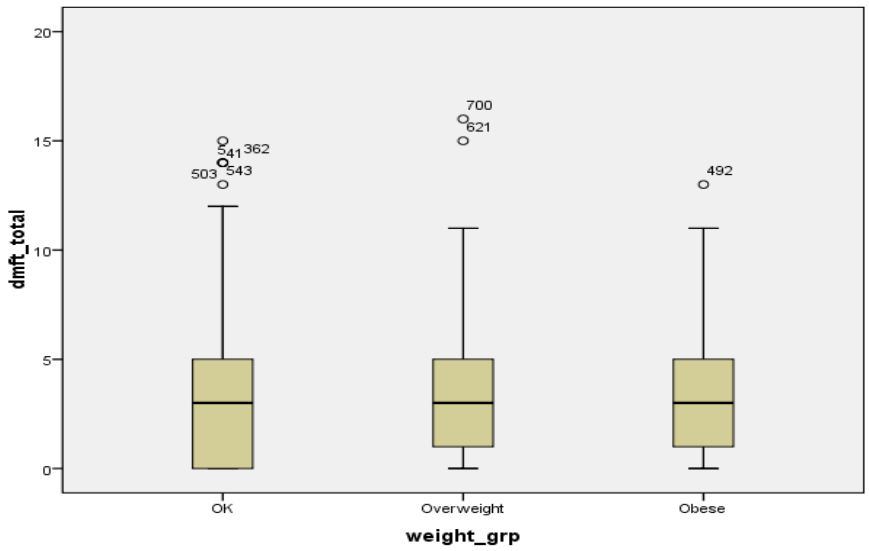
Independent variables	Dependent variable (DMFT)	
	B-Value (95% CI)	P-Value
Tooth Brushing	0.807 (-0.02, 1.635)	0.06
Tooth brushing frequency	-0.210 (-0.480, 0.061)	0.13
Brushing time	-0.121 (-0.336, 0.094)	0.27
Visit the dentist last 12 months	-0.640 (-1.051, -0.230)	0.00
Use of Fluoride tables	-0.555 (-1.063,-0.047)	0.03

5.4.2.4 Association between BMI and DMFT

Although the data was not normally distributed, the sample size was large enough and the result using either the raw data or log transformed data gave similar results. Pearson correlation coefficient between DMFT/ Decay and BMI was calculated. Although the correlation coefficient was positive the size of it was small r= 0.097 and was significant at CI=1.95 (1.041, 2.859), (p=0.006). This significance is because of the large sample size. Linear regression was performed to investigate the nature of the association; the result demonstrated that with each extra 10 point in BMI there is a 0.57 increase in DMFT.

The box plot in Figure 5-3 illustrates that the mean DMFT in the three weight groups is not significantly different. The mean DMFT for normal, overweight and obesity was 3.07 (sd±2.99), 3.30 (sd±2.86) and 3.52 (sd±3.04) respectively.

Figure 5-3: Box plot of DMFT and weight group



5.4.2.5 Multivariate analysis between DMFT and explanatory variables

The multivariate significant variables were established for each of the categories, socio-economic status, oral hygiene and dietary habits, these variables along with BMI were entered into the final model.

Evaluating the role of each socio-demographic indicators in the multivariate model for DMFT showed that adolescents whose fathers were highly educated had lower DMFT ($p<0.001$). Similarly, increase in age was also associated with higher DMFT ($p<0.001$). With respect to ethnicity, Arabs had significantly ($p=0.001$) higher DMFT in comparison with other nationalities. Furthermore, gender showed marginally an important factor in association with DMFT, girls were more likely to have higher DMFT ($p<0.04$) than boys. However, the other socio-demographic factors, such as mother's education, parental age, parental occupation, number of

adults or children in the house, number of maids, household income and school type did not show statistically significance (Table 5-30).

Table 5-30: Multivaritae analysis of DMFTand socio-demographics variables

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	-1.595	1.148		-1.390	.165	-3.849	.658
Father's Educ	-.354	.092	-.135	-3.850	.000	-.535	-.174
Age	.420	.075	.198	5.586	.000	.272	.567
Gender (Female)	.415	.202	.071	2.053	.040	.018	.812
Arab	.749	.215	.123	3.492	.001	.328	1.171

a. Dependent Variable: DMFT

Evaluating the role of each of the oral hygiene indicators in the multivariate model for DMFT showed that adolescents who were brushing their teeth had lower DMFT (p=0.045) (Table 5-31). Furthermore, visiting the dentist was positively associated with DMFT (p<0.002). However, the other oral hygiene factors, such as frequency of brushing, time of tooth brushing, use of tooth paste or Fluoride tablets and type of bottled water did not show statistical significance.

Table 5-31: Multivariate analysis of DMFT and oral hygiene variables

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	3.294	.554		5.949	.000	2.207	4.381
Tooth brushing	.840	.419	.070	2.003	.045	.017	1.663
Visited the dentist in last 12 months	-.651	.209	-.109	-3.115	.002	-1.061	-.241

a. Dependent Variable: DMFT_total

Evaluating the role of each dietary habit indicator in the multivariate model for DMFT showed that consumption of soft drinks was significantly associated with increase in DMFT ($p<0.001$). Furthermore, frequency of chocolate consumption and frequency of tea with sugar were both marginally significant ($p=0.07$) with DMFT. Whilst, adolescents who ate all three meals a day had lower DMFT ($p=0.006$). In addition, milk had marginally protective effect ($p=0.051$) (Table 5-32). Other dietary habit factors did not show statistical significance. However, milk and chocolate were significant in the absence of the other, which indicates that children who consume more chocolate were also drinking less milk, this association was confirmed by cross-tabing these two variables.

Table 5-32: Multivariate analysis of DMFT and dietary habits

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	**Std. Error**	**Beta**			**Lower Bound**	**Upper Bound**
(Constant)	2.519	.297		8.486	.000	1.936	3.101
Has all three meals everyday	-.570	.209	-.096	-2.729	.006	-.980	-.160
Drinking frequency: soft drinks	.310	.082	.142	3.777	.000	.149	.472
Drinking frequency: tea & sugar	.124	.069	.064	1.810	.071	-.011	.260
Drinking frequency: milk	-.131	.067	-.070	-1.952	.051	-.263	.001
Eating frequency: chocolate	.154	.086	.068	1.796	.073	-.014	.323

a. Dependent Variable: DMFT_total

5.4.2.6 Final model of DMFT and explanatory variables

The variables selected to enter into model multivariate were dependent on their significance after evaluating each category. Thus each variable in the multivariate model was adjusted for all the others.

The final model is shown in Table 5-33 confirmed the significance of the predictors; father's education and adolescent's age were positively association with DMFT ($p<0.001$), Arabs ($p=0.001$) and female ($p=0.008$) had higher DMFT. In addition, consumption of tea with sugar ($p=0.024$) and especially soft drinks ($p<0.001$) were significantly associated with DMFT. However, having all three meals ($p=0.009$) and visiting dentist ($p=0.007$) had a protective effect.

Table 5-33: Final multivaritae model of DMFT and explanatory variables

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	-.700	1.239		-.565	.572	-3.132	1.732
Drinking frequency: soft drinks	.307	.074	.144	4.147	.000	.162	.453
Drinking frequency: tea & sugar	.149	.066	.079	2.256	.024	.019	.279
Father's education	-.333	.091	-.127	-3.639	.000	-.512	-.153
Age	.344	.075	.162	4.598	.000	.197	.491
Sex (Female)	.544	.205	.094	2.647	.008	.141	.947
Arab	.688	.211	.113	3.269	.001	.275	1.102
Visited dentist last 12 months	-.538	.198	-.092	-2.710	.007	-.927	-.148
Has all three meals everyday	-.523	.201	-.090	-2.601	.009	-.917	-.128

a. Dependent Variable: DMFT

In order to check whether the results observed in this multivariate regression model would persist, and no other variables were significant, all other explanatory variables including BMI were added into the model one at a time, this included adding socio-demographic variables, dietary habits, oral hygiene variables and

BMI. This model confirmed the significance of above factors. None of the other variables were significant.

5.4.2.7 Multivariate analysis between decay and explanatory variables

The multivariate significant variables were established for each of the categories, socio-economic status, oral hygiene and dietary habits, these variables along with the BMI was entered into the final model

Table 5-34: Multivariate analysis of decay and socio-demographic variables

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B	
	B	**Std. Error**	**Beta**	**t**	**Sig.**	**Lower Bound**	**Upper Bound**
(Constant)	.677	1.010		.671	.503	-1.305	2.659
Father's education	-.321	.089	-.132	-3.610	.000	-.495	-.146
Age	.261	.070	.133	3.703	.000	.123	.399
Arab	.862	.208	.152	4.141	.000	.453	1.271
School price	-.183	.091	-.076	-2.014	.044	-.362	-.005

a. Dependent Variable: Decay

Evaluating the role of each socio-demographic indicators in the multivariate model for total decay showed that adolescents whose fathers were highly educated had lower decay ($p<0.001$). Similarly, an increase in age was also relevant to higher decay ($p<0.001$). With respect to ethnicity, Arabs had significantly ($p=0.001$) higher dental caries in comparison to other nationalities as illustrated in Table 5-34 Furthermore, school price was an important factor in the association with dental caries. Adolescents from Private schools with higher fees were less likely to have decay ($p=0.04$). Of the other socio-demographic factors, only gender was close to significance ($p=0.053$). Mother's education, parental age, parental occupation, number of adults or children in the house, number of maid, household income and school type did not show statistical significance.

Table 5-35: Multivariate analysis of decay and dietary habits

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	3.435	.422		8.144	.000	2.607	4.262
Drinking frequency: soft drinks	.391	.072	.193	5.449	.000	.250	.532
Main meal frequency per day	-.380	.135	-.097	-2.810	.005	-.645	-.115
Times of snacks per day	-.212	.092	-.081	-2.291	.022	-.393	-.030
Drinking frequency: milk	-.150	.061	-.085	-2.446	.015	-.270	-.030
Drinking frequency: tea & sugar	.138	.063	.076	2.181	.029	.014	.263

a. Dependent Variable: decayed_total

The role of dietary habit indicators in the multivariate model for total decay showed that consumption of soft drinks was significantly associated with increase in decay ($p<0.001$). Furthermore, consumption of tea with sugar ($p=0.029$) and number of snacking episodes per day ($p=0.022$) was positively associated with decay. Whilst, the adolescents that had more main meals per day had lower decay ($p=0.005$). In addition, milk had a protective effect ($p=0.015$) (Table 5-35). Other dietary habit factors did not show statistical significance.

Table 5-36: Multivariate analysis of decay and oral hygiene variables

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	1.893	.429		4.417	.000	1.052	2.735
Tooth brushing	.808	.392	.073	2.064	.039	.039	1.577

a. Dependent Variable: decayed_total

Oral hygiene indicators in the multivariate model for decay showed that adolescents who were brushing their teeth had less decay ($p=0.039$) (Table 5-36). Whilst other oral hygiene factors, such as frequency of brushing, time of tooth

brushing, use of tooth paste or Fluoride tablet and type of water did not show statistical significance after tooth brushing was adjusted for.

5.4.2.8 Final model of decay and explanatory variables

The variables that were selected to enter into final model of decay and explanatory variables related to their significance after evaluating each category. Hence, the multivariate regression model was adjusted for the following factors.

The final model confirmed the significance of these predictors; father's education and adolescent's age were positively association with decay (p<0.001), Arabs (p<0.001) and female (p=0.037) had higher decay. In addition, consumption of tea with sugar (p=0.017) and soft drinks (p<0.001) were significantly associated with decay. However, having all three meals (p=0.051) and main meal frequency (p=0.006) had a protective effect (5-37).

Table 5-37: Final multivariate model of decay and explanatory variables

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	.526	1.150		.457	.647	-1.731	2.783
Drinking frequency: soft drinks	.312	.069	.158	4.524	.000	.177	.448
Drinking frequency: tea & sugar	.148	.062	.084	2.398	.017	.027	.269
Father's education	-.333	.085	-.137	-3.925	.000	-.500	-.166
Age	.236	.070	.120	3.381	.001	.099	.373
Sex (Female)	.401	.192	.074	2.091	.037	.024	.777
Arab	.719	.196	.127	3.664	.000	.334	1.104
Main meal frequency per day	-.372	.135	-.097	-2.746	.006	-.637	-.106
Has all three meals everyday	-.382	.195	-.071	-1.954	.051	-.765	.002

a. Dependent Variable: decayed_total

In order to check whether the results observed in multivariate regression model would persist, the other explanatory variables including BMI were added into model, this included adding socio-demographic variables, dietary habits, oral

hygiene variables and BMI. This model confirmed that no other factors were significant. Table 5-38 summerizes the significant variables in each category and in final model.

Table 5-38: Independently significant variables associated with DMFT in multivariate analysis

Variables	Coefficient (95% CI)	P- value
Oral hygiene		
Visit the dentist	-0.651 (-1.061, -0.241)	0.002
Tooth brushing	0.840 (0.017, 1.663)	0.045
Dietary habits		
Soft drinks	0.310 (0.149, 0.472)	<0.001
Milk	-0.131 (-0.263, -0.001)	0.051
All three main meal	-0.570 (- 0.980, -0.160)	0.006
Tea & sugar	0.124 (0.011, 0.260)	0.071
Socioeconomic status		
Age	0.420 (0.272, 0.5677)	< 0.001
Father education	-0.354 (-0.535, -0.174)	<0.001
Gender	0.415 (0.018, 0.812)	0.04
Arab	0.749 (0.328, 1.171)	0.001
Body Mass Index (BMI)	0.057 (0.016, 0.098)	0.006
All significant Variables		
Age	0.344 (0.197, 0.491)	< 0.001
Soft drink	0.307 (0.162, 0.453)	<0.001
Father education	-0.333 (-0.512, -0.153)	<0.001
Dental visit	-0.538 (-0.927, -0.148)	0.012
Gender	0.544 (0.141, 0.947)	0.008
All three main meal	-0.523 (-0.917, -0.128)	0.009
Tea & sugar	0.149 (0.019, 0.279)	0.024

Although BMI was univariately significantly associated with DMFT, it was not significant in the multivariate regression model; it is possible because of confounding by dietary habits. Based on the study theoretical framework in chapter 3 socio-economic positions is the most distal factor, which might not have a direct association but rather they are more likely to act through intermediate factors links to our health outcome.

5.4.3 Association between Self-Esteem and explanatory variables

5.4.3.1 Rosenberg Self-Esteem by socio-demographic variables

The aim of this section is to investigate the association between Rosenberg Self-Esteem and socio-demographic details. As shown in Table 5-39 self-esteem score was not the same among all age group, it appears that self-esteem score was lower at younger ages. Moreover, the mean Rosenberg score was significantly ($p<0.001$) lower among Indian nationality in comparison to other nationalities.

There was no difference among gender, school type, income or parental education in relation to their self-esteem score.The association between BMI and Rosenberg score showed that Rosenberg self-esteem score was negatively associated with BMI when BMI was treated as a continouse variable.

Table 5-39: Association between Rosenberg Self-Esteem and socio-demographic variables using ANOVA and univariate linear regression

Variables	Mean (sd)	ANOVA P-value	Regression P-value
Age			
10	19.1 (2.3)		
11	19.5 (3.7)		
12	18.8 (3.5)		
13	20.2 (4)	0.004	0.003
14	20.1 (4)		
15	21 (3.7)		
16	19.6 (3.7)		
17	20.5 (0.84)		
Gender			
Male	19.8 (3.8)		
Female	19.8 (3.8)	0.98	0.98
Nationality			
Emirati	19.8 (3.9)		
Arabs	20.1(3.7)	0.01	------
Indian sub-cont	18.8 (3.6)		
Others	20.1(3.7)		
School type			
Public	20 (3.9)		
Private	19.6 (3.8)	0.197	0.197
Mother's Education			
None	21.2(3.4)		
Primary	19.9 (3.8)		
Secondary	19.4 (3.4)	0.79	0.908
High School	19.7 (3.8)		
College	19.9 (4)		
Father's Education			
None	19.9 (2.9)		
Primary	20.4 (3.2)		
Secondary	20 (3.9)	0.045	0.906
High School	19.1 (3.6)		
College	20 (3.9)		
Income			
1000-3000 Dhs	19.4 (4.0)		
3000-7000 Dhs	19.4 (3.5)	0.131	0.063
>7000 Dhs	20 (3.9)		
Weight group			
Normal	20 (3.5)		
Overweight	19.5 (4.2)	0.095	0.032
Obese	19.2 (3.8)		
Coefficient (95% CI)			
BMI	-0.055 (-0.107, -0.002)		0.041
DMFT	0.054 (-0.035, 0.143)		0.232

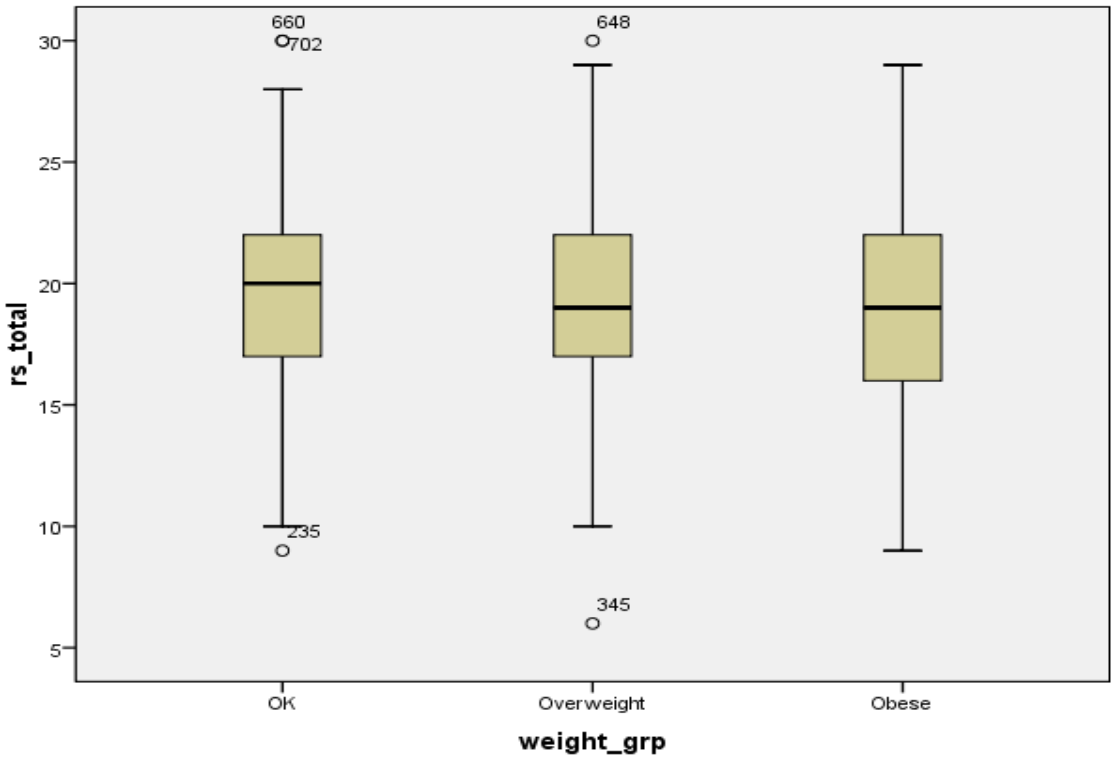
5.4.3.2 Association between BMI and Rosenberg Self-Esteem

The Rosenberg score between the three weight groups was compared and a summary of the result is given in Table 5-40 below and Boxplot (Figure 5-4). Our result indicates that the median Rosenberg was slightly lower in both overweight and obese in comparison to normal weight.

Table 5-40: Mean and Standard deviation of Rosenberg self esteem by weight groups

Weight group	Mean (sd)	95% (CI)	ANOVA P-Value
Normal weight	19.98 (3.53)	(19.67, 20.30)	0.095
Overweight	19.50 (4.18)	(18.90, 20.10)	
Obese	19.25 (3.82)	(18.46, 20.03)	

Figure 5-4: Box plot of Rosenberg Self-Esteem scores and weight groups



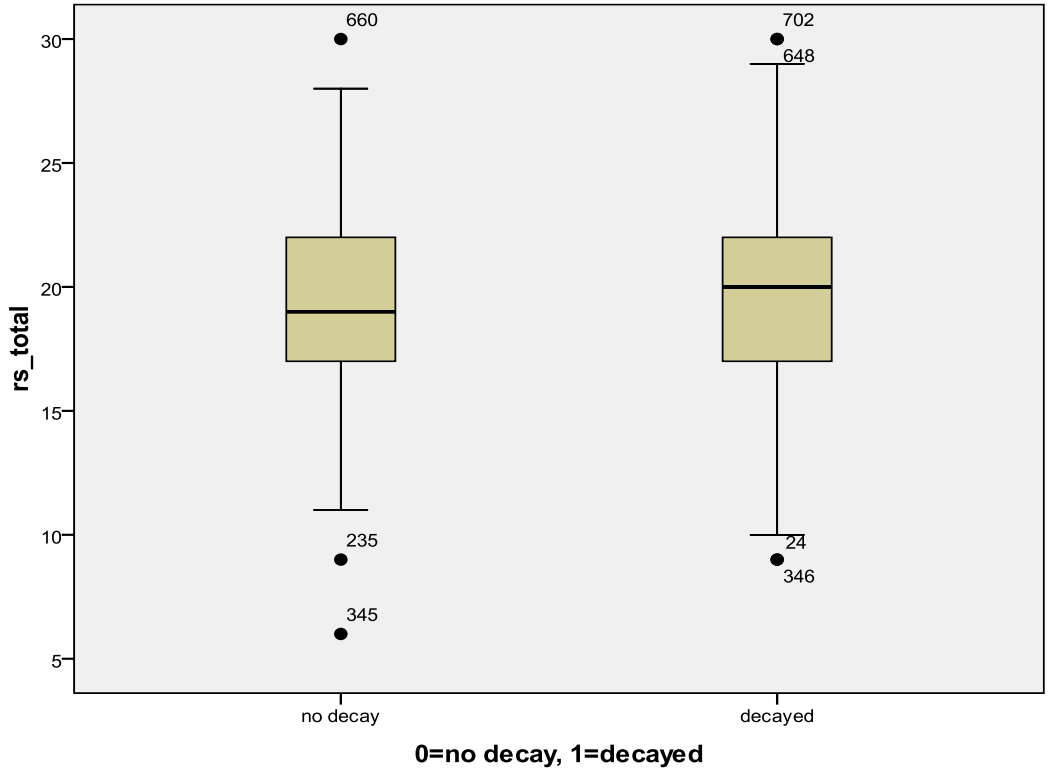
5.4.3.3 Association between Rosenberg Self-Esteem and DMFT

The Rosenberg score was compared between subject with decay and no decay and a summary of the result is given in Table below (Table 5-4) and Boxplot (Figure 5-5). The result shows no statistically significant difference in the mean Rosenberg self-esteem score in either groups.

Table 5-41: Mean and standard deviation of Rosenberg Self Esteem score by caries experience

Variables	Mean(sd)	P-Value
Decay	19.87 (3.80)	0.199
No Decay	19.49 (3.87)	

Figure 5-5: Box plot of Rosenberg Self Esteem score and decay



Self-esteem scale was also associated with tooth brushing. The adolescents who had higher self-esteem were more likely to brush their teeth (Table 5-42).

Table 5-42: Mean and standard deviation of Rosenberg Selff -Esteem scores by tooth brushing

Tooth brushing	Mean (sd)	95% (CI)	P-Value
Yes	19.8 (3.85)	19.55, 20.10	0.066
No	18.8 (3.29)	17.92, 19.74	

5.4.3.4 Final model of Self-Esteem and the explanatory variables

All the socio-demographic variables including BMI and DMFT were selected to enter into the final model. The final model confirms the significance of following predictors. Age was positively associated with Rosenberg self-esteem score, the older children had significantly (p=0.001) higher self-esteem level. BMI was negatively associated (p=0.006) and Indian sub-continent origin had also significantly (p=0.004) lower self-esteeem score (Table 5-43).

Table 5-43: Final Multivariate model of Rosenberg Self-Esteem and explanatory variables

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	**Std. Error**	**Beta**			**Lower Bound**	**Upper Bound**
(Constant)	16.035	1.645		9.750	.000	12.806	19.264
BMI	-.077	.028	-0.101	-2.730	.006	-.133	-.022
Indian sub-cont	-1.097	381	-0.110	2.877	.004	-1.845	-.348
school type	0.165	0.324	0.021	.511	.610	-.471	.801
age	0.336	0.105	0.122	3.192	.001	.129	543
mother's education	0.103	0.160	0.032	.646	.518	-.211	.418
income	0.324	0.220	0.057	1.470	.142	-.109	.757
DMFT	0.011	0.048	0.009	.237	.813	-.083	.105
father's education	-0.047	0.173	-0.014	-.270	.787	-.386	.293

5.4.4 Summary of results

- The characteristics of adolescents' behaviour, namely dietary habits, physical activity and oral hygiene habits in association with socio-demographic showed age, gender and ethnicity to be an important factor in these differences.
- Few dietary items showed significant association with age. Consumption of milk, fruit and vegetables significantly reduced by age, whilst consumption of soft drinks significantly increased by age.
- With regard to gender, girls skipped more breakfast and preferred more sweets and carbohydrates. Boys skipped more lunch and dinner; in addition the frequency of all kind of drinks, particularly soft drink was higher among boys.
- Indians sub-continent had more regular mea and more fruit and vegetables, less fast food and soft drink compared to other nationalities.
- Arabs and Emiratis were more likely to watch TV while eating, consumed less fruit and vegetables and milk and drank more soft drinks. In addition Emiratis more likely to report preferring fast food and sweets and carbohydrates.
- Frequency of physical activity reduced by age, whilst sedentary life style increased significantly by age. Reported physical activity was more among boys.
- Overall reported daily hours spent on sedentary activity was 1-4 hours. Arabs had the lowest frequency of physical activity and more hours spent in sedentary activity.
- Oral hygiene was more commonly practiced among females compared to males. Arabs brushed less commonly as compared to other nationalities.

- Dental visits were least reported among Indians, whilst the Emiratis visited the dentist most and used fluoride tablets.
- Prevalence of obesity and overweight was 14.7% and 23.5% respectively. Prevalence and mean BMI were highest among Arabs.
- Prevalence off dental caries was 72% with mean DMFT of 3.19 (sd 2.9). Prevalence of dental caries and mean DMFT was highest among Arabs copared to other nationalities.
- The multivariate regression models were developed for the three health outcomes of BMI, DMFT and self-esteem.
- With respect to obesity (BMI) a single distal predictor of age, history of family obesity and few dietary items, especially soft drinks and having all three meals regularly contributed significantly to obesity in the final model.
- With respect to dental caries, three distal explanatory factors contributed to the development of dental caries. These explanatory predictors were increased age, females, Arabs, lower father education and few dietary items, especially soft drink and having all three meals regularly contributed significantly to dental caries in the final model .
- With respect to self-esteem, two distal explanatory variables, younger age group and Indian sub-continent origin contributed to lower self-esteem.

Chapter 6. Discussion

6.1 Introduction

The main aim of this chapter is to discuss the common risk factors that have contributed significantly to the development of obesity and dental caries in adolescent population reseident in Sharjah City, UAE. Further, this chapter will discuss other risk factors that were identified in playing an important role and associated with the health outcomes investigated namely obesity, dental caries and self-esteem. I will also discuss the controversy in relationships between obesity and oral health and finally this section draws conclusion with an outline of suggested policy implications.

6.2 Common risk factors contributed to development of obesity and dental caries in the final model

This section will discuss the common predictors, namely soft drink, having all three main meals regularly and the effect of age on development of obesity and dental caries amongst adolescents population reseident in Sharjah City, UAE.

6.2.1 Soft drink in relation to both obesity and dental caries

Our analysis suggests that a statistically significant association between the intake of soft drinks and BMI. This is in line with several studies, that concluded consumption of soft drinks made a unique contribution to the risk of weight gain (Giamatteei et al, 2003, Schulze et al, 2004, Striegel Moore, 2006, Marshal et al , 2007, Wolf and Dansingen, 2008).

The consumption of soft drinks has increased in parallel with increasing prevalence of obesity and overweight. Malik and colleagues (2007), in their

systematic review supported the link between sugar-sweetened beverage and risk of overweight and obesity. The explanation for such a finding is firstly, soft drinks consumption can be a source sugar intake. Excessive sugar intake replaces more nutritious food which is beneficial to health such as vitamins, minerals, protein and fibres and provides “empty calories” in small volume (Gaby, 2005) and increases overall energy intake. Secondly, soft drinks replace the consumption of milk (Vartanian et al, 2007). It was found that for adolescents, carbonated soda consumption was negatively correlated with both milk and juice consumption. Decreased calcium intake, in turn increase the risk of obesity through the effect of calcium on fat absorption or the regulation of lipogenesis and lipolysis with in adipoctes (Parikh et al, 2003). Similarly, this study showed that milk and butter milk consumption were negatively associated with soft drinks and had a protective effect. This provided strong evidence of the independent role of soft drinks in the promotion of weight gain and obesity in adolescents. It is worth noting that a single food such as soft drinks have been proposed as an important contributor to the caloric intake and therefore, represents an important factor in underlying the development of obesity.

In relation to dental caries, the final model, after adjusting for other parameters (Table 5-37), soft drinks remained in the model and did not lose its significance. Furthermore, soft drinks consumption and milk were negatively associated in this study. Soft drinks have been negatively associated with milk consumption in previous study (Sorvari and Rytomaa, 1991). Similarly, Heller in the national study of US children reported increased risk of caries with soft drinks. This finding could be explained by three mechanisms; firstly the effect of soft drinks on the teeth by their low pH, secondly their sugar content (Tahmassebi, 2006) and thirdly soft

drink consumption can replace milk intake and subsequently calcium intake (Sorvari and Rytomaa, 1991).

This study has demonstrated a statistically significant positive association between soft drink consumption and both BMI and dental caries. This gives a powerful massage in that a single dietary item (soft drink) is highly contributory to the development of obesity and dental caries.

6.2.2 Regular meals in relate to obesity and dental caries

Our findings suggest that having all three main meals (breakfast, lunch and dinner) each day is protective; this indicates that adolescents had a nutrition benefit, and therefore lower BMI. There are few explanations to this finding; having all three main meals could reduce the snacking frequency latter in the day, as reported by Brugman and colleagues (1998) and imbalanced eating which is associated with obesity (Croezen et al, 2009). Association between skipping meals and especially breakfast with poorer nutrition intake and subsequent obesity has previously been reported by Cho and colleagues (2003).

It is also logical to hypothize that having three regular meals could relate to more frequent family meals. Family meals have been associated with positive nutrition behaviour, similarly Utter (2008) reported that family and home environment play important roles in an adolescent's nutrition, and further, adolescents who regularly ate family meals were less likely to consume unhealthy snacks. Moreover, food eaten away from home or in restaurants typically contains high calories, fat and sugar, as the most popular food being served in restaurants are potato chips, sugar containing drinks or soft drinks (Gillis and Bar Or 2003), and lower in valuable nutrition compared to food prepared at home (Sallis and Glanz, 2006).

This study showed the positive association between BMI and preference of traditional food. In this current study due to an ethnically diverse population of adolescents, with a reported preference of traditional food, it is not possible to come to any conclusion, as to whether having traditional food is of nutritional benefit, as traditional food could have different nutritional value in relation to ethnicity. Adair (2005) reported type of food consumed in different countries that for example, some traditional food may contain more vegetables and beans compared to others.

In relation to dental caries, it is important to emphasize the character of food and number of times consumed rather than quantity (Weiss et al, 1960). This concept is based on significant finding of Stephan (1940), related to effect of sugar on pH of dental plaque. Our study showed that, having all three meals regularly had a protective effect. Justification in relation to these findings are that most people in this country customarily consume three meals each day, and which probably include substantial amounts of refined carbohydrate, where a frequency of three exposures to refined carbohydrate is considered to be safe (Gustafsson, 1954). Our main concern is the frequency of eating between meals which iis important factor in development of dental caries. Therefore, it is logical to conclude that the adolescents, who had their three main meals regularly, would have fewer snacks during the day (Brugman et al, 1998) and therefore a protective effect was demonstrated.

6.2.3 Age in relate to obesity and dental caries

In our study there was an overall positive and significant association between age and mean BMI ($p < 0.001$). This can be best explained as reported by Ahn (2008),

that higher BMI in older children could be due to their biological growth and behavioural factors.

Our findings confirm previous studies that found a significant difference in prevalence of overweight with increase in age. Al-Haddad (2005) reported that BMI increased with age, and there was a notable increase after the early adolescent years of 10 years old. In addition, Al-Haddad also reported that before the age of 9 years the children were below the IOTF cut-off points. Even though the prevalence of overweight and obesity has increased in all age and sex, the prevalence of overweight in adolescents has increased significantly more. It has been reported that since 1980 the proportion of overweight in children has doubled whilst among adolescent has tripled (Odgen et al, 2006). There are three critical periods (prenatal, adiposity rebound around the age of 5-6 and adolescence). However, the evidence in relation to long-term follow-up studies such as Third Harvard Growth Study 1922-1935, has shown the association between obesity in adolescence with morbidity and mortality later life, whilst no published study has linked younger age group or the period of adiposity rebound to subsequent morbidity and mortality (Dietz, 1994). Therefore, the adolescent period is considered to be the most critical period for development and persistance of obesity.

In a previous study of Kranz and co-workers (2008), they showed that quality of diet, decreased with increase of age. Similarly, in this study significant reduction in consumption of milk and fruit and vegetables, and increase in soft drinks was observed. This could have been due to behavioural change of adolescents (Ahne, 2008). In relation to age and dental caries, this study has shown a positive

association between age and DMFT, this could be explained by the fact that dental caries is cumulative and not reversible and therefore the DMFT score either remains stable or increase with age. It is worth noting that although according to Tuomi (1989) obesity develops faster than decay, however, dental caries is not reversible, whilst obesity can be reversible.

The next section will provide an overview on other risk factors that were identified to play an important role and were associated with the health outcomes investigated. It is important to understand the context of these results. Therefore, I will now discuss the demographic characteristics of the study population and description of adolescents' health behaviour and lifestyle.

6.3 Demographic characteristics

6.3.1 Age

Our sample included all intermediate stage pupils (Grade 6, 7, 8 and 9). The usual age of children attending these grades is 11- 14 years old. Most often children in UAE commence school (primary stage) at about 5 to 6 years old. The age range in our study population was 10 to 17 years old, with the majority (89%) of students aged 11 to 14 years old. However, a few aged, 10 (2%), 15 (6%), 16 (3%) and 17 (1%) were included. These variations were due to either early commencement of school and for the older children having failed their academic year.

6.3.2 Nationality

In our sample only 325 (41%) were UAE nationals, whilst the majority 59% were foreigners. This almost represents the population of UAE, which is a most cosmopolitan country. The ratio of foreign to local population in the UAE has

remained high in the past years and is expected to widen in the future because of a rapid growth in expatriates; previously (2005) reported percentage of foreigners and locals was 65% and 35% respectively, (http://www.internetworldstats.com/middle.htm).

6.3.3 School Type

In our sample 269 (34%) of the study population attended Public school but the majority were at Private School 534 (66%). This sample represented the distribution of schools in Sharjah City; where the number of Private schools is double that of Public schools. This is related to a higher population ratio of foreign to locals in the UAE, and Public schools are accessible only to UAE nationals. Therefore, a higher number of Private schools are needed in order to accommodate the foreign students. In our sample 325 (41%) were UAE nationals and the majority of Emiratis 269 (34%) attended the Public schools whilst; only 7% attended Private schools.

6.3.4 Parental education and income

The percentage of higher education up to the level of college was high for both fathers and mothers, 55%, 45% respectively. Even though the majority of mothers had higher education level up to college, a large number of them (75%) were housewives. There was an association between the father's occupation and ethnicity. The majority of foreigners (62%) had professional occupations and income of above 7000 Dhs. The number of unemployed was higher among Emiratis (5%) in comparison to other nationalities, this is due to the UAE residency law which states that foreigners need to comply with its law before considering moving to the country. Once a foreigner has obtained a work permit they can apply for a residence permit. The law requires that residents must have a minimum monthly salary of 5,000 Dhs to bring their close relatives such as mother, father,

son, daughter and wife to the country. However, if a UAE resident wants to bring his/her distant relative such as in-laws, uncles, cousins etc they must have a minimum salary of 8,000 Dhs. Therefore, the resident has to have reasonable level of education in order to get professional job and average income in order to sponsor their family (http://www.uaeinteract.com/news/default.asp?cntDisplay=10&ID=155).

A total of 803 parents were included in the study, the age range for mothers was 25-66 years old with mean age of 39 (sd±5). This represents the fact that our sample adolescents were between 11-17 years. The age range for fathers was 32-68 years with mean age of 45 (sd±6). This may be due to a difference in culture, where for the majority of the couples in the Arab community the men are generally older than the women by a few years. It is unusual to see couples of the same age or the male being younger than the female.

The majority of Emiratis (80%) had help in their house, whilst for other nationalities 80% of them reported not having any help at home. This could again be associated with the UAE labour law which states that foreigners need to pay more for employing live-in housemaids and are subject to stricter law and limited number of housemaids applying to them in comparison to indigenous householders. In addition, the UAE nationals generally have higher income than foreigners. Similarly, in this study the majority (78%) of Emiratis reported a monthly salary of more than 7000Dhs.

6.3.5 Description of adolescents' behaviour by socio-demographic factors

It is important to keep in mind that this study was conducted in the Emirate of Sharjah and also to recognize the variety in the racial, socio-economic and cultural backgrounds. The large expatriate community affects the structure of the

population significantly; people with different ethnic backgrounds have imported their lifestyle, culture and food habits into the UAE. So, it is not surprising that accordingly dietary habits of the local people have changed, by consuming other types of food beside their own traditional food. It is also important to remember that the reported dietary habits were self-reported, these could therefore be biased by the responders and in recall of information.

6.3.6 Diet

The findings of our study reflect a substantial variation in dietary habits across socio-demographic characteristics. A number of factors such as age, gender and ethnicity appeared to play an important role in these differences. In our study 36% skipped breakfast, this high prevalence of skipping breakfast has been reported previously among adolescents (Siega-Riz et al, 1998). Skipping meals could be because of increased independence and autonomy amongst this age group. During childhood, parents can influence food consumption patterns by limiting availability and accessibility, as well as modeling, and discipline (Spurrier et al, 2008). As children grow up, however, they may use food choice as part of the process of individualization, or skipping meals and seeking their own choice of food or rejection of family meals and accompanied by the growing influence of peers and increasing participation in a social life outside the family (Strauss, 2000) and therefore, the influence of peers and school environment outweigh the impact of family.

Notable also, are the gender differences in skipping meals, particularly breakfast. Girls skipped breakfast more often. This could be explained that by skipping meals and in particular breakfast, be a method of weight control, but often results in a greater consumption of mid-morning snacks which tend to have a higher sugar

content as a substitute. This was consistent with previous study by Brugman (1998), who reported Dutch girls skipped breakfast due to body image concern among children aged 4-15 years old.

Girls on the other hand, had lunch and dinner more frequently. A possible reason could be related to biological and behavioural differences among gender (Ahne, 2008) or gender-specific socialization, culture and religious influences. Boys are more commonly allowed to spend time away from the home or have outdoor activity, which makes skipping lunch and dinner more likely and results in them having food away from home and not a regular family meal. Therefore, in this study slightly higher number of snacking episodes was reported among boys compared to girls. The preference of sweets and carbohydrates were also different between genders, more girls reported preferring sweets and carbohydrates than boys, this could be due to missing breakfast which resulted in mid-morning sugary snack (Brugman et al, 1998, Dye, 2004).

Another important factor was noticed that reported consumption of all kinds of drink and particularly soft drink was higher amongst males. This could be due to boys spending more times outdoors and in physical activity compared to girls, which subsequently resulting in drinking more liquid. Cook and Wardel (2005) reported that overall the dietary pattern of boys was less healthy than girls among 1,129 British school children. Girls significantly preferred fruit ($p<0.05$) and vegetables ($p<0.001$), whilst boys preferred fatty and sugary foods ($p<0.005$), meat ($p<0.001$) and processed meat products ($p<0.001$) (Cook and Wardel, 2005).

Food and drinks are closely linked with socio-economic status. Young people from lower socioeconomic status group consume snacks and sweets and eat less fruit and vegetables than young people from higher socio-economic groups (Van der Horst, 2007 and Sausenthaler, 2007). Our study also revealed that adolescents from lower income families were more likely to skip breakfast and also had less regular meals compared to higher income families. However, in contrast to Brugman and co-workers (1998) who demonstrated that socio-economic deprivation was inversely associated with breakfast consumption, our study showed that parental education level was not associated with breakfast consumption and most dietary items, which suggest adolescents' dietary behaviour is complex and influenced by multiple factors (Pearson, 2009).

Our study confirmed an earlier finding, in relation to the variation of dietary habits and food preference among ethnic groups. Kranz (2008) stated that certain ethnic groups have better quality of diet than others, mainly because of their cultural background. For instance, Mexican Americans, although frequently from lower income families, their traditional diet contained a lot of fruit and vegetables compared to Mexican Non-Hispanic White Americans (Kranz, 2008).

Our study has also shown significant differences in dietary habits and food preferences by nationality. Emiratis preferred significantly more sweets, carbohydrates and fast food, less fruit and vegetables and were more likely to consume fast food and processed food, this might be related to higher income, as reported by Al-Hissani and Rugg-Gunn (1998). They found higher sugar food and drinks were more freely purchased and given to children in higher income families as well as lower educated parents among UAE children aged 2-5 years old.

Similarly, this study revealed a significant ($p<0.000$) positive association between fast food intake and household income. The Indian sub-continent nationals in the UAE demonstrated better dietary habits, they consumed more fruit and vegetables, presumably because many Indian sub-continent are vegetarian, which is not the case for Emiratis or other Arabs. In this study, high consumption of soft drink was reported by Emiratis and Arabs and they almost never drank milk, which was consistent with the finding of Vartanian et al (2007), who stated soft drinks can replace milk consumption. Similarly, our study showed that children, who consumed more soft drinks, also had lower consumption of milk.

6.3.7 Physical activity

The poor level of physical activity observed in present study is of concern; this lower level of physical activity observed amongst adolescents in our study was possibly due to weather restriction. A hot summer between April and September with temperature exceeding 45°C may be a factor by which less physical activity is undertaken. The self-reported physical activity however could be higher in this study than their actual physical activity, as our study was conducted between February and July, when the climate conditions are more favourable. The lower level of physical activity observed among females is probably due to cultural and social restrictions. The inactivity of female adolescents in UAE has been previously reported by Henry (2004). Moreover, with the rapid development of the city the population has moved from the simple Bedouin lifestyle to modern westernized society. This environmental change (obesogenic environment), the combinations of city development and safety of the roads (Hill and Peter, 1998) has affected the opportunity for physical activity (Swinburn et al, 1999) and especially weather restrictions make it impossible for children in the UAE to walk to school, as the schools are located some distance away from the residential

areas. Therefore, the majority (96%) either used school bus or private car as a means of transport to school; public transport is limited and not commonly used in the UAE.

The combination of advanced technology and weather restriction means that many children and adolescents prefer indoor activities, such as television watching, computer and video games (Henry, 2004). Similarly, our study showed that 60% spent between one to four hours per day on sedentary activity and 27% spent up to eight hours. The number of hours spent on sedentary activity per day was significantly different across ethnicity. Emiratis and Arabs were the highest reported watching TV, whilst Indian sub-continents the least. This might be due to a dependence on the housemaid, which discourages the adolescents from performing household activity, therefore, spending more hours in front of the TV.

6.3.8 Television viewing

Most of the literature mentions that there is an association between overweight and hours of television viewing (Robinson, 1999, Boynton-Jarret et al, 2003, Kuryai, 2007), the duration of television viewing in our study was high, overall 60% spent between 1-4 hours a day in sedentary activity and 79% watching TV whilst eating. This was far beyond American Physical Activity Guideline, Australian Physical Activity Guideline, AAPD (American Academy of Paediatrics), WHO and IOTF recommendation, all of whom recommended restricting sedentary activity to not more than two hours per day.

In our study, the number of sedentary activities and eating whilst watching TV was not associated with obesity. However, we found that the subjects who ate while watching TV were at higher risk of having dental caries. This is inconsistent with

the finding of previous studies, in that television viewing was associated with childhood obesity in the cross sectional studies of Ditz and Gortmaker (1984), Viner and Cole (2005) and the prospective study of Gortmaker and colleagues (1996). In their study risk estimation was if watching TV between 4-5 and more than 5 hours per day, the children were 3 to 5.3 times more likely to be obese, although not directly comparable, as they have looked only at time spent in watching TV, whilst we collected information on hours spent in sedentary activity such as video game, computers including watching TV.

In our study, eating whilst watching TV demonstrated an increase risk of dental caries. As expected, children are less active during long periods of television viewing, and children engaged in more physical activity when they are not watching TV. The risk associated with this behaviour may operate through several mechanisms, increase in more frequent snacking, less fruit and vegetables and unhealthy food choice through advertisement (Boynton-Jarrett, et al, 2003) which could increase the risk of dental caries.

6.3.9 Oral hygiene

This study has demonstrated the attitudes and behaviour of adolescents toward oral hygiene and compared dental behaviour between male and female adolescents. In the present study female adolescents took better care of their teeth and brushed more frequently than males. This difference has been attributed to higher concern regarding personal hygiene and health care among the girls. This was in agreement with the result of Rise (1991) and Kuusela, (1997) who both demonstrated that girls brushed more often among 11 year old children in 22 European countries and Canada.

Dental visits were slightly more among adolescents from Public school, which may reflect free access to health care facilities for UAE nationals whilst in the Private schools, foreigners have to seek treatment in the private sector. Fluoride use was more popular in Public schools as was associated with preventive measures implemented by the Ministry of Health a few years ago in Government schools.

6.4 Prevalence of obesity

It should be noted that it is often difficult to make a direct comparison of the prevalence of overweight between countries or even with other studies, due to inconsistencies in the classifications used for overweight, or definition and cut-off points (Chinn, 2006, Guillaume, 1999a, Cole et al., 2000).

The prevalence of overweight and obesity in UAE was 23.4% and 14.7% respectively using IOTF cut-off point among students. Our finding was higher than that reported by Al-Haddad (2000). However, he used a US cut-off point in estimating overweight and obesity and the study was in the Emirate of Ras-Al-Khaima. In that study, the reported prevalence was 9% for overweight and 8% for obese and the age range of school students studied was 6 to 16 years, although these findings are not directly comparable because of different time period, age range, reference value and location of data collection, he reported lower prevalence than our study.

Malik and Bakir (2007), found the overall prevalence of overweight and obesity was 22% and 14% respectively among 5 to 17 year old children, from Abu-Dhabi, Dubai and Al-Ain, using IOTF cut-off point which was similar to our finding. However, this can not be directly compared, due to age range and selected regions.

In the present study, the prevalence of overweight in males and females was 25% and 22% respectively, and for obesity was 15% and 14% respectively and this was not statistically significant. This was not in agreement with Malik and Bakir (2007) who noted the prevalence of both overweight and obesity was significantly higher in girls than boys as did Al-Hazimi (2002) in Saudi Arabia, and Al-Isa (2004) in Kuwait who found that girls were significantly more overweight than boys.

It is important to consider the prevalence of overweight and obesity in male and female separately, since the rate of disease occurrence is different. Another important reason is that prevention and management approach of overweight could also be different between male and female adolescents.

In previous studies reported in western countries, a significant difference in the prevalence of overweight across ethnic groups has been observed. Odgen (2006) reported significantly higher prevalence of overweight among certain ethnic groups, prevalence of obesity was significantly higher in Black American, followed by Mexican American compared to non-Hispanic White American. Similarly, Baltrus (2005) in the United States reported that Black American tended to be heavier throughout their life than Whites. Jebb (2004) reporting in a nationally representative data set in the UK found that Asians were four times more obese than Whites.

Similarly, our study showed statistically significant differences across ethnic groups, Indian sub-continents were least obese compared to other nationalities, whilst non-local Arabs were more overweight than others and had the highest mean BMI. Reasons for such significant differences in obesity are complex and

could be related to a combination of SES, socio-cultural beliefs and practice, and overall difference in the lifestyle of different nationalities, which caused such variations in mean BMI. As previously stated, non-local Arabs had the worst dietary habits compared to other nationalities, lowest reported salary, which would influence their living conditions. However, the studies that have been conducted in either UAE or Gulf region, did not report prevalence of obesity in relation to ethnicity (Al-Haddad, 2000, Al-Hazimi, 2002, Malik and Bakir, 2007), therefore it is not possible to compare this study to any other study in the region.

In contrast to other studies (Baltrus et al, 2005 and Ahne et al, 2008), this study did not demonstrate any association between overweight and parental education and income. This could be that adolescents in this age group choose their own food, as a development process of independence and individualization as well as less parental influence.

It appears that the prevalence of overweight in UAE is generally more than other findings that have been reported earlier (Al-Haddad, 2005, Al-Haddad, 2007). The greatest concern is that the prevalence found in this study is equally high as reported in other studies indicating the possibility of nutritional problems in this population. Another explanation might be that the UAE population is considered to have high income level in comparison to other Arabic or Middle East countries, this high income level encourage UAE inhabitants to live affluent sedentary lifestyle and accompanying diet. Khai et al (2007) reported that although modernization, economic growth has improved living standards, this has also contributed to change in dietary pattern and increased the risk of diet related diseases such as diabetes, cardiovascular disease and obesity.

Parental or familial obesity is a well recognized risk factor for childhood obesity (Bouchard, 2009). Our study showed significantly higher proportion of cases (57%) with positive family history of obesity than in non- cases (9%). We considered those who had a history of obesity in the immediate family (parents or siblings), however, this should be considered cautiously as there might be bias, since the history of overweight in parents or siblings was self-reported, and no anthropometric measurement of obesity for the member of family was done. Even though, the role of genetic and familial influences in the pathogenesis of obesity is obvious, it is difficult to evaluate the role of genetics in this study. There was evidence that obesity tends to run in the families of the overweight subjects. It could be hypothesized that those adolescents who are predisposed would be more likely to become obese if their intake was similar to those adolescents without such a history. Another explanation is that overweight in a family member probably influence the risk of obesity because of shared genes or environmental factors within families (Bouchard et al, 1990).

In studying the distribution of obesity according to school type there was no significant difference in obesity prevalence. In government schools, the prevalence of obesity was 15% compared to 14% of Private schools. This finding is not strange as in the UAE; the type of school is not necessarily reflecting the socio-economic level as in other countries, where rich people tend to study in private schools. The immigration rules in the UAE that allow non-local students to join governmental school is restrictive, it only permits admission for UAE nationals. Accordingly, even poorer students have to join Private schools, which also vary in their student's socio-economic mix based on tuition fees. Our result did not show

significant difference in obesity prevalence related to school annual tuition fees either.

6.5 Prevalence of dental caries

In this study the prevalence of dental caries was 72%. This finding was in line with the study of Al-Mughary, who reported that 72% of Abu-Dhabi children had experienced dental caries and not dissimilar to the study of Hisham et al (2006). Al-Hossani and Rugg-Gunn's study was higher, with a prevalence of 94%, 90% and 82% for Abu Dhabi, Al-Ain and Western region children respectively. However, in all the above studies, the reported prevalence was for the primary dentitions rather than permanent dentitions in the present study. Comparison with recent findings from studies in countries neighbouring UAE (Gulf countries) suggests that the dental caries level is similarly high (Al-Dousari et al, 2004, Al-Mutawa et al, 2006, Al-Malik and Rehbini, 2006).

The nationality of children was also investigated as a risk factor for dental caries development. Generally, non-local Arabs had the highest mean DMFT (3.73) and prevalence (82%) than Local Arabs (Emiratis) (DMFT= 3.01 and 69%) whereas the Indian sub-continent adolescents had the lowest mean DMFT (2.38) and prevalence (58%). Ethnic differences in caries experience has also been reported by Dye (2004), this can be accounted by different cultural background which will influence dietary practice.

The measure of SES (parental education and income) was associated with dental caries and DMFT suggesting that our result was similar to those previously reported (de la Rosa 1978, Savara and Suhar, 1995, Peres et al, 2004 and 2007).

Our study revealed that DMFT was significantly associated with dental visits in last 12 month. Similarly, de la Rosa (1978) reported among Mexican children, that

DMFT increased with socio-economic status, which indicates more dental care and using more dental services. Our study also revealed significant association between income and dental visit ($p<0.000$). In relation to dental caries our study showed a significant negative association between decay and father's education level.

Dental caries prevalence was higher among boys, whilst DMFT score was higher among girls. This could be due to more health awareness and higher concern regarding health care, as our study also revealed that girls looked after their teeth better and brushed more frequently than boys.

Over the past decades large numbers of research papers have shown that dental caries is linked to socio-economic status. The effect of educational background on measures of dental caries was found and particularly strong when disease prevalence was high. The multivariate regression analysis of risk factors for dental caries carried out in this study, in order to control for the effect of all parameters of dietary, oral hygiene and BMI showed that high level of father's education was protective and low education level a risk factor. This observation may be mainly because SES exerts this effect by inadequate knowledge of appropriate food choice.

6.6 Obesity and oral health

Based on the concept that common risk factors contribute to development of dental caries and obesity, this study proposed to examine a possible association between dental caries and obesity. The univariate analysis for the present study revealed a positive association between obesity and dental caries. This is based on the finding that with an increase in 10 points in BMI there is an increase of 0.5

DMFT. An interesting finding was that the multivariate regression analysis showed when controlling for other covariates, that BMI lost its significance when other parameters such as socio-demographic background, dietary habits and oral hygiene were entered.

Father's education and consumption of soft drinks were the strongest predictors of dental caries which had powerful effect on caries development, indicated that low SES could exert an effect due to inadequate knowledge of appropriate food choice, lifestyle, etc, and therefore resulting in development of more dental caries.

There are a number of studies which have considered weight as a risk factor for development of dental caries (Larsson et al, 1995, Willershausen et al., 2004, Hilgers et al., 2006, Willerhausen et al., 2007, Marshall et al., 2007, Bailleul-Forestier et al., 2007, Gerdin et al., 2008). However, these various published studies which examined the relationship between BMI or weight status and dental caries have been questionable due to their various finding.

Larson and colleagues, who reported in 1995 that BMI was the only variable which was independently, associated with caries score DMFS, among 15 year old Swedish adolescents in both univariate and multiple linear regressions, but they did not take into account the socio-economic factors. In addition, all participants included in the dental health care programs of fluoride mouthwash, brushing once or twice with fluoridated toothpaste, professional application of fluoride and instruction on sucrose restriction.

Further similar observations were made by Willehousen (2004), who concluded that normal weight children had significantly lower caries in both primary and permanent dentition compared to overweight. This study included only weight status, gender and caries. When looking at the relationship between obesity and dental caries, other parameters such as socio-economic, dietary, and oral hygiene should be considered.

Bailleul-Forestier and colleagues (2007), reported a significant association between BMI and DMFT indices (p=0.01) in severely obese adolescents, DMFT was 6.9 for obese as compared to 4.3 in normal group. Their survey included 82 (41 obese and 41 non-obese) aged 12-18 year olds being treated in a residential Paris suburb healthcare centre, who were recieving treatment for obesity, weight loss programms, including a balance diet, physical activity and educational support. The non obese were recruited from high schools located in the same suburb matched by age, gender, however, socio-occupational background and oral hygiene were not taken into account. This could create a bias in that the obese adolescents on the programme had a controled diet in comparision to normal group. In our study the difference in mean DMFT was slightly higher among obese (DMFT=3.52, sd 3.04) as compared to normal weight (DMFT= 3.07, sd 2.99).

In a study by Chen in Taiwan, the author found that the prevalence was not significantly different among BMI groups; this result deviated from our study because the children were only 3 years old, at this age there are other important factors considered to be risk factors such as bottle feeding and there is still major parental control over diet. It is not the time for children to eat away from home or

consume of soft drinks. Tuomi (1989) searched for the possibility of predicting future decay, using obesity and earlier caries experience variables in 5-13 year old children, she reported that although incorrect diets can predict both obesity and caries. Obesity develops more rapidly than caries and therefore obesity alone was not a good predictor for caries in Finish (3-15 year olds) children.

Our study although not directly comparable due the different age range could be compared, to that of Marshal et al (2007), among US children aged 5-7 and 8-11, where they looked at the relationship between obesity and caries, and also explored diet and socio-economic status as additional risk factors. Children with caries had lower family income, lower parental education, heavier mother and higher soda pop intakes ($p<0.05$), however in their step-wise logistic regression for the predictors of caries, mother education was the only predictor left in the model as a risk factor.

The reason for such conflicting results can be considered as influencing factors are: different in age range, methods of oral examination, such as use of radiograph or reporting DFS rather than DMFT or only considering posterior molars, primary or permanent teeth. The other explanation is the children involved in the above study were involved in preventive programmes during the study period. Further, some of the above study under-estimated the role of socio-economic status and diet as a risk factors.

6.7 Self-esteem

6.7.1 Obesity and self-esteem

The data demonstrated significant positive relationship between self-esteem and age, this change of self-esteem by age during adolescence could be psychological, as early adolescence is a critical time for formation of self-worth. During pre-adolescence, family support and interaction is important, whilst during adolescence approval from peers is also particularly important (Strauss, 2000). The other explanation is that body image concern become more predominant during early adolescence (Skempt-Arlt, 2006, Waden et al, 1989), therefore it can be concluded that adverse psychological consequence of overweight and obesity could also be related to age development (Robins, 2002). Strauss (2000) in a previous study reported that girls were more affected and had significantly lower self-esteem than boys. However, this study did not demonstrate any difference in level of self-esteem across gender.

The relationship between ethnicity and self-esteem was found to have some variation in the level of self-esteem. For example, Indian sub-continent had the lowest score, whilst non-local Arabs had the highest. The influence of race on psychological factors has been reported by Strauss (2000) and Fallon (2005), weight concern can vary among different ethnic groups, for instance Hispanic men and women demonstrated less weight concern compared to White of the same suburbs (Stern et al., 1982). Therefore, different ethnicity might demonstrate different patterns of self-esteem in relation to overweight and obesity. These data also demonstrated lower levels of self-esteem among obese and overweight adolescents, which is consistent with the findings of French (1995), Strauss (2000)

and Franklin (2006) which demonstrated lower self-esteem among obese adolescents aged 13-18 years.

6.7.2 Oral health and self-esteem

Several aspects of oral health status in association with self-esteem have been reported in previous studies (Locker, 2009, Neocomedo, 2008, Bryan Welbury, 2006, 2003 Macgregor, 1994). The present study looked at the relationship between DMFT and oral hygiene practice in association with the level of self-esteem. Our result did not show any association. However, adolescents who had a higher self-esteem level took better care of their teeth. None of the previous studies have looked at the relationship between Rosenberg self-esteem and DMFT. Nevertheless, they have mostly investigated the aesthetic point of view such as shape, color and size of the teeth in relation to psychological health (Bryan and Welbury, 2003, Bryan and Welbury, 2006). Our finding in relation to oral hygiene was consistent with study of Macgregor (1991) and Regis (1994), who stated that, tooth brushing frequency increased with increase self-esteem.

6.7.3 Strengths and limitations of the study

This study has provided us with data which has the potential for significant impact in the UAE. It has provided an important base and path for future research and studies in the region. The strength of the study is based on the fact that we have a large representative UAE population sample and a rigorous cross-sectional sampling framework, with wide variety of racial and socio-economic backgrounds, including substantial information about their health behaviour, lifestyle and clinical examination. This has allowed me to undertake a comprehensive univariate and

then multivariate analysis to explore and control for many parameters and factors which may contribute to being overweight or experience dental caries.

However, this study had also some limitations. Theses are essentially related to the use of cross-sectional data to examine possible relationship between obesity and dental caries which could not detect causality. The reported dietary habits were self-reported leading to possible responders and recall bias. DMFT is well established epidemiological measurement tool for dental caries which is clear and used in daily clinical practice and because the researcher (FK) has previously been trained in oral epidemiological and because in this study the clinical examination was carried out by a single examiner and due to difficulty of returning to the schools and disturbing the students which most of the school were not keen that this should happen and therefore did not permit further disturbace of the school day , the clinical calibration was not performed, recognised that in ideal circumstances this would have been desirable.

Chapter 7. Conclusions and policy implications

7.1 Conclusion

- Adolescent health behaviour and lifestyle in Sharjah City, UAE was significantly different by socio-demographic characteristic where age, gender and nationality (ethnicity) played an important role.

- It is concluded from the current study that the prevalence of obesity and overweight and similarly dental caries was high amongst adolescents in Sharjah City.

- The determinants of obesity and overweight as a health problem are multifactorial and often interacting. According to the current study the risk factors of obesity were positive family history of obesity, age, having all three meals and consumption of soft drinks.

- The determinants of dental caries are also multifactorial and interacting. According to our study, the risk factors of dental caries were low level of father education, Arab origin, female, age, having all three meals and consumption of soft drinks.

- An association between obesity and dental caries was found utilizing univariate analysis but in the multivariate model, the BMI was confounded with dietary habits and a single dietary item of soft drinks, contributed to development of both obesity and dental caries.

- This study demonstrated an association between oral hygiene practice and self-esteem, adolescents with higher self-esteem, were more likely to brush their teeth.

7.2 Policy implication

- Obesity and overweight is a serious health problem which is now recognized as an epidemic throughout the world. However, health care planners do not always view it as a high priority, and as a result prevention and management programmes are needed.Therefore, promoting a healthy lifestyle is one of the most important factors in preventing and even managing overweight in adolescents. The promotion of a healthy lifestyle should include promoting healthy eating habits.

- Health and nutrition education should be disseminated to school students. The students must be encouraged to adopt desirable dietary practices such as balanced food intake, must educate them on the hazardous of skipping meals especially breakfast, frequent snacking and consumption of soft drink.

- This could be implicated by incorporation of breakfast meal into school programme, as breakfast plays a key role in improving childrens' concentration levels, attention span, school performance, education level and behaviour difficulties. It also meets children needs of having balnced diet and preventing them from having unhealthy snacks during the day, further for many families providing adequate healthy food is a major struggle both in terms of economics and time to prepare.

  In summary the potential benefit of incorporating breakfast into school program are:

  - Improving health and nutrition

  - Improving childrens' education

- Improving child socialization

- Improving and supporting parent and family

- Ministry of Education should pay more attention to canteen and food purchased at school and applying strict food policies in schools especially focused on reduced consumption of soft drinks. In addition Ministry of Education should stress the importance of incorporating a compulsory physical activity into the education system and nutritional education into school health programme.

- Health education programs should be established with in health care and community services to target individuals and population subgroups that have developed, or at risk of developing obesity and dietary counseling to prevent both obesity and dental caries.

- Ministry of Health should increase access and availability to dental services for those adolescents most at need. More emphasis on dental services is needed especially targeting high risk group. Monitoring the height and weight as a routine clinical check-up or could be even incorporated into dental check-up.

- Even though the link between oral health and obesity is not clear, our obligation as health care providers and as a paediatric dentist who has frequent contact with children, we have an obligation to battle against obesity and should not ignore the impact of weight on general health and consider the complication derived from obesity and therefore, targeting obesity in daily routine dental check-up.

- The psychological impact of an obese individual is often not considered and therefore tackling healthy dietary habits and physical activity will improve the psychological aspects of obesity. This could be implemented in that, when overweight present to clinic assessing body fat, it is beneficial to identify in a brief and simple way the psychological aspect of it, as these people are at the greater need of weight control, because they might be already manifesting psychological symptom.

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Glossary

AAPD: American Academy of Pediatric

AR: Adiposity Rebound

BASCD: British Association for the study of Community Dentistry

BF: Body Fat

BIA: Bio-Electrical Impedance

BMI: Body Mass Index

CDC: Center of Disease Control

CVD: Cardio Vascular Disease

DEXA: Dual Energy X-ray Absorpiometry

DMFS / dmfs: Decay, Missing, Filled Surfaces / decay, missing, filled surfaces

DMFT / dmft: Decay, Missing, Filled Teeth / decay, missing, filled, teeth

HRQOL: Health Related Quality Of Life

IOTF: International Obesity Task Force

MRI: magnetic Resonance Image

NCHS: National Center for Health Statistics

NFCS: Nationwide Food Consumption Survey

NHNES: National Health and Nutrition Examination

NLSY: national Longitudinal Survey of Youth

SES: Socio Economic Status

SF: Skin Fold

SFT: Skin Fold Thickness

SPPC: Self-Perception profile for Children

WHO: World Health Organization

Appendices

Appendix I: International Obesity Task Force (IOTF) - Cut-off Points

IOTF cut-offs for overweight and obesity by age and sex

Age	BMI 25(Overweight)		BMI 30(Obese)	
(Years)	Boys	Girls	Boys	Girls
2	18	18.0	20.1	19.8
2.5	18.1	17.8	19.8	19.5
3	17.9	17.6	19.6	19.4
3.5	17.7	17.4	19.4	19.2
4	17.6	17.3	19.3	19.1
4.5	17.5	17.2	19.3	19.1
5	17.4	17.1	19.3	19.2
5.5	17.5	17.2	19.5	19.3
6	17.6	17.3	19.8	19.7
6.5	17.7	17.5	20.2	20.1
7	17.9	17.8	20.6	20.5
7.5	18.2	18.0	21.1	21.0
8	18.4	18.3	21.6	21.6
8.5	18.8	18.7	22.2	22.2
9	19.1	19.1	22.8	22.8
9.5	19.5	19.5	23.4	23.5
10	19.8	19.9	24.0	24.1
10.5	20.2	20.3	24.6	24.8
11	20.6	20.7	25.1	25.4
11.5	20.9	21.2	25.6	26.1
12	21.2	21.7	26.0	26.7
12.5	21.6	22.1	26.4	27.2
13	21.9	22.6	26.8	27.8
13.5	22.3	23.0	27.2	28.2
14	22.6	23.3	27.6	28.6
14.5	23.0	23.7	28.0	28.9
15	23.3	23.9	28.3	29.1
15.5	23.6	24.2	28.6	29.3
16	23.9	24.4	28.9	29.4
16.5	24.2	24.5	29.1	29.6
17	24.5	24.7	29.4	29.7
17.5	24.7	24.8	29.7	29.8
18	25	25	30	30

Appendix II: Trends of Dental Caries

Table A: Trends of dental caries (DMFT) in 12-year-olds in European countries
http://www.whocollab.od.mah.se/euro.html

Country	Year	DMFT
Austria	1978 1984 1988 1994 1997 2002	3.0 3.8 4.3 3.0 1.7 1.0
Denmark	1975 1978 1980 1985 1988 1991 1995 2000 2003 2005 2007	5.2 6.4 5.0 2.1 2.2 1.3 1.2 1.0 0.9 0.8 0.7
Finland	1975 1994 1997 2000	6.9 1.2 1.1 1.2
France	1987 1993 1998 2006	4.2 2.1 1.9 1.2
Italy	1979 1986 1991 1996 2001-02 2004	6.9 4.9 2.9 2.1 1.5* 1.1
Norway	1985 1993 1998 2000 2004	3.4 2.1 1.5 1.5 1.7
Sweden	1937 1977 1990 1995 1997 1999 2000 2001 2002 2005	7.8 6.3 2.0 1.4 1.0 0.9 1.0 0.9 1.1 1.0
Switzerland	1964-68 1988 1992 1996 2000 2004	8.0 2.0 1.4 0.84 0.9 0.86
United Kingdom (UK)	1983 1993 1996-97 2000-01 2004-05	3.1 1.4 1.1 0.9 0.7

Table B: Trends of dental caries (DMFT) in 12-year-olds in Middle East
http://www.whocollab.od.mah.se/euro.html

Country	Year	DMFT
Bahrain	1986 1995	1.3 1.4
Jordan	1962 1984 1995	0.2 3.2 3.3
Kuwait	1982 1993 2000	2.0 2.6 2.6
Lebanon	1994 2000	5.7 3.4
Saudi Arabia	1979 1985 1995 (12-14 Year-old) 2002	2.0 2,0 1.7 5.9

Appendix III: Ethical Approval – Queen Mary Research Ethic Committee – UK

Queen Mary
University of London

Queen Mary, University of London
Joint R @ D Office
24-26 Walden Street
Whitechapel
London
E1 2AN

Queen Mary Research Ethics Committee
Hazel Covill
Research Ethics Committee Administrator
Tel: +44 (0) 20 7882 2207
Email: h.covill@qmul.ac.uk

c/o Professor Elizabeth Davenport
Institute of Dentistry
QMUL
Whitechapel Campus
London

9th April 2008

To Whom It May Concern:

Re: QMREC2007/60 – Obesity and Oral Health of Children.

The above study was conditionally approved by the Queen Mary Research Ethics Committee on the 21st November 2007; the full approval was ratified by the Chairman on 28th January 2008.

This approval is valid for a period of two years, (if the study is not started before this date then the applicant will have to reapply to the Committee).

Yours faithfully

Elizabeth Hall – QMREC Chairman.

Appendix IV: Permission – Ministry of Education & Ministry of Health – UAE

UNITED ARAB EMIRATES
MINISTRY OF EDUCATION
Deputy Chief Executive for
Teaching & Learning

دولة الإمارات العربية المتحدة
وزارة التربية والتعليم
نائب المدير التنفيذي
للشؤون التعليمية

الرقم: 146/ 2008م
التاريخ: 6 / 2 / 2008م

السيدة/ مديرة منطقة الشارقة التعليمية المحترمة

تحية طيبة ،،،

نتوجه بالتحية والتقدير لإدارتكم الكريمة آملين تحقيق المزيد من التقدم والنجاح .

هذا وبناء على طلب الدكتورة فروغ عبدالله خضري بشأن إجراء بحث علمي في المدارس الحكومية والخاصة بالدولة بعنوان (السمنة وصحة الفم والأسنان في مرحلة المراهقة بدولة الامارات العربية المتحدة) —

برجى من سيادتكم التعميم على المدارس الحكومية والخاصة لتسهيل مهمة المذكورة المشار إليها أعلاه .

هذا للعلم وإجراء ما يلزم .

شاكرين لكم حسن تعاونكم

وتفضلوا بقبول وافر الاحترام والتقدير ،،،

د . فوزية محمد سعيد بدري

المدير التنفيذي للشؤون التعليمية بالإنابة

وزارة التربية والتعليم — الإمارات العربية المتحدة — المعهد التنفيذي للشؤون التعليمية

الملف .

UAE - Dubai ♦ Tel: +971 4 - 263 8099 ♦ Fax: +971 4 - 263 8102 ♦ P.O.Box 3962
E-mail: fouzia.badri@moe.gov.ae
Website: www.moe.gov.ae

United Arab Emirates
Ministry of Education
Educational Affairs

دولة الإمارات العربية المتحدة
وزارة التربية والتعليم
الشـــون التعليميـــة

الرقـم : 34

التاريخ : 10 / 02 /2008 م

المحترمة

الأستاذة / فوزية حسن غريب

مدير منطقة الشارقة التعليمية

تحية طيبة وبعـــد ...

يطيب لنا أن نشكر لكم جهودكم وتعاونكم في دعم الأنشطة التربوية ، ونحيطكم علماً بأنه ليس لـدينا مانع من أن تقوم الدكتورة / فروغ عبدالله خضري – بإجراء بحث علمي بالمدارس الحكوميـة والخاصـة بمنطقتكم الموقرة بعنوان (السمنة وصحة الفم والأسنان في مرحلة المراهقة بدولـة الإمـارات العربيـة المتحدة) وذلك ضمن المتطلبات الدراسية لبرنامج الدكتوراه الذي تلتحق به المذكورة.

لذا يرجى التفضل بالإيعاز لمن يلزم بتسهيل مهمة الباحثة المذكورة في إجراء البحث المـشار إليـه بمدارس منطقتكم العامرة.

شاكرين حسن تعاونكم .

وتقبلوا صادق التحية والاحترام

مدير إدارة الأنشطة الطلابية

وزارة التربية والتعليم
الشئون التعليمية
إدارة الأنشطة الطلابية

United Arab Emirates
Ministry Of Education
Sharjah Educational Zone
التاريخ 2008/02/11 م

دولة الإمارات العربية المتحدة
وزارة التربية والتعليم
منطقة الشارقة التعليمية
الرقم .....

بشأن تسهيل مهمة

السادة / مديري مدارس التعليم الثانوي والأساسي ح1 ، ح2 والمشتركة ومديراتها ، المحترمين

السادة / مديري مدارس التعليم الخاص ومديراتها المحترمين

السلام عليكم ورحمة الله وبركاته ،،،

تهديكم إدارة المنطقة خالص تحياتها ، ويسرنا أن نرسل لكم كتاب وزارة التربية رقم (34) المؤرخ بتاريخ 2008/02/10 م بشأن تسهيل مهمة الدكتورة / فروغ عبد الله خضري لإجراء بحث علمي بعنوان(السمنة وصحة الفم والأسنان في مرحلة المراهقة بدولة الإمارات العربية المتحدة) .

شاكرين لكم حسن تعاونكم الدائم....

مدير إدارة منطقة الشارقة التعليمية

فوزية حسن بن غريب

دولة الإمارات العربية المتحدة
وزارة التربية والتعليم
منطقة الشارقة التعليمية
SHARJAH EDUCATIONAL ZONE

نسخة لكل من :
- قسم المناهج والبرامج التعليمية
- المدارس المعنية

رئيس قسم المناهج والبرامج .....

شخصية قيادية لجيل مبدع يسمو لتطوير ذاته
Tel:06 5723082,Fax:06 5733147,P.O.Box:452
Sharjah-United Arab Emirates
Email: sez@sez.gov.ae
www.sez.gov.ae
هاتف : ٠٦ ٥٧٢٣٠٨٢ ،البراق : ٠٦ ٥٧٣٣١٤٧ ، ص.ب : ٤٥٢
الشارقة - الإمارات العربية المتحدة
البريد الإلكتروني : sez@sez.gov.ae

UNITED ARAB EMIRATES
MINISTRY OF EDUCATION
Assistant Undersecretary
Student Activities & Welfare
Department of Sport & Health Programs

دولة الإمارات العربية المتحدة
وزارة التربية والتعليم
وكيل الوزارة المساعد
للأنشطة والرعاية الطلابية
إدارة البرامج الرياضية والصحية

الرقم : ٢٤٩
التاريخ : ٢٠١٤/١١/٢٣

Dear School Principal,

This is to certify that the Department of Sports & Health Programs of the Ministry of has no objection that **Dr. Foroogh Abdulla Khadri** conducts a scientific research in public and private schools under the title of **(Obesity & Oral Health Among Adolescence in the United Arab Emirates)** as a part of requirement for the Ph.D. program in her academic field.

This letter was issued upon her request to facilitate her efforts while visiting schools.

Sincerely yours,

Nasser Aman Al- Rahma
Director
Dept. of Sport & Health Programs

السيدات والسادة/مديرات ومديري المدارس المحترمون

تحية طيبة وبعد،،

يطيب لنا إحاطتكم علما بإنه ليس لدينا مانع من أن تقوم الدكتورة/فروغ عبدالله خضري بإجراء بحث علمي بالمدارس الحكومية والخاصة بالدولة بعنوان **(السمنة وصحة الفم و الأسنان في مرحلة المراهقة بدولة الإمارات العربية المتحدة)** وذلك ضمن المتطلبات الدراسية لبرنامج الدكتوراه التي تلتحق به المذكورة.

وقد أعطيت لها هذه الشهادة بناء على طلبها لتسهيل مهمتها في إجراء البحث بالمدارس.

مع خالص الشكر والتقدير،،

ع. ناصر أمان ال رحمة
مدير إدارة البرامج الرياضية والصحية

UAE - Abu Dhabi ◆ Tel: +971 2 - 632 3261 / 621 0888 ◆ Fax: +971 2 - 633 6774 ◆ P.O.Box 295
الإمارات العربية المتحدة، أبوظبي ◆ هاتف: ٦٣٢ ٣٢٦١ / ٦٢١ ٠٨٨٨ ◆ ٩٧١+ ٢ - فاكس: ٦٣٣ ٦٧٧٤ ◆ ٩٧١+ ص.ب: ٢٩٥
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E-mail: uso@moe.gov.ae

UNITED ARAB EMIRATES
MINISTRY OF EDUCATION
Assistant Undersecretary
Student Activities & Welfare
Department of Sport & Health Programs

دولة الإمارات العربية المتحدة
وزارة التربية والتعليم
وكيل الوزارة المساعد
للأنشطة والرعاية الطلابية
إدارة البرامج الرياضية والصحية

الرقم : 243
التاريخ : 12-11-2007

The Bart & The London
School of Medicine & Dentistry
Queen Mary University of London
UK

Dear Sir/Madam,

This is to certify that the Department of Sports & Health Programs of the Ministry of Education in the United Arab Emirates has no objection that **Dr. Foroogh Abdulla Khadri** conducts a scientific research in public and private schools under the title of **(Obesity & Oral Health Among Adolescence in the United Arab Emirates)** as a part of requirement for the Ph.D. program in her academic field.

This letter was issued upon her request to be submitted to Queen Mary University of London.

Sincerely yours,

Nasser Aman Al- Rahma
Director
Dept. of Sports & Health Programs
Ministry of Education

UAE - Abu Dhabi ⋄ Tel: +971 2 - 632 3261 / 621 0888 ⋄ Fax: +971 2 - 633 6774 ⋄ P.O.Box 295
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الإمارات العربية المتحدة، دبـــي ⋄ هاتف: ٢١٧ ٦١٤٠ / ٢٦٣ ٨٨٤٤ - ٤ ٩٧١+ ⋄ فاكس: ٢٦٣ ٨٠٤٤ - ٤ ٩٧١+ ⋄ ص.ب: ٣٩٦٢
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UNITED ARAB EMIRATES
MINISTRY OF EDUCATION
Assistant Undersecretary
Student Activities & Welfare
Department of Sport & Health Programs

دولة الإمارات العربية المتحدة
وزارة التربية والتعليم
وكيل الوزارة المساعد
للأنشطة والرعاية الطلابية
إدارة البرامج الرياضية والصحية

الرقم : ٢٤٨
التاريخ : ٢٠٠٧/١١/١٤

سعادة/مدير منطقة الشارقة الطبية **الموقر**

تحية طيبة وبعـــــد،،

يطيب لنا إحاطتكم علما بأنه ليس لدينا مانع من أن تقوم الدكتورة/فروغ عبدالله خضري بإجراء بحث علمي بالمدارس الحكومية والخاصة بالدولة بعنوان (السمنة وصحة الفـم الأسـنان فـي مرحلـة المراهقة بدولة الإمارات العربية المتحدة) وذلك ضمن المتطلبات الدراسية لبرنامج الدكتوراه التـي تلتحق به المذكورة.

وقد أعطيت لها هذه الشهادة بناء على طلبها لتقديمها لمنطقة الشارقة الطبية.

وتفضلوا بقبول فائق التحية والاحترام ،،

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Appendix V: Student's Questionnaire – Arabic Version

رقم الطالب..... تاريخ الاستبانة.....

استبانة الطلبة

تاريخ الميلاد:

الجنس: أنثى ☐ ذكر ☐

الجنسية؟

الرجاء وضع إشارة عند الإجابة المناسبة لكل قسم

<u>العادات الغذائية:</u>

يتعلق هذا القسم بأسئلة محددة عن نوعية أكلك و عدد المرات التي تأكل و تشرب فيها و عن ما تفضله من أطعمة.

كم مرة في اليوم الاعتيادي تتناول فيها شيئاً مع ضم ساعات المدرسة ؟

11 مرة فأكثر في اليوم | 10-9 مرات في اليوم | 8-7 مرات في اليوم | 6-5 مرات في اليوم | 4-3 مرات في اليوم | 2-1 في اليوم

كم وجبة رئيسة تتناول في اليوم؟

1 ☐ 2 ☐ 3 ☐ 4 ☐

هل تتناول وجباتك الرئيسية بانتظام؟

نعم ☐ لا ☐

ما هي الوجبة التي تتناولها يومياً؟ (بإمكانك الإشارة إلى أكثر من اختيار)

الفطور ☐ الغداء ☐ العشاء ☐ جميعهم ☐

كم مرة في اليوم تتناول الوجبات الخفيفة ؟

0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 فأكثر ☐

كم مرة في الأسبوع تتناول الوجبات السريعة (ماكدونالدز/ كنتاكي/ بيتزا)؟

0 ☐ 1 ☐ 2 ☐ 3 ☐ 3 فأكثر ☐

كم مرة في الأسبوع تتناول الطعام المصنّع؟ (قطع الدجاج (ناجتس)/ همبرجر/ هوت دوغ)

0 ☐ 1 ☐ 2 ☐ 3 ☐ 3 فأكثر ☐

ما هو اختيارك المفضل من الأطعمة؟

نباتي (خضراوات/ فواكه) ☐

غير نباتي (منتجات حيوانية) ☐

الطعام التقليدي ☐

الأطعمة السريعة ☐

الحلويات و النشويات ☐

كم مرة اعتدت أن تأكل من التالي؟
(لكل نوع من أنواع الطعام، ضع إشارة في الصندوق الذي تنطبق عليه عاداتك في الأكل)

	5 مرات فأكثر في اليوم	4-3 مرات في اليوم	2-1 مرات في اليوم	4-3 مرات في الأسبوع	2-1 مرات في الأسبوع	لا أتناولها
الشوكولاتة						
الحلويات أو السكاكر						
الحبات الجيلاتينية (الهلامية)						
آيس كريم (البوظة)						
البسكوت أو الكعك المحلى						
التمر						
قطع الثلج						

هل تشاهد التلفاز و أنت تأكل؟

نعم ☐ لا ☐

إذا كانت الإجابة بنعم، فما الذي تأكله غالباً حين تشاهد التلفاز؟ حدد.....

هل تأكل أكثر حينما تكون متوتراً أو تعاني من مشكلة؟

نعم ☐ لا ☐

كم مرة في اليوم تتناول الفاكهة ؟

0 ☐ 1 ☐ 2 ☐ 3 ☐

كم مرة في اليوم تتناول الخضروات؟

0 ☐ 1 ☐ 2 ☐ 3 ☐

كم مرة تشرب فيها شيئاً خلال اليوم الاعتيادي؟

11 مرة فأكثر في اليوم ☐ **10-9 مرات في اليوم ☐** **8-7 مرات في اليوم ☐** **6-5 مرات في اليوم ☐** **4-3 مرات في اليوم ☐** **2-1 مرات في اليوم ☐**

كم مرة تشرب من الأشربة التالية عادة؟
(لكل نوع من أنواع الشراب، ضع إشارة في المربع الذي تنطبق عليه عادتك في الشرب)

	+5 مرات في اليوم	4-3 مرات في اليوم	2-1 مرات في اليوم	4-3 مرات في الأسبوع	2-1 مرات في الأسبوع	و لا مرة
المشروبات الغازية						
عصير فواكه طبيعي (على سبيل المثال: مرموم، المراعي)						
عصائر فواكه أخرى _ على سبيل المثال: راني، صفا، نكتار)						
الحليب						
اللبن						
شاي بالسكر						
أشربة أخرى (الرجاء تحديدها في الأسفل)						

<u>النشاط الجسدي:</u>

نرغب في معرفة حجم النشاط الجسدي الذي تبذله في اليوم الواحد. إن النشاط الجسدي هو أي جهد يزيد من معدل ضربات قلبك و يجعل نفسك متقطعاً في بعض الأحيان. قد يتمثل النشاط الجسدي بالرياضة،أو اللعب مع الأصدقاء، أو الذهاب إلى المدرسة مشياً على الأقدام. و من الأمثلة الأخرى على النشاط الجسدي المشي السريع او الهرولة، ركوب الدراجة، الرقص، كرة القدم ...الخ.

خلال **الأسبوع الاعتيادي**، كم يوماً في الأسبوع بذلت نشاطاً جسدياً لما لا يقل بمجمله عن <u>30 دقيقة في اليوم</u> (10 دقائق متواصلة على الأقل)؟

0 يوم ☐ 1 يوم ☐ يومان ☐ 3 أيام ☐ 4 أيام ☐ 5 أيام ☐ 6أيام ☐ 7 أيام ☐

كم مرة في الأسبوع تمارس التمارين الرياضية؟

0 ☐ 1 ☐ 2 ☐ 3 ☐

كم من الوقت تقضي في كل تمرين؟

نصف ساعة ☐ ساعة ☐ أكثر من ساعة ☐

هل تمارس أي نوع من أنواع الرياضة بانتظام؟ نعم ☐ لا ☐

هل تشارك في أي نوع من أنواع الرياضة أو الألعاب في المدرسة/ نادي ؟

نعم ☐ لا ☐

إذا كانت الإجابة بنعم، فأرجو التحديد.....

كيف تأتي إلى المدرسة؟

مشياً ☐ في سيارة خاصة ☐ في حافلة المدرسة ☐

كم ساعة في اليوم تقضيها في المشي؟

أقل من نصف ساعة ☐ أكثر من نصف ساعة ☐

كم من الوقت في يومك المعتاد تقضي في مشاهدة التلفاز أو ممارسة ألعاب الكمبيوتر أو التحدث إلى الأصدقاء أو القيام بغيرها من النشاطات المختلفة والتي تستدعي الجلوس؟

أقل من ساعة في اليوم ☐ 1-2 ساعة في اليوم ☐ 3-4 ساعات في اليوم ☐

5-6 ساعات في اليوم ☐ 7-8 ساعات في اليوم ☐ أكثر من 8 ساعات في اليوم ☐

كم ساعة تنام؟.....

هل تعاني من أية مشاكل أثناء نومك؟

نعم ☐ لا ☐

<u>نظافة الفم</u>

نود التعرف إلى طريقتك في المحافظة على فمك وأسنانك ولثتك من خلال طرحنا للأسئلة التالية عن أوقات تنظيف فمك وطريقتها:

هل تقوم باستخدام الفرشاة لتنظيف أسنانك

نعم ☐ لا ☐

إذا كانت إجابتك بـ لا، كيف تقوم بتنظيف أسنانك؟ .....

كم مرة تستخدم فرشاة الأسنان في اليوم؟

لا أستخدمها ☐ مرة ☐ مرتان ☐ ثلاث مرات ☐

متى تستخدم فرشاة الأسنان؟

صباحا ☐ مساءً ☐ في الصباح والمساء ☐ لا أنظفها أبداً ☐

هل قمت بزيارة طبيب الأسنان خلال السنة الماضية؟

نعم ☐ لا ☐

إذا كانت أجابتك بـ نعم، حدد الغرض من الزيارة .....

<u>استخدام الفلورايد</u>

هل تستخدم معجون الأسنان

نعم ☐ لا ☐

إذا كانت إجابتك بـ نعم، حدد نوعية معجون الأسنان الذي تستخدمه؟

.....

إذا كانت إجابتك بـ لا، حدد ما تستعمل بدلا عن معجون الأسنان؟

.....

هل استخدمت أقراص الفلورايد من قبل؟

نعم ☐ لا ☐

إذا كانت إجابتك بـ نعم، حدد الفترة الزمنية لها؟ .....

هل تشرب الماء؟ نعم ☐ لا ☐

ما نوع الماء الذي تشربه؟

ماء زلال ☐ مياه الصنبور ☐ نوع آخر من المياه ☐

حدد .....

<u>وجبات المدرسة الخفيفة</u>

كم يوما في الأسبوع الدراسي:-

تحضر طعامك من البيت ؟

لا تحضر طعاما ☐ مرة ☐ مرتان ☐

ثلاث مرات ☐ أربع مرات ☐ خمس مرات ☐

تشتري الوجبات الخفيفة من مقصف المدرسة؟

0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

تشتري المشروبات الغازية من آلة البيع؟

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

خلال يوم اعتيادي من أيام الدراسة، كم مرة في اليوم:-

تشتري الوجبات الخفيفة من مقصف المدرسة؟

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

تشتري المشروبات الغازية من آلة البيع؟

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

مقياس روزنبرج لاحترام الذات

التعليمات: العبارات التالية تتعلق بشعورك العام تجاه نفسك. ضع إشارة x تحت الاختيار الذي يعبر عن رأيك.

		موافق بشدة	موافق	لا أوافق	لا أوافق أبداً
.1	أنا راض عن نفسي بشكل عام				
.2	أحيانا أظن بأنني لا أصلح لشيء بتاتا				
.3	أشعر بأن لي عدة مزايا				
.4	أنني قادر على القيام بالأشياء كما يفعل معظم الناس				
.5	ليس لدي الكثير لأفتخر به				
.6	أحس أحيانا بأني لا أصلح لشيء				
.7	اشعر بأني شخص عادي كالآخرين				
.8	أتمنى لو كان لدي قدر أكبر من احترام الذات				
.9	عموما، أميل إلى الشعور بأني شخص فاشل				
.10	سلوكي تجاه نفسي هو سلوك إيجابي				

Appendix VI: Guardian Questionnaire – Arabic Version

رقم الطالب..... تاريخ الاستبانة.....

استبانة أولياء الأمور

يرجى تعبئة الاستبانة التالي

يرجى تزويدنا بالتاريخ الطبي والأداء المدرسي لطفلك في الأجزاء التالية

<u>التاريخ الطبي:</u>

هل يعاني طفلك من أي حالة مرضية؟ نعم ☐ لا ☐

إذا كان الجواب نعم يرجى التحديد.....

هل يأخذ طفلك أي دواء؟ نعم ☐ لا ☐

إذا كان الجواب نعم يرجى التحديد.....

هل هناك في عائلتك من تظنه سميناً؟

نعم ☐ لا ☐

إذا كان الجواب نعم، من.....

<u>أداء الطفل في المدرسة:</u>

ضع إشارة أمام الأمور التي تنطبق على طفلك.

صعوبة في التعامل مع المدرسين..... ☐

صعوبة في التعامل مع الطلاب الآخرين..... ☐

مشكلة الانتباه..... ☐

حل الواجبات المنزلية..... ☐

الغياب عن المدرسة..... ☐

يرجى التحديد

عدد الغياب في السنة الماضية؟

أهم أسباب الغياب؟

عدد مرات الغياب بسبب أمراض في الفم/الأسنان؟

يرجي تزويدنا بمعلومات عن العائلة

معلومات/تفاصيل العائلة:

مهنة:

أ. الأب:.....

ب. الأم:.....

المؤهلات العلمية:	بدون تعليم	ابتدائية	إعدادية	ثانوية عامة	جامعة
ج. الأب:	.....	.....	.....	.....	.....
د. الأم	.....	.....	.....	.....	.....

عمر:

ه. الأب:.....

و. الأم:.....

كم عدد الراشدين في أسرتك؟

كم عدد الأطفال في أسرتك؟

هل لديك خادمات في البيت؟ نعم ☐ لا ☐

كم عدد الخدم في بيتك؟

ما هو إجمالي دخل الأسرة الشهري؟

☐ 1000- 3000 درهم ☐ 3000- 7000 درهم ☐ أكثر من 7000 درهم

شكراً لمشاركتكم في هذه الدراسة

Appendix VII: Student's Questionnaire – English Version

Subject Number…….. Date of Questionnaire.....

Questionnaire for Students

Date of Birth:

Sex: Female ☐ Male ☐

Country of origin/Nationality?

Please tick the best answer for each section

Dietary Habits:

This part is to do with some specific questions about what and how often you eat and drink as well as your food preference.

How many times during a typical day do you have something to eat including schools hours?

11+ times per day	9-10 times per day	7-8 times per day	5-6 times per day	3-4 times per day	1-2 times per day

How many main meals do you have in a day?

1x ☐ 2x ☐ 3x ☐ 4x ☐

Do you have your main meals regularly?

Yes ☐ No ☐

Which do you have every day? (You can tick more than one)

Breakfast ☐ Lunch ☐ Dinner ☐ ll of them

How many times a day do you eat snacks?

0 ☐ 1x ☐ 2x ☐ 3x ☐ 4x ☐ >5x ☐

How often do you eat fast food (Macdonald/KFC/Pizza) in a week?

0 ☐ 1x ☐ 2x ☐ 3x ☐ >3x ☐

How often do you eat processed food (chicken nugget/hamburger/hotdog) in a week?

0 ☐ 1x ☐ 2x ☐ 3x ☐ >3x ☐

What is your food preference?

Vegetarian (Veg/Fruirts) ☐

Non-Vegetarian (meat products) ☐

Traditional food ☐

Fast foods ☐

Sweet & Carbohydrates ☐

How often do you eat the following?

(for each type of food, tick the box which applies)

	5+times per day	3-4 times per day	1-2 times per day	3-4 times per week	1-2 times per week	Never
Chocolate						
Candies or sweets						
Jelly beans						
Ice-Cream						
Sweet biscuits						
Dates						
Ice muncher						

Do you watch T.V while eating?

Yes ☐ No ☐

If Yes what do you eat mostly while watching T.V? Specify……..

Do you eat more when you are under tension/problem?

Yes ☐ No ☐

How many times a day do you eat fruits?

0 ☐ 1x ☐ 2x ☐ 3x ☐

How many times a day do you eat vegetables?

0 ☐ 1x ☐ 2x ☐ 3x ☐

How many times during a typical day do you have something to drink?

11+times per day ☐ 9-10 times per day ☐ 7-8 times per day ☐ 5-6 times per day ☐ 3-4 times per day ☐ 1-2 times per day ☐

How often do you usually drink the following?
(For each types of drink, tick the box which applies)

	5+times per day	3-4 times per day	1-2 times per day	3-4 times per week	1-2 times per week	Never
Soft drinks						
Natural fruit juice (eg Marmom, Maraai)						
Other fruit juices (eg Rani, Safa, Nictar)						
Milk						
Butter milk						
Tea with sugar						
Other drinks(please specify below)						

Physical Activity:

We wish to find out about how much exercise you do in any one day. Physical activity is any activity that increases your heart rate and makes you get out of breathe some of the time. Physical activity can be done in sports, playing with friends, or walking to school. Some examples of physical activity are running fast walking, biking, dancing, football, etc...

During a **typical or usual week**, on how many days are you physically active for a total of at least 30 minutes per day (at least 10 mins. at a stretch)?

0 days ☐ 1day ☐ 2 days ☐ 3 days ☐ 4 days ☐ 5 days ☐ 6 days ☐ 7days ☐

How many times in a week do you exercise?

0 ☐ 1x ☐ 2x ☐ 3x ☐

How long do you spend each time in exercise?

Half an hour ☐ an hour ☐ >1 hour ☐

Do you do any sport regularly? Yes ☐ No ☐

Are you involved in any Sports, games in school / School club?

Yes ☐ No ☐

If Yes specify……..

How do you get to school?

Walking ☐ private car ☐ school bus ☐

How many hours do you spent on walking each day?

Less than half an hour ☐ More than half an hour ☐

How much time do you spend during a typical or usual day sitting and watching television, playing computer games, talking with friends, or doing other sitting activities?

Less than 1 hour per day ☐ 1-2 hours per day ☐ 3-4 hours per day ☐

5-6 hours per day ☐ 7-8 hours per day ☐ >8 hours per day ☐

How many hours do you sleep?.....

Do you have any problem while sleeping?

Yes ☐ No ☐

If Yes specify……..

<u>Oral hygiene:</u>

We wish to find out about the practice of keeping your mouth, teeth and gums clean by asking when and how you clean your mouth

Do you brush your teeth?

Yes ☐ No ☐

If No what do you use to clean your teeth?

How often do you brush your teeth per day?

0 ☐ 1x ☐ 2x ☐ 3x ☐

When do you brush?

Morning ☐ Evening ☐ Morning & Evening ☐ Not at all ☐

Have you visited your dentist during last 12 month?

Yes ☐ No ☐

If yes specify the purpose of the visit……..

Fluoride use:

Do you use tooth paste?
Yes ☐ No ☐

If Yes specify……..
If No any other used instead……..

Did you ever use fluoride tablets?
Yes ☐ No ☐

If yes for how long?.....

Do you drink water? Yes ☐ No ☐

What kind of water do you drink?

Zulal bottled water ☐ Tap water ☐ other bottled water ☐

specify……

School Snacking:

*During a normal school week how many days per **week** do you?*

Bring food from home?

0 ☐ 1x ☐ 2x ☐ 3x ☐ 4x ☐ 5x ☐

Get snack from school cafeteria/canteen?

0 ☐ 1x ☐ 2x ☐ 3x ☐ 4x ☐ >5x ☐

Get soft drink from vending machine or canteen?

0 ☐ 1x ☐ 2x ☐ 3x ☐ 4x ☐ >5x ☐

*During a normal school day how many times per **days** do you?*

Get food/snack from school's canteen/cafeteria?

0 ☐ 1x ☐ 2x ☐ 3x ☐ >3x ☐

Get soft drink from vending machine/canteen?

0 ☐ 1x ☐ 2x ☐ 3x ☐ >3x ☐

Rosenberg Self-Esteem Scale

Instructions: Below is a list of statements dealing with your general feelings about yourself. If you strongly agree, circle SA. If you agree with the statement, circle A. If you disagree, circle D. If you strongly disagree, circle SD.

1.	**On the whole, I am satisfied with myself.**	**SA**	**A**	**D**	**SD**
2.*	**At times, I think I am no good at all.**	**SA**	**A**	**D**	**SD**
3.	**I feel that I have a number of good qualities.**	**SA**	**A**	**D**	**SD**
4.	**I am able to do things as well as most other people.**	**SA**	**A**	**D**	**SD**
5.*	**I feel I do not have much to be proud of.**	**SA**	**A**	**D**	**SD**
6.*	**I certainly feel useless at times.**	**SA**	**A**	**D**	**SD**
7.	**I feel that I'm a person of worth, at least on an equal plane with others.**	**SA**	**A**	**D**	**SD**
8.*	**I wish I could have more respect for myself.**	**SA**	**A**	**D**	**SD**
9.*	**All in all, I am inclined to feel that I am a failure.**	**SA**	**A**	**D**	**SD**
10.	**I take a positive attitude toward myself.**	**SA**	**A**	**D**	**SD**

Rosenberg M. Society and the adolescent self image
Princeton, NJ: Princeton University Press; 1965

Appendix VIII: Guardian Questionnaire – English Version

Subject Number…….. Date of Questionnaire.....

Questionnaire for Guardian

Kindly fill out the section below

For sections below, please provide us with you child's medical history and school performance

Medical History:

Does your child have any medical condition? Ye☐ No☐

If Yes specify……..

Does your child take any medication? Yes ☐ No ☐

If Yes specify……..

Is there any one in the family who you think is Overweight/Obese*?

Yes ☐ No ☐

If yes specify who……..

***overweight=weigh too much**
Obese=very fat

Student's performance:

Please tick the following items if there is any.

Trouble getting along with teachers…… ☐

Trouble getting along with other students…… ☐

Paying attention. …….. ☐

Getting home work done. …… ☐

Missing school. …….. ☐

Please specify

The number of absences last year?

The most common reason for being absent?

Number of absences due to mouth/teeth diseases?

Kindly provide us with family information

Family information/Details:

Occupation of:

a. Father: ……

b. Mother: ……..

Education:	No Education	Primary	Secondary	High School	College University
c. Father:	……..	……..	……..	……..	……..
d. Mother:	……..	……..	……..	……..	…….

Age of:

e. Father: ……

f. Mother: ……..

How many adults are in your household?

How many children are in your household?

Do you have Helper/Housemaid in the house? Yes ☐ No ☐

How many Helpers/Housemaids do you have?

What is the monthly total household income?

☐ Dhs 1000-3000 ☐ Dhs 3000-7000 ☐ More than Dhs7000

Thank you for participating in this study

Appendix IX: Clinical Examination Forms

BMI Measurement

Subject's Number…… ***Examination Date……***

Student's Name:

Date of Birth:

Sex: Female ☐ Male ☐

School's Name: Grades: Address:

School Type: Public ☐ Private ☐

Body Mass Index (BMI) Calculation

$$\frac{\textbf{Weight [kg]}}{\textbf{Height [m}^2\textbf{]}} = \textbf{BMI [kg/m}^2\textbf{]}$$

Date	
Age[years]	
Height[m]	
Weight[kg]	
BMI[kg/m^2]	

Reference

Body Mass Index reference curves for the UK, 1990(TJ Cole, JV Freeman, MA Preece. *Arch Dis Child* 1995; **73:**25-29

Establishing a standard definition for child overweight and obesity: international survey,
(Cole TJ, Bellizi MC, Deitz WH) *BMJ 2000;* **320:** 1240-3

Dental status/Caries Recording Form

Name_____ Date_____20___
Public/Private_____ Subject's Numb._____
School_____ Class_____
Age____ Boy [ ] Girl [ ] Examiner_____ Recorder_____

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

Permanent	
0	sound
1	decayed
2	Filled& decayed
3	Filled, decay
4	Missing due caries
5	Missing, other reason
6	sealant
7	Bridge abutment, crown
8	unerupted
9	excluded

World Health Organization. "Oral health survey - Basic method"
Fourth Edition. Geneva 1997

Oral cleanliness

Upper

	Right			Middle			Left		
Gums	0	1	9	0	1	9	0	1	9
Plaque	0	1	9	0	1	9	0	1	9

Lower

	Right			Middle			Left		
Gums	0	1	9	0	1	9	0	1	9
Plaque	0	1	9	0	1	9	0	1	9

British Association For the Study of Community dentistry (BASCD)
Criteria For Standard Clinical Assessment of Dental Health (1998/99)

WHO Criteria

Code			Condition/status
Primary teeth	Permanent teeth		
Crown	Crown	Root	
A	0	0	Sound
B	1	1	Decayed
C	2	2	Filled, with decay
D	3	3	Filled, no decay
E	4	-	Missing, as a result of caries
-	5	-	Missing, any other reason
F	6	-	Fissure sealant
G	7	7	Bridge abutment, special crown or veneer/implant
-	8	8	Unerupted tooth (crown)/unexposed root
T	T	-	Trauma (fracture)
-	9	9	Not recorded

***World Health Organization.**
"Oral health survey - Basic method"
Fourth Edition. Geneva 1997

BSCAD Criteria

Gums

Healthy (no treatment)……..0
Not healthy……..1
Assessment can not be made……9

Plaque

Non visible……0
Plaque visible……1
Assessment can not be made……..9

***British Association For the Study of Community Dentistry (BASCD)**
Criteria For Standard Clinical Assessment of Dental Health (1998/99)

Appendix X: Coding Variables

Diet

Variables	Coding
Eating frequency per day	1 = "1-2 times/day", 2 = "3-4 times/day", 3 = "5-6 times/day", 4 = "7-8 times/day", 5 = "9-10 times/day", 6 = "11+ times/day"
Main meal frequency per day	1= "one", 2 = "two", 3 = "three", 4 = "four"
Do you have main meals regularly?	1 = "yes", 2 = "no"
Has breakfast everyday	1 = "checked", 0 = "not checked"
Has lunch everyday	1 = "checked", 0 = "not checked"
Has dinner everyday	1 = "checked", 0 = "not checked"
Has all three meals everyday	1 = "checked", 0 = "not checked"
Times of snacks per day	0 = "none", 1 = "one", 2 = "two", 3 = "three", 4 = ">3"
Fast food frequency per week	0 = "none", 1 = "one", 2 = "two", 3 = "three", 4 = ">3"
Processed food frequency per week	0 = "none", 1 = "one", 2 = "two", 3 = "three", 4 = ">3"
Food preference: vegetarian	1 = "checked", 0 = "not checked"
Food preference: non-vegetarian	1 = "checked", 0 = "not checked"
Food preference: traditional food	1 = "checked", 0 = "not checked"
Food preference: fast food	1 = "checked", 0 = "not checked"
Food preference: sweets & carbs	1 = "checked", 0 = "not checked"
Eating frequency: chocolate	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Eating frequency: candy/sweets	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Eating frequency: jelly beans	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Eating frequency: ice cream	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Eating frequency: sweet biscuits	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"

Diet *(continued)*

Variables	Coding
Eating frequency: dates	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Eating frequency: ice muncher	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Watches TV while eating	1 = "yes", 2 = "no"
What do you eat while watching TV	0 = "none", 1 = "main meal", 2 = "snacks", 3 = "fruit & vegetables", 4 = "not mentioned"
Eat more under tension?	1 = "yes", 2 = "no"
No. of times subject eats fruit/day	0 = "none", 1 = "one", 2 = "two", 3 = "three"
No. of times subject eats vegetables/day	0 = "none", 1 = "one", 2 = "two", 3 = "three"
No. of times subject drinks per day	0 = "none", 1 = "one", 2 = "two", 3 = "three"
Drinking frequency: soft drinks	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Drinking frequency: natural fruit juice	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Drinking frequency: other fruit juices	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Drinking frequency: milk	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Drinking frequency: butter milk	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Drinking frequency: tea & sugar	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"
Drinking frequency: other drinks	0 = "never", 1 = "1-2 times/week", 2 = "3-4 times/week", 3 = "1-2 times/day", 4 = "3-4 times/day", 5 = "5+ times/day"

Physical activity

Variables	Coding
No. of times of exercise/week	0 = "none", 1 = "one", 2 = "two", 3 = "three"
Length of exercise	1 = "half an hour", 2 = "an hour", 3 = "> 1 hour"
Subject has a regular sport	1 = "yes", 2 = "no"
Involvement in sports at school	1 = "yes", 2 = "no"
Transportation to school	1 = "walking", 2 = "private car", 3 = "school bus"
Length of walking/day	0 = "not walking at all", 1 = "< half an hour", 2 = "> half an hour"
Length of sitting activities/day	1 = "< 1 hour/day", 2 = "1-2 hours/day", 3 = "3-4 hours/day", 4 = "5-6 hours/day", 5 = "7-8 hours/day", 6 = ">8 hours/day"
No. of hours of sleep	----------
Problems while sleeping?	1 = "yes", 2 = "no"
Specify sleeping problem	0 = "none", 1 = "health relevant", 2 = "others"

Oral Hygiene

Variables	Coding
Tooth brushing	1 = "yes", 2 = "no"
If no what used instead	String
Frequency of brushing/day	0 = "none", 1 = "one", 2 = "two", 3 = "three"
Brushing time	0 = "not at all", 1 = "morning", 2 = "evening", 3 = "morning & evening"
Visited the dentist in last 12 months	1 = "yes", 2 = "no"
Purpose of dental visit	1 = "Check-up", 2 = "Treatment", 3 = "Pain", 4 = "Ortho"
Use of tooth paste	1 = "yes", 2 = "no"
Use of fluoride tablets	1 = "yes", 2 = "no"
Drinks water?	1 = "yes", 2 = "no"
Type of water	1 = "Zulal bottled water", 2 = "tap water", 3 = "other bottled water"
If other specify	1 = "flouridated", 2 = "non-flouridated"

Guardian Questionnaire

Variables	Coding
Age	----------
Sex	1 = "male", 2 = "female"
Country of origin/nationality	1 = "Emirati", 2 = "Arab", 3 = "Indian subcontinent", 4 = "other"
School type	1 = "public", 2 = "private"
School price scale	0 = "free", 1 = "low price", 2 = "average price", 3 = "high price"
Does child have medical condition?	1 = "yes", 2 = "no"
Type of medical condition	1 = "Allergy (asthma, eczema)", 2 = "Blood disorder (anaemia, sickle cell, thalesemia)", 3 = "Congenital heart disease", 4 = "Diabetes", 5 = "Epilepsy & Nacturia"
Does your child take any medicine	1 = "yes", 2 = "no"
Name of drug	1 = "Relevant to disease", 2 = "Not relevant to disease"
Overweight/ obese family member(s)?	1 = "yes", 2 = "no"
Type of overweight/obese family member(s)?	1 = "Immediate family", 2 = "Not Immediate family"
Trouble getting along with teachers	1 = "checked", 0 = "not checked"
Trouble getting along with other students	1 = "checked", 0 = "not checked"
Pays attention	1 = "checked", 0 = "not checked"
Gets homework done	1 = "checked", 0 = "not checked"
Misses school	1 = "checked", 0 = "not checked"
Number of absences due to oral disease	----------
Father's occupation	1 = "Manager", 2 = "Professional Job", 3 = "Business, Self-employed", 4 = "Administrative Job", 5 = "Education associated professional", 6 = "Military & Police", 7 = "Elementary / Non-skilled job", 8 = "Unemployed /housewife"
Mother's occupation	1 = "Manager", 2 = "Professional Job", 3 = "Business, Self-employed" 4 = "Administrative Job", 5 = "Education associated professional", 6 = "Military & Police", 7 = "Elementary/ Non-skilled job", 8 = "Unemployed /housewife"

Guardian Questionnaire *(continued)*

Variables	Coding
Father's education	1 = "no education", 2 = "primary", 3 = "secondary", 4 = "high school", 5 = "college/university"
Mother's education	1 = "no education", 2 = "primary", 3 = "secondary", 4 = "high school", 5 = "college/university"
Father's age	----------
Mother's age	----------
No. of adults in household	----------
No. of children in household	----------
Helper/housemaid in the house?	1 = "yes", 2 = "no"
Monthly total household income	1 = "1000-3000 dhs", 2 = "3000-7000 dhs", 3 = "more than 7000 dhs"

Appendix XI: Information Sheet & Consent Forms

Dear parents,

I am pleased to inform you that the Ministry of Health in collaboration with Queen Mary University of London and the University of Sharjah are currently conducting a through evaluation on oral health of adolescents in the UAE.

The main objective of this project is to assess the association between oral health and body weight of UAE children attending private and public schools in the city of Sharjah.

If you agree that your child participate in this project, we will provide a highly professional and hygienic, free dental check-up using disposable dental instruments. In addition, measurement of your child's weight and height will be taken. If your child has any tooth decay that needs to be treated by a dentist will be informed verbally. These two assessments will not take more than 5-10 minutes.

The participants will be rewarded with tooth brush, paste and dental floss after proper oral hygiene instruction.

While we encourage your child to participate, the participation is voluntary and the refusal has no influence on his/her status as a student at the school.

Please note that all information will be kept confidential. Participants name will be replaced by codes, therefore, only Dr. Foroogh Abdalla Khadri (Paediatric Dentist) will have access to the original lists of participant name.

If you have any question or concern, please do not hesitate to contact

Dr. Foroogh Abdalla
BDS, M.Clin.Dent (UK)
Paediatric Dentist
PhD Researcher
Ph: 06-5057314

Agree ☐ Disagree ☐

Barts and The London
Queen Mary's School of Medicine and Dentistry

Oral Growth and Development
Institute of Dentistry

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Title of Study: _____

Queen Mary Research Ethics Committee Ref: _____

- Thank you for considering taking part in this research. The person organizing the research must explain the project to you before you agree to take part.
- If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.
- *I understand that if I decide at any other time during the research that I no longer wish to participate in this project, I can notify the researchers involved and be withdrawn from it immediately.*
- *I consent to the processing of my personal information for the purposes of this research study. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.*

Participant's Statement:

I _____ agree that the research project named above has been explained to me to my satisfaction and I agree to take part in the study. I have read both the notes written above and the Information Sheet about the project, and understand what the research study involves.

Signed: Date:

Investigator's Statement:

I _____ confirm that I have carefully explained the nature, demands and any foreseeable risks (where applicable) of the proposed research to the volunteer.

Signed: Date:

INFORMATION SHEET

Obesity and Oral Health in children

We would like to invite you to participate in this postgraduate/PhD research project. You should only participate if you want to; choosing not to take part will not disadvantage you in any way. Your decision will not affect your access to treatment or services. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. If you do decide to take part, please let us know beforehand if you have been involved in any other study during the last year.

This research is to investigate the relationship between obesity and the oral health in children aged 11-14, resident in Sharjah city.

The first part of the study will be to find out about you, your teeth and what you like to eat, how much physical activity you take and why. We would therefore like you to fill out a questionnaire about your eating and drinking habits (dietary habits), physical activity and mouth cleaning habits.

The second part of study is to carry out an examination or your mouth and to measure your height and weight. We will use simple procedures such as a probe and mirror to examine the teeth and gums and scales and tape measure to measure your height and weight. The whole procedure should take no longer than 20 minutes.

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect the standard of care you receive.

In the event of you suffering any adverse effects as a consequence of your participation in this study, you will be compensated through Queen Mary University of London's 'No Fault Compensation Scheme'.

The toothbrush and tooth paste we have given you is a gift to recognise the time spent in the study.

تقوم وزارة الصحة بالشارقة بالتعاون مع جامعة كوينز ماري بلندن و جامعة الشارقة بعمل دراسة هامة حو ل صحة الفم والأسنان في الإمارات لتوضيح العلاقة بين السمنة و صحة الفم و الأسنان لدى المراهقين .

وقد تم اختيار ابنكم /ابنتكم من ضمن 1000 طالب للمشاركة في هذه الدراسة.
بعد موافقتكم سيتم الكشف على أسنان ابنكم/ابنتكم (من غير عمل أشعة) بالإضافة الى قياس الوزن و الطول و سيتم اعلامكم اذا كانوا بحاجة الى أي علاج و سنقوم بتوزيع فرشاة أسنان ومعجون لكل طالب اشترك في الفحص بعد تثقيفهم بالطريقة الصحيحة لتنظيف الأسنان.

مشاركة طفلكم اختيارية و رفضها لن يؤثر على الوضع الدراسي للطالب .

المعلومات ستحاط بسرية تامة و لن يتم الاطلاع على أسماء المشاركين الا من قبل الدكتورة/ فروغ عبدالله خضري(أخصائية طب أسنان للأطفال) .

لأي تساؤل الرجاء عدم التردد بالاتصال بنا .
د/فروغ عبداللة خضري 5057314

أوافق ☐

لا أوافق ☐

Appendix XII: Dietary Habits

Table A: Food frequency and socio-demographic

Variables / Dietary Habits 1 Food frequency	Gender		P	School type		P	Income			P	Total N (%)
	Male N (%)	**Female** N (%)		**Public** N (%)	**Private** N (%)		**1000-3000 Dhs** N (%)	**3000-7000 Dhs** N (%)	**>7000 Dhs** N (%)		
Have main meal regularly											
Yes	258 (63.5)	217 (54.7)	NS	127 (47.2)	348 (65.2)	.000	43 (50.6)	138 (62.2)	294 (59.3)	NS	475 (59.2)
No	148 (36.5)	180 (45.3)		142 (52.8)	186 (34.8)		42 (39.4)	84 (37.8)	202 (40.7)		328 (40.8)
Have breakfast every day											
Yes	59 (14.5)	46 (11.6)	NS	36 (13.4)	69 (12.9)	NS	8 (9.4)	29 (13.1)	68 (13.7)	NS	105 (13.1)
No	347 (85.5)	351 (88.4)		233 (86.6)	465 (87.1)		77 (90.6)	193 (86.9)	428 (86.3)		698 (86.9)
Have lunch every day											
Yes	130 (32)	183 (46.1)	.000	117 (43.5)	196 (36.7)	NS	35 (41.2)	68 (30.6)	210 (42.3)	NS	313 (39)
No	276 (68)	214 (53.9)		152 (56.5)	338 (63.3)		50 (58.8)	154 (69.4)	286 (57.7)		490 (61)
Have dinner every day											
Yes	56 (13.8)	87 (21.9)	.003	73 (27.1)	70 (13.1)	.000	19 (22.4)	28 (12.6)	96 (19.4)	NS	143 (17.8)
No	350 (86.2)	310 (78.1)		196 (72.9)	464 (86.9)		66 (77.6)	194 (87.4)	400 (80.6)		660 (82.2)
Time of snack per day											
None	19 (4.7)	15 (3.8)		12 (4.5)	22 (4.1)		4 (4.7)	12 (5.4)	18 (3.6)		34 (4.2)
1X	107 (26.4)	134 (33.8)		79 (29.4)	162 (30.3)		27 (31.8)	75 (33.8)	139 (28)		241 (30)
2X	148 (36.5)	145 (36.5)	NS	98 (36.4)	195 (36.5)	NS	27 (31.8)	80 (36)	186 (37.5)	NS	293 (36.5)
3X	81 (20)	60 (15.1)		40 (14.9)	101 (18.9)		18 (21.2)	37 (16.7)	86 (17.3)		141 (17.6)
>3	51 (12.6)	43 (10.8)		40 (14.9)	54 (10.1)		9 (10.6)	18 (8.1)	67 (13.5)		94 (11.7)
Fast food / week											
None	79 (19.5)	68 (17.1)		41 (15.2)	106 (19.9)		18 (21.2)	58 (26.1)	71 (14.3)		147 (18.3)
1X	171 (42.1)	191 (48.1)		109 (40.5)	253 (47.4)		45 (52.9)	99 (44.6)	218 (44)		362 (45.1)
2X	82 (20.2)	82 (20.7)	NS	52 (19.3)	112 (21)	.000	11 (12.9)	36 (16.2)	117 (23.6)	.001	164 (20.4)
3X	37 (9.1)	31 (7.8)		36 (13.4)	32 (6)		5 (5.9)	19 (8.6)	44 (8.9)		68 (8.5)
>3	37 (9.1)	25 (6.3)		31 (11.5)	31 (5.8)		6 (7.1)	10 (4.5)	46 (9.3)		62 (7.7)
Processed food /week											
None	44 (10.8)	54 (13.6)		22 (8.2)	76 (14.2)		13 (15.3)	39 (17.6)	25 (11.3)		98 (12.2)
1X	144 (35.5)	133 (33.5)		78 (29)	199 (37.3)		29 (34.1)	84 (37.8)	164 (33.1)		277 (34.5)
2X	104 (25.6)	105 (26.4)	NS	69 (25.7)	140 (26.2)	.000	18 (21.2)	53 (23.9)	138 (27.8)	NS	209 (26)
3X	52 (12.8)	54 (13.6)		44 (16.4)	62 (11.6)		14 (16.5)	21 (9.5)	71 (14.3)		106 (13.2)
>3	62 (15.3)	51 (12.8)		56 (20.8)	57 (10.7)		11 (12.9)	25 (11.3)	77 (15.5)		113 (14.1)

Table A: Food frequency and socio-demographic *(continued)*

Variables / Dietary Habits 1 Food frequency	Father's Education					P	Mother's Education				
	None N (%)	**Primary** N (%)	**Secondary** N (%)	**High Sch.** N (%)	**College** N (%)		**None** N (%)	**Primary** N (%)	**Secondary** N (%)	**High Sch.** N (%)	**College** N (%)
Have main meal regularly											
Yes	16 (66.7)	39 (59.1)	42 (54.5)	103 (55.4)	264 (62)	NS	22 (64.7)	50 (57.5)	59 (59.6)	123 (56.4)	219 (60.8)
No	8 (33.3)	27 (40.9)	35 (45.5)	83 (44.6)	162 (38)		12 (35.3)	37 (42.5)	40 (40.4)	95 (43.6)	141 (39.2)
Have breakfast every day											
Yes	2 (8.3)	6 (9.1)	11 (14.3)	28 (15.1)	57 (13.4)	NS	2 (5.9)	7 (8)	10 (10.1)	38 (17.4)	47 (13.1)
No	22 (91.7)	60 (90.9)	66 (85.7)	158 (84.9)	369 (86.6)		32 (94.1)	80 (92)	89 (89.9)	180 (82.6)	313 (86.9)
Have lunch every day					176 (41.3)						
Yes	6 (25)	22 (33.3)	28 (36.4)	67 (360)	250 (58.7)	NS	12 (35.3)	29 (33.3)	37 (37.4)	80 (36.7)	151 (41.9)
No	18 (75)	44 (66.7)	49 (63.6)	119 (64)			22 (64.7)	58 (66.7)	62 (62.6)	138 (63.3)	209 (58.1)
Have dinner every day											
Yes	4 (16.7)	11 (16.7)	18 (23.4)	33 (17.7)	67 (15.7)	NS	6 (17.6)	16 (18.4)	13 (13.1)	38 (17.4)	67 (18.6)
No	20 (83.3)	55 (83.3)	59 (76.6)	153 (82.3)	359 (84.3)		28 (82.4)	71 (81.6)	86 (86.9)	180 (82.6)	293 (81.4)
Time of snack per day											
None	1 (4.2)	1 (1.5)	4 (5.2)	11 (5.9)	17 (4)		1 (2.9)	5 (5.7)	4 (4)	9 (4.1)	15 (4.2)
1X	7 (29.2)	25 (37.9)	25 (32.5)	62 (33.3)	118 (27.7)		10 (29.4)	28 (32.2)	33 (33.3)	69 (31.7)	100 (27.8)
2X	12 (50)	24 (36.4)	27 (35.1)	61 (32.8)	160 (37.6)	NS	17 (50)	38 (43.7)	33 (33.3)	76 (34.9)	126 (35)
3X	3 (12.5)	12 (18.2)	12 (15.6)	29 (15.6)	75 (17.6)		5 (14.7)	11 (12.6)	15 (15.2)	36 (16.5)	73 (20.3)
>3	1 (4.2)	4 (6.1)	9 (11.7)	23 (12.4)	56 (13.1)		1 (2.9)	5 (5.7)	14 (14.1)	28 (12.8)	73 (20.3)
Fast food / week											
None	3 (12.5)	15 (22.7)	17 (22.1)	34 (18.3)	78 (18.3)		9 (26.5)	19 (21.8)	19 (19.2)	42 (19.3)	58 (16.1)
1X	8 (33.3)	29 (43.9)	31 (40.3)	82 (44.1)	202 (47.4)		12 (35.3)	40 (46)	41 (41.4)	102 (46.8)	167 (46.4)
2X	6 (250	11 (16.7)	16 (20.8)	35 (18.8)	89 (20.9)	NS	5 (14.7)	19 (21.8)	16 (16.2)	41 (18.8)	80 (22.2)
3X	7 (29.2)	4 (6.1)	10 (13)	17 (9.1)	26 (6.1)		7 (20.6)	3 (3.4)	12 (12.1)	18 (8.3)	27 (7.5)
>3	0 (0)	7 (10.6)	3 (3.9)	18 (9.7)	31 (7.3)		1 (2.9)	6 (6.9)	11 (11.1)	15 (6.9)	28 (7.8)
Processed food /week											
None	2 (8.3)	10 (15.2)	10 (13)	20 (10.8)	55 (12.9)		4 (11.8)	13 (14.9)	15 (15.2)	25 (11.5)	40 (11.1)
1X	7 (29.2)	21 (31.8)	32 (41.6)	65 (34.9)	146 (34.3)		13 (38.2)	28 (32.2)	33 (33.3)	80 (36.7)	23 (34.2)
2X	5 (20.8)	14 (21.2)	15 (19.5)	50 (26.9)	116 (27.2)	NS	3 (17.6)	22 (25.3)	22 (22.2)	59 (27.1)	98 (27.2)
3X	4 (16.7)	4 (6.1)	10 (13)	31 (16.7)	53 (12.4)		4 (11.8)	8 (9.2)	9 (9.1)	29 (13.3)	54 (15)
>3	6 (25)	17 (25.8)	10 (13)	20 (10.8)	56 (13.1)		7 (20.6)	16 (18.4)	20 (20.2)	25 (11.5)	45 (12.5)

Table A: Food frequency and socio-demographic *(continued)*

Variables / Dietary Habits 1 Food frequency	Nationality				P
	Emirati N (%)	**Other Arabs** N (%)	**Indian Sub-continent** N (%)	**Others** N (%)	
Have main meal regularly					
Yes	168 (51.7)	145 (52.2)	109 (80.7)	53 (81.5)	.000
No	157 (48.3)	133 (47.8)	26 (19.3)	12 (18.5)	
Have breakfast every day					
Yes	41 (12.6)	49 (17.6)	12 (8.9)	3 (4.6)	NS
No	284 (87.4)	229 (82.4)	123 (91.1)	62 (95.4)	
Have lunch every day					
Yes	135 (41.5)	123 (44.2)	35 (25.6)	20 (30.8)	.001
No	190 (58.5)	155 (55.8)	100 (74.1)	45 (69.2)	
Have dinner every day					
Yes	79 (24.3)	38 (13.7)	18 (13.3)	8 (12.3)	.001
No	246 (75.7)	240 (86.3)	117 (86.7)	57 (87.7)	
Time of snack per day					
None	9 (2.8)	14 (5)	9 (6.7)	2 (3.1)	NS
1X	89 (27.4)	95 (34.2)	45 (33.3)	12 (18.5)	
2X	124 (38.2)	87 (31.3)	55 (40.7)	27 (41.5)	
3X	54 (16.6)	56 (20.1)	17 (12.6)	14 (21.5)	
>3	49 (15.1)	26 (9.4)	9 (6.7)	10 (15.4)	
Fast food / week					
None	44 (13.5)	58 (20.9)	35 (25.9)	10 (15.4)	.000
1X	130 (40)	134 (48.2)	64 (47.4)	34 (52.3)	
2X	75 (23.1)	51 (18.3)	23 (17)	15 (23.1)	
3X	39 (12)	18 (6.5)	5 (3.7)	6 (9.2)	
>3	37 (11.4)	17 (6.1)	8 (5.9)	0 (0)	
Processed food /week					
None	20 (6.2)	48 (17.3)	27 (20)	3 (4.6)	.000
1X	101 (31.1)	99 (35.6)	46 (34.1)	31 (47.7)	
2X	85 (26.2)	69 (24.8)	37 (27.4)	18 (27.7)	
3X	51 (15.7)	25 (9)	20 (14.8)	10 (15.4)	
>3	68 (20.9)	37 (13.3)	5 (3.7)	3 (4.6)	

Table B: Food preference and socio-demographic

Variables / Dietary Habits 2 Food preference	Gender		P	School type		P	Income			p
	Male N (%)	**Female** N (%)		**Public** N (%)	**Private** N (%)		**1000-3000 Dhs** N (%)	**3000-7000 Dhs** N (%)	**>7000 Dhs** N (%)	
Vegetarian										
Yes	188 (46.3)	164 (41.3)	NS	102 (62.1)	250 (46.8)	NS	44 (51.8)	102 (45.9)	260 (41.5)	NS
No	218 (53.7)	233 (58.7)		167 (37.9)	284 (53.2)		41 (48.2)	120 (54.1)	290 (58.5)	
Non-vegetarian										
Yes	170 (41.9)	97 (24.4)	.000	71 (26.4)	196 (36.7)	.003	27 (31.8)	79 (35.6)	161 (32.5)	NS
No	236 (58.1)	300 (75.6)		198 (36.7)	338 (63.3)		58 (68.2)	143 (64.4)	335 (67.5)	
Traditional										
Yes	195 (48)	171 (43.1)	NS	110 (40.9)	256 (47.9)	NS	39 (45.9)	101 (45.5)	226 (45.6)	NS
No	211 (52)	226 (56.9)		159 (59.1)	278 (52.1)		46 (54.1)	121 (54.5)	270 (54.4)	
Fast food										
Yes	169 (41.6)	162 (40.8)	NS	134 (49.8)	197 (36.9)	.000	37 (43.5)	73 (32.9)	221 (44.6)	NS
No	237 (58.4)	235 (59.2)		135 (50.2)	337 (63.1)		48 (56.5)	149 (67.1)	275 (55.4)	
Sweet & carbohydrate										
Yes	129 (31.8)	135 (34)	NS	112 (41.6)	152 (28.5)	.000	28 (32.9)	71 (32)	165 (33.3)	NS
No	227 (68.2)	262 (66)		157 (58.4)	382 (71.5)		57 (67.1)	151 (68)	331 (66.7)	
Fruits /day										
None	26 (6.4)	35 (8.8)	.001	30 (11.2)	31 (5.8)	.000	8 (9.4)	10 (4.5)	43 (8.7)	NS
1X	152 (37.4)	186 (46.9)		131 (48.7)	207 (38.8)		38 (44.7)	93 (41.9)	207 (41.7)	
2X	118 (29.1)	113 (28.5)		56 (20.8)	175 (32.8)		17 (20)	82 (36.9)	132 (26.6)	
3X	110 (27.1)	63 (15.9)		52 (19.3)	121 (22.7)		22 (25.9)	37 (16.7)	114 (23)	
Vegatables /day										
None	57 (14)	72 (18.1)	NS	60 (22.3)	69 (12.9)	.000	13 (15.3)	29 (13.1)	87 (17.5)	NS
1X	159 (39.2)	173 (43.6)		122 (45.4)	210 (39.3)		31 (36.5)	94 (42.3)	207 (41.7)	
2X	124 (30.5)	107 (27)		60 (22.3)	171 (32)		28 (32.9)	65 (29.3)	138 (27.8)	
3X	66 (16.3)	45 (11.3)		27 (10)	84 (15.7)		13 (15.3)	34 (15.3)	64 (12.9)	
TV while eating										
Yes	330 (81.3)	302 (76.1)	NS	229 (85.1)	403 (75.5)	.002	67 (78.8)	161 (72.5)	404 (81.5)	NS
No	76 (18.7)	95 (23.9)		40 (14.9)	131 (24.5)		18 (21.2)	61 (27.5)	92 (18.5)	

Table B: Food preference and socio-demographic *(continued)*

Variables / Dietary Habits 2 Food frequency	Father's Education					P	Mother's Education				
	None N (%)	**Primary** N (%)	**Secondary** N (%)	**High Sch.** N (%)	**College** N (%)		**None** N (%)	**Primary** N (%)	**Secondary** N (%)	**High Sch.** N (%)	**College** N (%)
Vegetarian											
Yes	11 (45.8)	39 (59.1)	33 (42.9)	77 (41.4)	184 (43.2)	NS	17 (50)	46 (52.9)	45 (45.5)	99 (45.4)	144 (40)
No	13 (54.2)	27 (40.9)	44 (57.1)	109 (58.6)	242 (56.8)		17 (50)	41 (47.1)	54 (54.5)	119 (54.6)	216 (60)
Non-vegetarian											
Yes	6 (25)	20 (30.3)	19 (24.7)	63 (33.9)	154 (36.2)	NS	12 (35.3)	23 (26.4)	25 (25.3)	71 (32.6)	135 (37.5)
No	18 (75)	46 (69.7)	58 (75.3)	123 (66.1)	272 (63.8)		22 (64.7)	64 (73.6)	74 (74.7)	147 (67.4)	225 (62.5)
Traditional											
Yes	4 (16.7)	28 (42.4)	36 (46.8)	79 (42.5)	212 (49.8)	NS	10 (29.4)	45 (51.7)	37 (37.4)	98 (45)	175 (48.6)
No	20 (83.3)	38 (57.6)	41 (53.2)	107 (57.5)	214 (50.2)		24 (70.6)	42 (48.3)	62 (62.6)	120 (55)	185 (51.4)
Fast food											
Yes	14 (58.3)	25 (37.9)	34 (44.2)	78 (41.9)	171 (40.1)	NS	14 (41.2)	36 (41.4)	35 (35.4)	89 (40.8)	152 (42.2)
No	10 (41.7)	41 (62.1)	43 (55.8)	108 (58.1)	255 (59.9)		20 (58.8)	51 (58.6)	64 (64.6)	129 (59.2)	208 (57.8)
Sweet & carbohydrate											
Yes	9 (37.5)	19 (28.8)	24 (31.2)	68 (36.6)	138 (32.4)	NS	13 (38.2)	26 (29.9)	23 (23.2)	86 (39.4)	113 (31.4)
No	15 (62.5)	47 (71.2)	53 (68.8)	118 (63.4)	288 (67.6)		21 (61.8)	61 (70.1)	76 (76.8)	132 (60.6)	247 (68.6)
Fruits /day											
None	2 (8.3)	9 (13.6)	7 (9.1)	11 (5.9)	30 (7)		3 (8.8)	5 (5.7)	7 (7.1)	15 (6.9)	29 (8.1)
1X	13 (54.2)	20 (30.3)	33 (42.9)	88 (47.3)	169 (39.7)	NS	16 (47.1)	40 (46)	38 (38.4)	96 (44)	145 (40.3)
2X	4 (16.7)	25 (37.9)	22 (28.6)	47 (25.3)	129 (30.3)		8 (23.5)	19 (21.8)	37 (37.4)	65 (29.8)	102 (28.3)
3X	5 (20.8)	12 (18.2)	15 (19.5)	40 (21.5)	98 (23)		7 (20.6)	23 (26.4)	17 (17.2)	42 (19.3)	84 (23.3)
Vegatables /day											
None	3 (12.5)	8 (12.1)	14 (18.2)	33 (17.7)	65 (15.3)		5 (14.7)	12 (13.8)	17 (17.2)	35 (16.1)	57 (15.8)
1X	12 (50)	32 (48.5)	36 (46.8)	76 (40.9)	163 (38.3)	NS	15 (44.1)	42 (48.3)	39 (39.4)	92 (42.2)	143 (39.7)
2X	7 (29.2)	21 (31.8)	16 (20.8)	51 (27.4)	133 (31.2)		10 (29.4)	23 (26.4)	30 (30.3)	61 (28)	106 (29.4)
3X	2 (8.3)	5 (7.6)	11 (14.3)	26 (14)	65 (15.3)		4 (11.8)	10 (11.5)	13 (13.1)	30 (13.8)	54 (15)
TV while eating											
Yes	19 (79.2)	54 (81.8)	66 (85.7)	153 (82.3)	320 (75.1)	NS	27 (79.4)	69 (79.3)	76 (76.8)	180 (82.6)	275 (76.4)
No	5 (20.8)	12 (18.2)	11 (14.3)	33 (17.7)	106 (24.9)		7 (20.6)	18 (20.7)	23 (23.2)	38 (17.4)	85 (23.6)

Table B: Food preference and socio-demographic *(continued)*

Variables / Dietary Habits 2 Food Preference	Nationality				P
	Emirati N (%)	**Other Arabs** N (%)	**Indian Sub-continent** N (%)	**Others** N (%)	
Vegetarian					
Yes	123 (37.8)	140 (50.4)	60 (44.4)	29 (44.6)	NS
No	202 (62.2)	138 (49.6)	75 (55.6)	36 (55.4)	
Non-Vegetarian					
Yes	85 (26.2)	73 (26.3)	71 (52.6)	38 (58.5)	.000
No	240 (73.8)	205 (73.7)	64 (47.4)	27 (41.5)	
Traditional					
Yes	138 (42.5)	142 (51.1)	61 (45.2)	25 (38.5)	NS
No	187 (57.5)	136 (48.9)	74 (54.8)	40 (61.5)	
Fast food					
Yes	161 (49.5)	109 (39.2)	43 (31.9)	18 (27.7)	.000
No	164 (50.5)	169 (60.8)	92 (68.1)	47 (72.3)	
Sweet & carbohydrate					
Yes	134 (41.2)	80 (28.8)	31 (23)	19 (29.2)	.000
No	191 (58.8)	198 (71.2)	104 (77)	46 (70.8)	
Fruits/day					
None	37 (11.4)	19 (6.8)	3 (2.2)	2 (3.1)	.000
1x	156 (48)	114 (41)	52 (38.5)	16 (24.6)	
2x	65 (20)	85 (30.6)	55 (40.7)	26 (40)	
3X	67 (20.6)	60 (21.6)	25 (18.5)	21 (32.3)	
Vegetables/day					
None	69 (21.2)	46 (16.5)	10 (7.4)	4 (6.2)	.000
1x	152 (46.8)	111 (39.9)	46 (34.1)	23 (35.4)	
2x	72 (22.2)	79 (28.4)	55 (40.7)	25 (38.5)	
3X	32 (9.8)	42 (15.1)	24 (17.8)	13 (20)	
T.V while eating					
Yes	273 (84)	230 (82.7)	85 (63)	44 (67.7)	.000
No	52 (16)	48 (17.3)	50 (37)	21 (32.3)	

Table C: Drinking frequency and socio-demographic

Variables / Dietary Habits 3 Drinking frequency	Gender		P	School type		P	Income			p
	Male N (%)	**Female** N (%)		**Public** N (%)	**Private** N (%)		**1000-3000 Dhs** N (%)	**3000-7000 Dhs** N (%)	**>7000 Dhs** N (%)	
Soft drinks										
Never	25 (8.6)	29 (7.3)		17 (6.3)	47 (8.8)		2 (2.4)	22 (9.9)	40 (8.1)	
1-2 times/week	107 (26.4)	63 (41.1)		71 (26.4)	199 (37.3)		33 (38.8)	73 (32.9)	164 (33.1)	
3-4 times/week	55 (13.5)	52 (13.1)	.000	35 (13)	72 (13.5)	.001	9 (10.6)	26 (11.7)	72 (14.5)	NS
1-2 times/day	128 (31.5)	10 (27.7)		88 (32.7)	150 (28.1)		25 (29.4)	69 (31.1)	144 (29)	
3-4 times/day	47 (11.6)	26 (6.5)		37 (13.8)	36 (6.7)		9 (10.6)	23 (10.4)	41 (8.3)	
5+ times/day	34 (8.4)	17 (4.3)		21 (7.8)	30 (5.6)		7 (8.2)	9 (4.1)	35 (7.1)	
Natural fruit juice										
Never	44 (10.8)	75 (18.9)		44 (16.4)	75 (14)		16 (18.8)	33 (14.9)	70 (14.1)	
1-2 times/week	107 (26.4)	122 (30.7)		71 (26.4)	158 (29.6)		29 (34.1)	62 (27.9)	138 (27.8)	
3-4 times/week	71 (17.5)	53 (13.4)	.000	37 (13.8)	87 (16.3)	NS	12 (14.1)	32 (14.4)	80 (16.1)	NS
1-2 times/day	112 (27.6)	111 (28)		76 (28.3)	147 (27.5)		16 (18.8)	64 (28.8)	143 (28.8)	
3-4 times/day	43 (10.6)	23 (5.8)		23 (8.6)	43 (8.1)		6 (7.1)	21 (9.5)	39 (7.9)	
5+ times/day	29 (7.1)	13 (3.3)		18 (6.7)	24 (4.5)		6 (7.1)	10 (4.5)	26 (5.2)	
Other fruit juice										
Never	72 (17.7)	90 (22.7)		66 (24.5)	96 (18)		13 (15.3)	40 (18)	109 (22)	
1-2 times/week	109 (26.8)	141 (35.5)		62 (23)	188 (35.2)		32 (37.6)	75 (33.8)	143 (28.8)	
3-4 times/week	69 (17)	56 (14.1)	.000	41 (15.2)	84 (15.7)	NS	9 (10.6)	36 (16.2)	80 (16.1)	NS
1-2 times/day	91 (22.4)	87 (21.9)		67 (24.9)	111 (20.8)		15 (17.6)	48 (21.6)	115 (23.2)	
3-4 times/day	39 (9.6)	11 (2.8)		17 (6.3)	33 (6.2)		7 (8.2)	13 (5.9)	30 (6)	
5+ times/day	26 (6.4)	12 (3)		16 (5.9)	22 (4.1)		9 (10.6)	10 (4.5)	19 (3.8)	
Milk										
Never	54 (13.3)	113 (28.5)		68 (25.3)	99 (18.5)		19 (22.4)	55 (24.8)	93 (18.8)	
1-2 times/week	72 (17.7)	89 (22.4)		54 (20.1)	107 (20)		16 (18.8)	42 (18.9)	103 (20.8)	
3-4 times/week	49 (12.1)	31 (7.8)	.000	32 (11.9)	48 (9)	NS	11 (12.9)	21 (9.5)	48 (9.7)	NS
1-2 times/day	140 (34.5)	119 (28)		68 (25.3)	183 (34.3)		29 (34.1)	67 (30.2)	155 (31.2)	
3-4 times/day	45 (11.1)	29 (7.3)		25 (9.3)	49 (9.2)		6 (7.1)	19 (8.6)	49 (9.9)	
5+ times/day	46 (11.3)	24 (6)		22 (8.2)	48 (9)		4 (4.7)	18 (8.1)	48 (9.7)	
Tea &Sugar										
Never	99 (24.4)	164 (41.3)		80 (29.7)	183 (34.3)		24 (28.2)	73 (32.9)	166 (33.5)	
1-2 times/week	92 (22.7)	97 (24.4)		67 (24.9)	122 (22.8)		20 (23.5)	43 (19.4)	126 (25.4)	
3-4 times/week	42 (10.3)	31 (7.8)	.000	23 (8.6)	50 (9.4)	NS	8 (9.4)	15 (6.8)	50 (10.1)	NS
1-2 times/day	108 (26.6)	79 (19.9)		62 (23)	125 (23.4)		21 (24.7)	66 (29.7)	100 (20.2)	
3-4 times/day	36 (8.9)	17 (4.3)		20 (7.4)	33 (6.2)		6 (7.1)	16 (7.2)	31 (6.2)	
5+ times/day	29 (7.1)	9 (2.3)		17 (6.3)	21 (3.9)		6 (7.1)	9 (4.1)	23 (4.6)	

Table C: Drinking frequency and socio-demographic *(continued)*

Variables / Dietary Habits 3 Drinking frequency	Father's Education					P	Mother's Education				
	None N (%)	**Primary** N (%)	**Secondary** N (%)	**High Sch.** N (%)	**College** N (%)		**None** N (%)	**Primary** N (%)	**Secondary** N (%)	**High Sch.** N (%)	**College** N (%)
Soft drinks											
Never	1 (4.2)	7 (10.6)	5 (6.5)	12 (6.5)	37 (8.7)		2 (5.9)	8 (9.2)	5 (5.1)	14 (6.4)	35 (9.7)
1-2 times/week	13 (54.2)	24 (36.4)	17 (22.1)	62 (33.3)	163 (38.3)		9 (26.5)	24 (27.6)	27 (27.3)	74 (33.9)	136 (37.8)
3-4 times/week	3 (12.5)	4 (6.1)	12 (15.6)	19 (10.2)	66 (15.5)		4 (11.8)	12 (13.8)	14 (14.1)	18 (8.3)	59 (16.4)
1-2 times/day	13 (54.2)	24 (36.4)	31 (40.3)	54 (29)	108 (25.4)	.007	15 (44.1)	27 (31)	32 (32.3)	73 (33.5)	90 (25)
3-4 times/day	4 (16.7)	6 (9.1)	6 (7.8)	21 (11.3)	31 (7.3)		3 (8.8)	8 (9.2)	12 (12.1)	24 (11)	24 (6.7)
5+ times/day	1 (4.2)	5 (7.6)	6 (7.8)	18 (9.7)	21 (4.9)		1 (2.9)	8 (9.2)	9 (9.1)	15 (6.9)	16 (4.4)
Natural fruit juice											
Never	4 (16.7)	12 (18.2)	14 (18.2)	24 (12.9)	63 (14.8)		3 (8.8)	18 (20.7)	11 (11.1)	32 (14.7)	54 (15)
1-2 times/week	11 (45.8)	17 (25.8)	19 (24.7)	55 (29.6)	117 (27.5)		15 (44.1)	21 (24.1)	30 (30.3)	63 (28.9)	99 (27.5)
3-4 times/week	2 (8.3)	11 (16.7)	11 (14.3)	26 (140)	69 (16.2)		3 (8.8)	10 (11.5)	14 (14.1)	36 (16.5)	59 (16.4)
1-2 times/day	5 (20.8)	21 (31.8)	20 (26)	39 (21)	87 (20.4)	NS	8 (23.5)	23 (26.4)	30 (30.3)	55 (25.2)	106 (29.4)
3-4 times/day	1 (4.2)	6 (9.1)	4 (5.2)	18 (9.7)	21 (4.9)		4 (11.8)	8 (9.2)	9 (9.1)	20 (9.2)	25 (6.9)
5+ times/day	1 (4.2)	4 (6.1)	7 (9.1)	8 (4.3)	22 (5.2)		1 (2.9)	7 (8)	5 (5.1)	12 (5.5)	17 (4.7)
Other fruit juice											
Never	4 (4.8)	7 (10.6)	16 (20.8)	38 (20.4)	92 (21.6)		5 (14.7)	18 (20.7)	17 (17.2)	45 (20.6)	76 (21.1)
1-2 times/week	6 (25)	16 (24.2)	17 (22.1)	56 (30.1)	149 (35)		7 (20.6)	19 (21.8)	30 (30.3)	63 (28.9)	130 (36.1)
3-4 times/week	7 (29.2)	10 (15.2)	15 (19.5)	27 (14.5)	60 (14.1)		8 (23.5)	11 (12.6)	14 (14.1)	36 (16.5)	56 (15.6)
1-2 times/day	5 (20.8)	21 (31.8)	20 (26)	39 (21)	87 (20.4)	NS	10 (29.4)	25 (28.7)	26 (26.3)	47 (21.6)	68 (18.9)
3-4 times/day	1 (4.2)	6 (9.1)	4 (5.2)	18 (9.7)	21 (4.9)		2 (5.9)	7 (8)	7 (7.1)	20 (9.2)	13 (3.6)
5+ times/day	1 (4.2)	6 (9.1)	5 (6.5)	8 (4.3)	17 (4)		2 (5.9)	7 (8)	5 (5.1)	7 (3.2)	17 (4.7)
Milk											
Never	6 (25)	14 (21.2)	19 (24.7)	37 (19.9)	84 (19.7)		8 (23.5)	22 (25.3)	22 (22.2)	51 (23.4)	62 (17.2)
1-2 times/week	7 (29.2)	9 (13.6)	10 (13)	51 (27.4)	76 (17.8)		8 (23.5)	20 (23)	16 (16.2)	44 (20.2)	71 (19.7)
3-4 times/week	2 (8.3)	11 (16.7)	6 (7.8)	19 (10.2)	39 (9.2)		4 (11.8)	8 (9.2)	10 (10.1)	23 (10.6)	34 (9.4)
1-2 times/day	6 (25)	18 (27.3)	26 (33.8)	48 (25.8)	150 (35.2)	NS	9 (26.5)	22 (25.3)	39 (39.4)	60 (27.5)	121 (33.6)
3-4 times/day	1 (4.2)	8 (12.1)	8 (10.4)	14 (7.5)	42 (9.9)		3 (8.8)	8 (9.2)	5 (5.1)	19 (8.7)	39 (10.8)
5+ times/day	2 (8.3)	6 (9.1)	8 (10.4)	17 (9.1)	35 (8.2)		2 (5.9)	7 (8)	7 (7.1)	21 (9.6)	33 (9.2)
Tea &Sugar											
Never	7 (29.2)	24 (36.4)	16 (20.8)	58 (31.2)	151 (35.4)		12 (35.3)	27 (31)	26 (26.3)	69 (31.7)	126 (35)
1-2 times/week	2 (8.3)	9 (13.6)	21 (27.3)	48 (25.8)	103 (24.2)		6 (17.6)	13 (14.9)	16 (16.2)	61 (28)	93 (25.8)
3-4 times/week	4 (16.7)	5 (7.6)	6 (7.8)	18 (9.7)	38 (8.9)		3 (8.8)	5 (5.7)	11 (11.1)	22 (10.1)	31 (8.6)
1-2 times/day	7 (29.2)	16 (24.2)	24 (31.2)	42 (22.6)	91 (21.4)	NS	9 (26.5)	28 (32.2)	31 (31.3)	45 (20.6)	73 (20.3)
3-4 times/day	2 (8.3)	5 (7.6)	6 (7.8)	18 (9.7)	38 (8.9)		3 (8.8)	7 (8)	9 (9.1)	12 (5.5)	22 (6.1)
5+ times/day	2 (8.3)	9 (13.6)	4 (5.2)	10 (5.4)	26 (6.1)		1 (2.9)	7 (8)	6 (6.1)	9 (4.1)	15 (4.2)

Table C: Drinking frequency and socio-demographic *(continued)*

Variables / Dietary Habits 3 Drinking frequency	**Nationality**				**P**
	Emirati N (%)	**Other Arabs** N (%)	**Indian Sub-continent** N (%)	**Others** N (%)	
Soft drinks					
Never	19 (5.8)	20 (7.2)	19 (14.1)	6 (9.2)	.000
1-2 times/week	87 (26.8)	99 (35.6)	58 (43)	26 (40)	
3-4 times/week	43 (13.2)	34 (12.2)	21 (15.6)	9 (13.8)	
1-2 times/day	107 (32.9)	89 (32)	25 (18.5)	17 (26.2)	
3-4 times/day	43 (13.2)	16 (5.8)	7 (5.2)	7 (10.8)	
5+ times/day	26 (8)	20 (7.2)	5 (3.7)	0 (0)	
Natural fruit juice					
Never	52 (16)	36 (12.9)	28 (20.7)	3 (4.6)	NS
1-2 times/week	88 (27.1)	86 (30.9)	34 (25.2)	21 (32.3)	
3-4 times/week	49 (15.1)	42 (15.1)	23 (17)	10 (15.4)	
1-2 times/day	90 (27.7)	76 (27.3)	38 (28.1)	19 (29.2)	
3-4 times/day	25 (7.7)	23 (8.3)	8 (5.9)	10 (15.4)	
5+ times/day	21 (6.5)	15 (5.4)	4 (3)	2 (3.1)	
Other fruit juice					
Never	68 (20.9)	56 (20.1)	25 (18.5)	13 (20)	NS
1-2 times/week	91 (28)	88 (31.7)	54 (40)	17 (26.2)	
3-4 times/week	51 (15.7)	34 (12.2)	26 (19.3)	14 (21.5)	
1-2 times/day	73 (22.5)	64 (23)	26 (19.3)	15 (23.1)	
3-4 times/day	26 (8)	15 (5.4)	3 (2.2)	6 (9.2)	
5+ times/day	16 (4.9)	21 (7.6)	1 (0.7)	0 (0)	
Milk					
Never	79 (23.4)	74 (26.6)	13 (9.6)	4 (6.2)	.000
1-2 times/week	66 (20.3)	54 (19.4)	30 (22.2)	11 (16.9)	
3-4 times/week	34 (10.5)	31 (11.2)	8 (5.9)	7 (10.8)	
1-2 times/day	93 (28.6)	74 (26.6)	58 (43)	26 (40)	
3-4 times/day	29 (8.9)	22 (7.9)	11 (8.1)	12 (18.5)	
5+ times/day	27 (8.3)	23 (8.3)	15 (11.1)	5 (7.7)	
Tea &Sugar					
Never	102 (31.4)	80 (28.8)	57 (42.2)	24 (36.9)	NS
1-2 times/week	79 (24.3)	68 (24.5)	29 (21.5)	13 (20)	
3-4 times/week	28 (8.6)	31 (11.2)	5 (3.7)	9 (13.8)	
1-2 times/day	72 (22.2)	67 (24.1)	36 (26.7)	12 (18.5)	
3-4 times/day	25 (7.7)	16 (5.8)	6 (4.4)	6 (9.2)	
5+ times/day	19 (5.8)	16 (5.8)	2 (1.5%)	1 (1.5%)	

Appendix XIII: Physical Activity

Table A: Physical activity and socio-demographic

Variables Physical Activity	Gender		P	School type		P	Income			P	Total N (%)
	Male N (%)	**Female** N (%)		**Public** N (%)	**Private** N (%)		**1000-3000 Dhs** N (%)	**3000-7000 Dhs** N (%)	**>7000 Dhs** N (%)		
Number of Exercise/Week											
No	29 (7.1)	40 (10.1)		25 (9.3)	44 (8.2)		6 (7.1)	28 (12.6)	35 (7.1)		69 (8.6)
1X	76 (18.7)	150 (37.8)	.000	72 (26.8)	154 (28.8)	NS	29 (34.1)	65 (29.3)	132 (26.6)	.029	226 (28.1)
2X	115 (28.3)	107 (27)		75 (27.9)	147 (35.4)		26 (30.6)	64 (28.8)	132 (26.6)		222 (27.6)
3X	186 (45.8)	100 (25.2)		97 (36.1)	189 (35.4)		24 (28.2)	65 (29.3)	97 (39.7)		286 (35.6)
Regular Exercise											
Yes	268 (66)	154 (38.8)	.000	119 (44.2)	303 (56.7)	.001	36 (42.4)	105 (47.3)	281 (56.7)	.009	422 (52.6)
No	138 (34)	243 (61.2)		150 (55.8)	231 (43.3)		49 (57.6)	117 (52.7)	215 (43.3)		381 (47.4)
Transport to school											
Walk	26 (6.4)	3 (0.8)		11 (4.1)	18 (3.4)		2 (2.4)	10 (4.5)	17 (3.4)		29 (3.6)
Bus	229 (56.4)	242 (61)	.000	137 (50.9)	334 (62.5)	.007	53 (62.4)	156 (70.3)	262 (52.8)	.000	471 (58.7)
Car	151 (37.2)	152 (38.3)		121 (45)	182 (34.1)		30 (35.3)	56 (25.2)	217 (43.8)		303 (37.7)
Sedentary Activity											
<1h/Day	55 (13.5)	55 (13.9)		26 (9.7)	84 (15.7)		9 (10.6)	40 (18)	61 (12.3)		110 (13.7)
1-2h/Day	145 (35.7)	121 (30.5)		70 (26)	196 (36.7)		28 (32.9)	90 (40.5)	148 (29.8)		266 (33.1)
3-4h/Day	94 (23.2)	117 (29.5)	NS	77 (28.6)	134 (25.1)	.000	21 (24.7)	52 (23.4)	138 (27.8)	NS	211 (26.3)
5-6h/day	57 (14)	41 (10.3)		39 (14.5)	59 (11)		14 (16.5)	21 (9.5)	63 (12.7)		98 (12.2)
7-8h/Day	23 (5.7)	23 (5.8)		20 (7.4)	26 (4.9)		3 (4.9)	8 (3.6)	35 (7.1)		46 (5.7)
>8h/day	32 (7.9)	40 (10.1)		37 (13.8)	35 (6.6)		10 (11.8)	11 (5)	51 (10.3)		72 (9)

Table A: Physical activity and socio-demographic *(continued)*

Variables Physical Activity	Father's Education					P	Mother's Education					P
	None N (%)	**Primary** N (%)	**Secondary** N (%)	**High Sch.** N (%)	**College** N (%)		**None** N (%)	**Primary** N (%)	**Secondary** N (%)	**High Sch.** N (%)	**College** N (%)	
Number of Exercise/Week												
None	5 (14.7)	9 (10.3)	10 (10.1)	14 (6.4)	31 (8.6)		4 (16.7)	4 (6.1)	6 (7.8)	18 (9.7)	34 (8)	
1X	11 (32.4)	20 (23)	22 (22.2)	67 (30.7)	104 (28.9)	NS	4 (16.7)	23 (34.8)	20 (26)	47 (25.3)	126 (29.6)	NS
2X	6 (17.6)	33 (37.9)	31 (31.3)	55 (25.2)	96 (26.7)		8 (33.3)	18 (27.3)	17 (22.1)	54 (29)	116 (27.2)	
3X	12 (35.3)	25 (28.7)	36 (36.4)	82 (37.6)	129 (35.8)		8 (33.3)	21 (31.8)	34 (44.2)	67 (36)	150 (35.2)	
Regular Exercise												
Yes	15 (44.1)	45 (51.7)	52 (52.5)	106 (48.6)	201 (55.8)	NS	12 (50)	32 (48.5)	45 (58.4)	91 (48.9)	232 (54.5)	NS
No	19 (55.9)	42 (48.3)	47 (47.5)	112 (51.4)	159 (44.2)		12 (50)	34 (51.5)	32 (41.6)	95 (51.1)	194 (45.5)	
Transport to school												
Walk	1 (2.9)	6 (6.9)	4 (4)	9 (4.1)	9 (2.5)		0 (0)	5 (7.6)	6 (7.8)	6 (3.2)	12 (2.8)	
Bus	19 (55.9)	51 (69)	59 (59.6)	125 (57.3)	205 (56.9)	NS	13 (54.2)	39 (59.1)	49 (63.6)	118 (63.4)	235 (55.2)	NS
Car	14 (41.2)	21 (24.1)	36 (36.4)	84 (38.5)	146 (40.6)		11 (45.8)	22 (33.3)	22 (28.6)	62 (33.3)	179 (42)	
Sedentary Activity												
<1h/Day	3 (8.8)	12 (13.8)	12 (12.1)	26 (11.9)	57 (15.8)		3 (12.5)	7 (10.6)	7 (9.1)	25 (13.4)	65 (15.3)	
1-2h/Day	12 (35.3)	25 (28.7)	40 (40.4)	68 (31.2)	119 (33.1)		9 (37.5)	20 (30.3)	29 (37.7)	61 (32.8)	140 (32.9)	
3-4h/Day	10 (29.4)	27 (31)	22 (22.2)	59 (27.1)	92 (25.6)	NS	6 (25)	19 (28.8)	22 (28.6)	45 (24.2)	109 (25.6)	NS
5-6h/day	4 (11.8)	12 (13.8)	10 (10.1)	31 (14.2)	41 (11.4)		3 (12.5)	9 (13.6)	9 (11.7)	28 (15.1)	47 (11)	
7-8h/day	2 (5.9)	5 (5.7)	7 (7.1)	13 (6)	19 (5.3)		1 (4.2)	6 (9.1)	3 (3.9)	12 (6.5)	24 (5.6)	
>8h/day	3 (8.8)	6 (6.9)	8 (8.1)	21 (9.6)	32 (8.9)		2 (8.3)	5 (7.6)	7 (9.1)	15 (8.1)	41 (9.6)	

Table A: Physical activity and socio-demographic *(continued)*

Variables Physical Activity	**Nationality**				**P**
	Emirati N (%)	**Other Arabs** N (%)	**Indian Sub-continent** N (%)	**Others** N (%)	
Number of Exercise/Week					
No	23 (7.1)	31 (11.2)	13 (9.6)	2 (3.1)	
1X	88 (27.1)	79 (28.4)	44 (32.6)	15 (23.1)	NS
2X	84 (25.8)	82 (29.5)	37 (27.4)	19 (29.2)	
3X	130 (40)	86 (30.9)	41 (30.4)	29 (44.6)	
Regular Exercise					
Yes	170 (52.3)	126 (45.3)	78 (57.8)	48 (73.8)	.000
None	155 (47.7)	152 (54.7)	135 (42.2)	17 (26.2)	
Transport to school					
Walk	12 (3.7)	11 (4)	2 (1.5)	4 (6.2)	
Bus	149 (45.8)	170 (61.2)	112 (83)	40 (61.5)	.000
Car	164 (50.5)	97 (34.9)	21 (15.6)	21 (32.3)	
Sedentary Activity					
<1h/Day	34 (10.5)	29 (10.4)	43 (31.9)	4 (6.2)	
1-2h/Day	95 (29.2)	101 (36.3)	43 (31.9)	27 (41.5)	
3-4h/Day	88 (27.1)	82 (29.5)	25 (18.5)	16 (24.6)	
5-6h/day	47 (14.5)	31 (11.2)	11 (8.1)	9 (13.8)	.000
7-8h/day	21 (6.5)	12 (4.3)	10 (7.4)	3 (4.6)	
>8h/day	40 (12.3)	23 (8.3)	3 (2.2)	6 (9.2)	

Appendix XIV: Oral Hygiene

Table A: Oral hygiene and socio-demographic

Variables Physical Activity	Gender		P	School type		P	Income			P	Total N (%)
	Male N (%)	**Female** N (%)		**Public** N (%)	**Private** N (%)		**1000-3000 Dhs** N (%)	**3000-7000 Dhs** N (%)	**>7000 Dhs** N (%)		
Tooth brushing											
Yes	363 (89.4)	387 (97.5)	.000	248 (92.2)	502 (94)	NS	77 (90.6)	207 (93.2)	466 (94)	NS	750 (93.4)
No	43 (10.6)	10 (2.5)		21 (7.8)	32 (6)		8 (9.4)	15 (6.8)	30 (6)		53 (6.6)
Brushing frequency											
None	349 (8.4)	6 (1.5)	.000	13 (4.8)	27 (5.1)	.001	4 (4.7)	12 (5.4)	24 (4.8)	NS	40 (5)
1X	118 (29.1)	77 (19.4)		58 (21.6)	137 (25.7)		18 (21.2)	56 (25.2)	121 (24.4)		195 (24.3)
2X	198 (48.8)	236 (59.4)		133 (49.4)	301 (56.4)		54 (63.5)	128 (57.7)	252 (50.8)		434 (54)
3X	56 (13.8)	78 (19.6)		65 (24.2)	69 (12.9)		9 (10.6)	26 (11.7)	99 (20)		134 (16.7)
Brushing time											
None	32 (7.9)	6 (1.5)	.000	13 (4.8)	25 (4.7)	NS	4 (4.7)	12 (5.4)	22 (4.4)	NS	38 (4.7)
Morning	85 (20.9)	72 (18.1)		48 (17.8)	109 (20.4)		19 (22.4)	43 (19.4)	95 (19.2)		157 (19.6)
Evening	45 (11.1)	12 (29.2)		18 (6.7)	41 (7.7)		2 (2.4)	19 (8.6)	38 (7.7)		59 (7.3)
Morning & evening	244 (60.1)	305 (76.8)		19 (70.6)	359 (67.2)		60 (70.6)	148 (66.7)	341 (68.8)		549 (68.4)
Dental visit last 12 months											
Yes	196 (48.3)	175 (44.1)	NS	139 (51.7)	232 (43.4)	NS	28 (32.9)	89 (40.1)	254 (51.2)	.001	371 (46.2)
No	210 (51.7)	222 (55.9)		130 (48.3)	302 (566)		57 (67.1)	133 (59.9)	242 (48.8)		432 (53.8)
Fluoride tablet											
Yes	72 (17.7)	93 (23.4)	NS	96 (35.7)	69 (12.9)	.000	15 (17.6)	29 (13.1)	121 (24.4)	.002	165 (20.5)
No	334 (82.3)	304 (76.6)		173 (64.3)	465 (87.1)		70 (82.4)	193 (86.9)	375 (75.6)		638 (79.5)

Table A: Oral hygiene and socio-demographic *(continued)*

Variables Physical Activity	Father's Education					P	Mother's Education				
	None N (%)	**Primary** N (%)	**Secondary** N (%)	**High Sch.** N (%)	**College** N (%)		**None** N (%)	**Primary** N (%)	**Secondary** N (%)	**High Sch.** N (%)	**College** N (%)
Tooth brushing											
Yes	29 (85.3)	81 (93.1)	91 (91.9)	203 (93.1)	341 (94.7)	NS	22 (91.7)	60 (90.9)	72 (93.5)	173 (93)	399 (93.7)
No	5 (14.7)	6 (6.9)	8 (8.1)	15 (6.9)	19 (5.3)		2 (8.3)	6 (9.1)	5 (6.5)	1 3(7)	27 (6.3)
Brushing frequency											
None	5 (14.7)	4 (4.6)	4 (4)	14 (6.4)	13 (3.6)	NS	2 (8.3)	6 (9.1)	2 (2.6)	8 (4.3)	22 (5.2)
1X	8 (23.5)	24 (27.6)	30 (30.3)	49 (22.5)	81 (22.5)		4 (16.7)	14 (21.2)	22 (28.6)	40 (21.5)	105 (24.6)
2X	15 (44.1)	45 (51.7)	49 (49.9)	117 (53.7)	207 (57.5)		12 (50)	31 (47)	41 (53.2)	105 (56.5)	235 (55.2)
3X	6 (17.6)	6 (16.1)	16 (16.2)	38 (17.4)	59 (16.4)		6 (25)	15 (22.7)	12 (15.6)	33 (17.7)	64 (15)
Brushing time											
None	4 (11.8)	4 (4.6)	4 (4)	15 (6.9)	11 (3.1)	NS	2 (8.3)	5 (7.6)	2 (2.6)	8 (4.3)	21 (4.9)
Morning	7 (20.6)	22 (25.3)	18 (18.2)	41 (18.8)	68 (18.9)		4 (16.7)	18 (27.3)	20 (26)	29 (15.6)	77 (18.1)
Evening	2 (5.9)	8 (9.2)	8 (8.1)	13 (6)	26 (7.2)		2 (8.3)	2 (3)	6 (7.8)	10 (5.4)	37 (8.7)
Morning & eve.	2 (61.8)	53 (60.9)	69 (69.7)	149 (68.3)	255 (70.8)		16 (66.7)	41 (62.1)	49 (63.6)	139 (74.7)	291 (68.3)
Dental visit last 12 mths											
Yes	11 (32.4)	34 (39.1)	44 (44.4)	94 (43.1)	186 (51.7)	NS	4 (16.7)	26 (39.4)	30 (39)	92 (49.5)	209 (49.1)
No	23 (67.6)	53 (60.9)	5 (55.6)	124 (56.9)	174 (48.3)		20 (83.3)	40 (60.6)	47 (61)	94 (50.5)	217 (50.9)
Fluoride tablet											
Yes	10 (29.4)	16 (18.4)	18 (18.2)	53 (24.3)	66 (18.3)	NS	7 (29.2)	10 (15.2)	18 (23.4)	51 (27.4)	74 (17.4)
No	24 (70.6)	71 (81.6)	81(81.8)	165 (75.7)	294 (81.7)		17 (70.8)	56 (84.8)	59 (76.6)	135 (72.6)	352 (82.6)

Table A: Oral hygiene and socio-demographic *(continued)*

Variables Physical Activity	**Nationality**				**P**
	Emirati N (%)	**Other Arabs** N (%)	**Indian Sub-continent** N (%)	**Others** N (%)	
Tooth brushing					
Yes	307 (94.5)	248 (89.2)	133 (98.5)	62 (95.4)	.002
No	18 (5.5)	30 (10.8)	2 (1.5)	3 (4.6)	
Brushing frequency					
None	13 (4)	24 (8.6)	1 (0.7)	2 (3.1)	.000
1X	63 (19.4)	88 (31.7)	27 (20)	17 (26.2)	
2X	175 (53.8)	127 (45.7)	97 (71.9)	35 (53.8)	
3X	74 (22.8)	39 (14)	10 (7.4)	11 (16.9)	
Brushing time					
None	13 (4)	22 (7.9)	1 (0.7)	2 (3.1)	.000
Morning	56 (17.2)	59 (21.2)	30 (22.2)	12 (18.5)	
Evening	14 (4.3)	38 (13.7)	0 (0)	7 (10.8)	
Morning & evening	242 (74.5)	159 (57.2)	104 (77)	44 (67.7)	
Dental visit last 12 months					
Yes	161 (49.5)	141 (50.7)	34 (25.2)	35 (53.8)	.000
No	164 (50.5)	137 (49.3)	101 (74.8)	30 (46.2)	
Fluoride tablet					
Yes	312 (96)	255 (91.7)	134 (99.3)	62 (95.4)	.000
No	13 (4)	23 (8.3)	1 (0.7)	3 (4.6)	

Appendix XV: Weight Groups

Table A: Physical activity by weight group

Variables Physical Activity	Weight Group			P
	Normal N (%)	**Overweight** N (%)	**Obese** N (%)	
Number of Exercise/Week				
No	37 (7.5)	15 (7.9)	17 (14.4)	0.026
1X	153 (30.8)	49 (25.9)	24 (20.3)	
2X	123 (24.8)	63 (33.3)	36 (30.5)	
3X	183 (36.9)	62 (32.8)	41 (34.7)	
Regular Exercise				
Yes	276 (55.6)	92 (48.7)	54 (45.8)	0.073
No	220 (44.4)	97 (51.3)	64 (54.2)	
Transport to school				
Walk	20 (4)	4 (2.1)	5 (4.2)	0.003
Bus	178 (35.9)	63 (33.3)	62 (52.2)	
Car	298 (60.1)	122 (64.6)	51 (43.2)	
Sedentary Activity				
<1h/Day	73 (14.7)	27 (14.3)	10 (8.5)	0.604
1-2h/Day	160 (32.3)	67 (35.4)	39 (33.1)	
3-4h/Day	130 (26.2)	50 (26.5)	31 (26.3)	
5-6h/day	59 (11.9)	22 (11.6)	17 (14.4)	
7-8h/Day	31 (6.3)	10 (5.3)	5 (4.2)	
>8h/day	43 (8.7)	13 (6.9)	16 (13.6)	

Table B: Dietary habits by weight group

Variables / Dietary Habits 1 Food Frequency	Weight Group			P
	Normal N (%)	**Overweight** N (%)	**Obese** N (%)	
Have main meal regularly				
Yes	301 (60)	111 (58.7)	63 (53.4)	0.347
No	195 (39.3)	78 (41.3)	55 (46.6)	
Have breakfast every day				
Yes	59 (11.9)	33 (17.5)	13 (11)	0.120
No	437 (88.1)	156 (82.5)	105 (89)	
Have lunch every day				
Yes	176 (35.5)	81 (42.9)	56 (47.5)	0.026
No	320 (64.5)	108 (57.1)	62 (52.5)	
Have dinner every day				
Yes	94 (19)	29 (15.3)	20 (16.9)	0.526
No	402 (81)	160 (84.7)	98 (83.1)	
Time of snack per day				
None	17 (3.4)	10 (5.3)	7 (5.9)	
1X	153 (30.8)	55 (29.1)	33 (28)	
2X	177 (35.7)	75 (39.7)	41 (34.7)	0.136
3X	79 (15.9)	35 (18.5)	27 (22.9)	
>3	70 (14.1)	14 (7.4)	10 (8.5)	
Fast food / week				
None	87 (17.5)	46 (24.3)	14 (11.9)	
1X	223 (45)	84 (44.4)	55 (46.6)	
2X	98 (19.8)	34 (18)	32 (27.1)	0.126
3X	45 (9.1)	15 (7.9)	8 (6.8)	
>3	43 (8.7)	10 (5.3)	9 (7.6)	
Processed food /week				
None	62 (12.5)	23 (12.2)	13 (11)	
1X	165 (33.3)	70 (37)	42 (35.6)	
2X	128 (25.8)	52 (27.5)	29 (24.6)	0.940
3X	66 (13.3)	23 (12.2)	17 (14.4)	
>3	75 (15.1)	21 (11.1)	17 (14.4)	

Table B: Dietary habits by weight group *(continued)*

Variables / Dietary Habits 2 Food Preference	**Weight Group**			**P**
	Normal N (%)	**Overweight** N (%)	**Obese** N (%)	
Vegetarian				
Yes	221 (44.6)	88 (46.6)	43 (36.4)	0.192
No	275 (55.4)	101 (53.4)	75 (63.6)	
Non-Vegetarian				
Yes	168 (33.9)	63 (33.3)	36 (30.5)	0.784
No	328 (66.1)	126 (66.7)	82 (69.5)	
Traditional				
Yes	214 (43.1)	87 (46)	65 (55.1)	0.064
No	282 (56.9)	102 (54)	53 (44.9)	
Fast food				
Yes	216 (43.5)	71 (37.6)	44 (37.3)	0.234
No	280 (56.5)	118 (62.4)	74 (62.7)	
Sweet & carbohydrate				
Yes	183 (36.9)	51 (27)	30 (25.4)	0.008
No	313 (63.1)	138 (73)	88 (74.6)	
Fruits/day				
None	34 (6.9)	18 (9.5)	9 (7.6)	0.613
1x	212 (42.7)	75 (39.7)	51 (43.2)	
2x	150 (30.2)	53 (28)	28 (23.7)	
3X	100 (20.2)	43 (22.8)	30 (25.4)	
Vegetables/day				
None	77 (15.5)	32 (16.9)	20 (16.9)	0.354
1x	215 (43.3)	67 (35.4)	50 (42.4)	
2x	139 (28)	63 (33.3)	29 (24.6)	
3X	65 (13.1)	27 (14.3)	19 (16.1)	
T.V while eating				
Yes	389 (78.4)	149 (78.8)	94 (79.7)	0.956
No	107 (21.6)	40 (21.2)	24 (20.3)	

Table B: Dietary habits by weight group *(continued)*

Variables / Dietary Habits 3 Drinking Frequency	**Weight Group**			**P**
	Normal N (%)	**Overweight** N (%)	**Obese** N (%)	
Soft drinks				
Never	47 (9.5)	11 (5.8)	6 (5.1)	
1-2 times/week	165 (33.3)	73 (38.6)	32 (27.1)	
3-4 times/week	68 (13.7)	24 (12.7)	15 (12.7)	
1-2 times/day	146 (29.4)	51 (27)	41 (34.7)	0.362
3-4 times/day	41 (8.3)	17 (9)	15 (12.7)	
5+ times/day	29 (5.8)	13 (6.9)	9 (7.6)	
Natural fruit juice				
Never	79 (15.9)	28 (14.8)	12 (10.2)	
1-2 times/week	131 (26.4)	65 (34.4)	33 (28)	
3-4 times/week	68 (13.7)	31 (16.4)	25 (21.2)	
1-2 times/day	147 (26.6)	46 (24.3)	30 (25.4)	0.116
3-4 times/day	41 (8.3)	11 (5.8)	14 (11.9)	
5+ times/day	30 (6)	8 (4.2)	4 (3.4)	
Other fruit juice				
Never	102 (20.6)	38 (20.1)	22 (18.6)	
1-2 times/week	146 (29.4)	66 (34.9)	28 (32.2)	
3-4 times/week	77 (15.5)	34 (18)	14 (11.9)	
1-2 times/day	114 (23)	35 (18.5)	29 (24.6)	0.771
3-4 times/day	32 (6.5)	9 (4.8)	9 (7.6)	
5+ times/day	25 (5)	7 (3.7)	6 (5.1)	
Milk				
Never	97 (19.6)	40 (21.2)	30 (25.4)	
1-2 times/week	97 (19.6)	34 (18)	30 (25.4)	
3-4 times/week	44 (8.9)	25 (13.2)	11 (9.3)	
1-2 times/day	156 (31.5)	61 (32.3)	34 (28.8)	0.092
3-4 times/day	57 (11.5)	10 (5.3)	7 (5.9)	
5+ times/day	45 (9.1)	19 (10.1)	6 (5.1)	
Tea &sugar				
Never	166 (33.5)	62 (32.8)	35 (29.7)	
1-2 times/week	115 (23.2)	41 (21.7)	33 (28)	
3-4 times/week	45 (9.1)	15 (7.9)	13 (11)	
1-2 times/day	111 (22.4)	49 (25.9)	27 (22.9)	0.801
3-4 times/day	34 (6.9)	15 (7.9)	4 (3.4)	
5+ times/day	25 (5)	7 (3.7)	6 (5.1)	

Table C: Oral hygiene by weight group

Oral Hygiene	Weight Group			P
	Normal N (%)	**Overweight** N (%)	**Obese** N (%)	
Tooth brushing				
Yes	469 (94.6)	175 (92.6)	106 (89.8)	0.156
No	27 (5.4)	14 (7.4)	12 (10.2)	
Brushing frequency				
None	26 (5.2)	8 (4.2)	6 (5.1)	0.008
1X	98 (19.8)	58 (30.7)	39 (33.1)	
2X	284 (57.3)	99 (52.4)	51 (43.2)	
3X	88 (17.7)	24 (12.7)	22 (18.6)	
Brushing time				
None	22 (4.4)	10 (5.3)	6 (5.1)	0.122
Morning	87 (17.5)	41 (21.7)	29 (24.6)	
Evening	29 (5.8)	19 (10.1)	11 (9.3)	
Morning & evening	358 (72.2)	119 (63)	72 (61)	
Dental visit last 12 month				
Yes	231 (46.6)	82 (43.4)	58 (49.2)	0.593
No	265 (53.4)	107 (56.6)	60 (50.8)	
Fluoride tablet				
Yes	95 (19.2)	38 (20.1)	32 (27.1)	0.155
No	401 (80.8)	151 (79.9)	86 (72.9)	

Appendix XVI: BMI and dietary habits

Univariate linear regression analysis of adolescents' dietary habits & BMI

Independent Variables	Dependent variable (total decay)		
	B-Value	95% (confidence interval)	P-Value
Eating frequency per day	0.020	(-0.280, 0.321)	0.894
Main meal frequency per day	-0.261	(-0.752, 0.230)	0.297
Main meal regularly	0.804	(0.099, 1.510)	0.026
Have breakfast everyday	0.665	(-0.366, 1.696)	0.206
Have lunch every day	1.468	(0.762, 2.174)	<0.001
Have dinner	-0.203	(-1.112, 0.706)	0.662
Have all three meals	-1.476	(-2.164, -0.788)	<0.001
Number of snack	-0.166	(-0.496, 0.164)	0.323
Fast food frequency per week	-0.057	(-0.369, 0.255)	0.721
Processed food frequency per week	-0.001	(-0.283, 0.286)	0.993
Fast food preference	-0.662	(-1.367, 0.043)	0.06
Vegetarian preference	-0.745	(-1.444, -0.046)	0.037
Traditional food preference	0.860	(0.164, 1.556)	0.016
Sweet & Carbohydrate preference	-1.317	(-2.052, -0.582)	<0.001
Chocolate frequency	-0.076	(-0.344, 0.191)	0.575
Candy and sweets frequency	-0.157	(-0.398, 0.084)	0.201
Sweet biscuit frequency	-0.406	(0.666, 0.147)	0.002
Ice muncher frequency	-0.469	(-0.724, -0.214)	0.000
Date frequency	-0.227	(-0.425, -0.030)	0.024
Watch TV while eating	-0.010	(-0.860, 0.840)	0.981
Fruits per day	-0.018	(-0.404, 0.368)	0.925
Vegetables per day	-0.137	(-0.517, 0.243)	0.479
Soft drink frequency	0.382	(0.128, 0.635)	0.003
Natural fruit juice frequency	-0.116	(-0.356, 0.133)	0.361
Milk frequency	-0.418	(-0.637, 0.199)	<0.001
Tea & sugar	-0.048	(-0.276, 0.181)	0.682
Butter milk frequency	-0.249	(-0.489, -0.100)	0.041

Appendix XVII: Age and explanatory variables

Independent Variables	Dependent Variable (Age)		
	B-Value	95% (confidence interval)	P-Value
Physical activity			
No of exercise/week	-0.153	(-0.249, 0.057)	0.002
Subject has a regular sport	0.474	(0.286, 0.662)	0.000
Length of sedentary activity	0.138	(0.072, 0.204)	0.000
Oral hygiene			
Tooth brushing	0.537	(0.155, 0.918)	0.006
Brushing frequency	0.095	(-0.22, 0.030)	0.136
Dental visit in last 12 months	-0.095	(-0.285, 0.096)	0.329

Independent Variables	Dependent Variable (Age)		
	B-Value	95% (confidence interval)	P-Value
Eating frequency per day	0.082	(0.000, 0.164)	0.049
Main meal frequency per day	0.009	(-0.125, 0.144)	0.890
Main meal regularly	0.332	(0.140, 0.524)	0.001
Have breakfast everyday	0.218	(-0.063, 0.500)	0.129
Have lunch every day	0.358	(0.165, 0.551)	0.000
Have dinner	0.064	(-0.185, 0.312)	0.615
Have all three meals	-0.373	(-0.562, -0.185)	0.000
Number of snack	-0.016	(-0.106, 0.074)	0.733
Fast food frequency per week	0.052	(-0.034, 0.137)	0.235
Processed food frequency per week	0.043	(-0.035, 0.121)	0.276
Fast food preference	-0.077	(-0.270, 0.116)	0.432
Sweet & Carbohydrate preference	-0.036	(-0.239, 0.166)	0.726
Chocolate frequency	0.029	(-0.044,0.102)	0.436
Candy and sweets frequency	-0.014	(-0.080, 0.052)	0.672
Sweet biscuit frequency	-0.061	(0.132, 0.011)	0.095
Date frequency	-0.046	(-0.101, 0.008)	0.092
Watch TV while eating	-0.200	(-0.432,0.032)	0.091
Fruits per day	-0.157	(-0.262, 0.052)	0.003
Vegetables per day	-0.122	(-0.226, -0.019)	0.020
Soft drink frequency	0.147	(0.078, 0.216)	0.000
Natural fruit juice frequency	-0.056	(-0.124, 0.012)	0.105
Milk frequency	-0.079	(-0.139, -0.018)	0.011
Tea & sugar	0.059	(-0.003, 0.122)	0.062