

AMERICAN UNIVERSITY OF BEIRUT

MALOCCLUSION AND ORTHODONTIC  
TREATMENT NEED IN ELEMENTARY SCHOOL  
CHILDREN IN BEIRUT: PREVALENCE AND  
RELATED FACTORS

by

ANTOINE ELIAS HANNA

A thesis  
submitted in partial fulfillment of the requirements  
for the degree of Master of Science in Epidemiology  
to the Department of Epidemiology and Population Health  
of the Faculty of Health Sciences  
at the American University of Beirut

Beirut, Lebanon  
October, 2012

AMERICAN UNIVERSITY OF BEIRUT

MALOCCLUSION AND ORTHODONTIC  
TREATMENT NEED IN ELEMENTARY SCHOOL  
CHILDREN IN BEIRUT: PREVALENCE AND  
RELATED FACTORS

By

ANTOINE ELIAS HANNA

Approved by:

Dr. Monique Chaaya, Professor and Chair  
Epidemiology and Population Health



Advisor

Dr. Miran Jaffa, Assistant professor  
Epidemiology and Population Health



Member of Committee

Dr. Joseph Ghafari, Professor and Head  
Orthodontics and Dentofacial Orthopedics



Member of Committee

Mrs. Mayada Kanj, Instructor  
Health Promotion and Community Health



Member of Committee

Date of thesis defense: October 9, 2012

# AMERICAN UNIVERSITY OF BEIRUT

## THESIS RELEASE FORM

I, Antoine Elias HANNA,

authorize the American University of Beirut to supply copies of my thesis to libraries or individuals upon request.

do not authorize the American University of Beirut to supply copies of my thesis to libraries or individuals for a period of two years starting with the date of the thesis.

---

Signature

---

Date

## ACKNOWLEDGMENTS

My recognition and gratitude are addressed to everyone who has been part of my journey for the past three years and helped me in completing this thesis and my residency in orthodontics.

I am greatly thankful to my advisor Dr. Monique Chaaya for her valuable advice, constructive criticism, encouragement and support throughout my study period and thesis project.

I would like to extend my gratitude to Dr. Miran Jaffa for her much appreciated support and scholarly guidance.

My honest appreciation goes to Dr. Joseph Ghafari whose tireless efforts have inspired me and made this work successful.

My utmost appreciation goes to each member of the department of orthodontics and dento-facial orthopedics at AUBMC for their encouragement and support.

I would like to acknowledge with great appreciation Mr. Khalil Asmar for his contribution in this thesis.

I extend my sincere appreciation to Mrs. Mayada Kanj for being part of this journey.

My utmost appreciation goes to Ajialouna NGO whose help was vital in the achievement of this thesis.

I am also grateful for the cooperation of all the private, public schools and parents who have accepted to be part of our study.

My sincere gratitude goes to my parents and friends who highly contributed to my work and for their unlimited support.

Thanks are also due to Ms. Asma Shihab for her continuous assistance.

# AN ABSTRACT OF THE THESIS OF

Antoine Elias Hanna

for Master of Science  
Major: Epidemiology

Title: Malocclusion and orthodontic treatment need in elementary school children in Beirut: prevalence and related factors

## ***Introduction:***

Malocclusion, defined as any deviation from the norm of the arrangement of the teeth, can be caused by genetic and/or environmental factors. Occlusal indices are used to quantify the severity of the malocclusion and assess the treatment need in a given population. Lebanon lacks data on the severity of malocclusion and its associated factors. The objective of this study was to assess the prevalence and severity of the malocclusion and orthodontic treatment need comparing between public and private schools in a sample of 6-11 years Lebanese elementary school children in Beirut as well as the relationship between these components and socio demographic and selected behavioral background factors of both children and parents.

## ***Design:***

A comparative cross-sectional study of elementary school children aged 6-11 years, grades 2 to 5, in public and private schools in Beirut-Lebanon.

## ***Methods:***

The sample comprised 655 school children aged 6-11 years selected from 2 public schools (PB) and 5 private schools (PV) in Beirut. Dental screening was performed by a calibrated examiner to record information regarding occlusion, overjet (OJ), overbite (OB), posterior crossbite (PXB), midline diastema and crowding (II). Data on socio-demographic background, health status, oral hygiene habits and nutritional habits were collected via a questionnaire sent to the parents. The index for orthodontic treatment need was computed (IOTN). Multinomial, binomial and multiple linear regressions were performed to test the association of selected factors with occlusal indices.

## ***Results:***

Malocclusion was more severe in PB compared to PV with statistically significant difference regarding overjet ( $p=0.22$ ), anterior crossbite ( $p=0.008$ ) and occlusion ( $p=0.002$ ) when stratified based on the overjet. After adjusting for appropriate variables, age was positively associated with OJ (RRR: 1.35; 95%CI: 1.06; 1.71 /  $\beta$ : 0.14; 95%CI: 0.046; 0.249), OB (RRR: 2.23; 95%CI: 1.03; 4.83) and PXB (OR: 1.29; 95% CI: 1.18; 1.39). Increased sucking habit duration was associated with a shallower OB (RRR: 0.98; 95%CI: 0.97; 0.99) and a PXB (OR: 1.01; 95%CI: 1.01; 1.18). Crowding is more prevalent among males (RRR: 1.69; 95% CI: 1.36; 2.1) and is associated with an increase in the DMFT (Decayed, Missing, and Filled Teeth) score (RRR: 1.04; 95%CI: 1.03; 1.06), which was evaluated in another part of this epidemiologic study.

The IOTN (Index of Orthodontic Treatment Need) scores revealed that nearly one fourth of the children are in urgent need of treatment.

***Conclusion:***

Orthodontic treatment need evaluated in Lebanese children 6-11 years of age is 2.7 times higher than in comparative data in the USA (ages 8-11 years). Differences in population age limit comparisons with data from other countries, however, the findings suggest the need for education campaigns to parents in order to have their children screened early for orthodontic needs (age 7) along with the integration of orthodontic screening in schools on an annual basis with greater attention in public schools. Mouth breathing and sucking habits should be detected in a timely manner.

Long term follow up is needed on the screened subjects to build up a cohort for subsequent assessment of oral health in general and malocclusion in particular. Such data should form the basis for third-party entities (government, NGO agencies, and insurance companies) to engage in the prevention or early treatment of occlusal problems.

# CONTENTS

ACKNOWLEDGMENTS.....	V
ABSTRACT.....	VI
GRAPHS.....	XI
FIGURES.....	XII
TABLES.....	XIII
ABBREVIATIONS.....	XV

## Chapter

I. INTRODUCTION.....	1
II. LITERATURE REVIEW.....	5
A. Epidemiology Of Malocclusion.....	5
1.Prevalence.....	5
2.Occlusal Indices.....	8
a. Introduction.....	8
b. Overview Of Occlusal Indices.....	9
c. Epidemiological Surveys Using The IOTN.....	11
B. Factors Associated With Malocclusion.....	14
1.Genetic.....	14
2.Environmental.....	15
3.Social Determinants Of Oral Health.....	17
C. Significance.....	17
D. Objectives.....	18
III. METHODOLOGY.....	19
A. Research Design.....	19
B. Participants.....	19
1.Public Schools.....	19
2.Private Schools.....	20
C. Exclusion Criteria.....	21
D. Calibration.....	21
E. Measures.....	21

1.Occlusal Indices.....	22
a. Occlusion.....	22
b. Overjet.....	23
c. Anterior Crossbite.....	24
d. Overbite.....	24
e. Open Bite.....	25
f. Posterior Crossbite.....	26
g. Midline Diastema.....	26
h. Irregularity Index.....	26
i. Additional Findings.....	27
j. Index Of Orthodontic Treatment Need (IOTN).....	27
F. Procedure.....	30
1.Dental Screening.....	31
2.Questionnaire.....	31
a. The Socio-Demographic Background Of Child And Parents.....	32
b. The General Health Status Of The Child.....	32
c. Sucking Habits Of The Child.....	32
d. Feeding Methods Of The Child.....	33
e. Oral Health Behaviors.....	33
G. Ethics.....	34
1.Respect For Person.....	34
2.Beneficence/Non-Maleficence.....	34
3.Justice.....	35
H. Statistical Analysis.....	36
IV. RESULTS.....	38
A. Introduction.....	38
B. Characteristics Of The School Children In Public And Private Schools.....	38
1.Socio-Demographic Characteristics.....	38
2.Health Status Of The Children.....	39
3.Habits.....	39
4.Parents' Perception Of Orthodontic Treatment Need.....	40
C. Malocclusion Measures Of The School Children In Public And Private Schools.....	40
1.Saggital Measures.....	40
a. Molar Occlusion.....	40
b. Canine Occlusion.....	40
c. Overjet.....	41
d. Anterior Crossbite.....	42

2. Vertical Measures.....	42
a. Open Bite.....	42
b. Overbite.....	42
3. Transverse Measures.....	43
4. Contact Point Displacement.....	43
D. Bivariate Associations.....	43
1. Overjet.....	44
2. Overbite.....	44
3. Posterior Crossbite.....	45
4. Irregularity Index.....	45
E. Multivariate Analysis.....	45
1. Overjet.....	46
a. Categorical Outcome.....	46
b. Continuous Outcome.....	46
2. Overbite.....	47
3. Crossbite.....	47
4. Irregularity Index.....	48
F. Index Of Orthodontic Treatment Need (IOTN).....	48
V. DISCUSSION.....	49
A. Summary And Discussion Of Major Findings.....	49
1. Prevalence Of Malocclusion.....	49
2. Associations.....	51
3. Orthodontic Treatment Need.....	54
B. Strength Of The Study.....	56
C. Limitations Of The Study.....	56
VI. CONCLUSION AND RECOMMENDATIONS.....	58
A. Conclusion.....	58
B. Recommendations.....	58
1. Short Term Recommendations.....	59
2. Long Term Recommendations.....	60
REFERENCES.....	81
APPENDICES.....	93
Appendix I: Questionnaire.....	94
Appendix II: Consent form for public school parents .....	101
Appendix III: Consent form for private school parents .....	103
Appendix IV: Assent form for school children .....	105

## GRAPHS

Graph	Page
1. Linear association between overjet and age in public and private school.....68 children	68
2. Linear association between overjet and DMFT in public and private school.....68 children	68
3. Linear association between overjet and age in public and private school.....77 children adjusting for all other variables	77
4. Linear association between overjet and DMFT in public and private school.....77 children adjusting for all other variables	77
5. Graphical representation of orthodontic treatment need among students.....78 aged 6-11 years by type of school	78

## FIGURES

Figure	Page
1. Progression of a molar relationship from a full Cl III to a full Cl II .....	23
2. Variations in horizontal overjet.....	24
3. Variations in vertical overbite.....	25
4. Recording of posterior crossbite.....	26
5. Measurement of midline diastema.....	26
6. Measurement of the irregularity index.....	27

## TABLES

Table	Page
1. Percent distribution of students aged 6-11 by socio-demographic and socio-economic characteristics and type of school.....	62
2. Percent distribution of students aged 6-11 by health state and type of school.....	63
3. Percent distribution of students aged 6-11 by nutritive and non-nutritive habits and type of school.....	63
4. Percent distribution of students aged 6-11 by sagittal characteristics of malocclusion and type of school.....	64
5. Percent distribution of students by aged 6-11 vertical characteristics of malocclusion and type of school.....	65
6. Percent distribution of students by aged 6-11 transverse characteristics of malocclusion and type of school.....	65
7. Percent distribution of students' intra-arch contact point displacement and type of school.....	66
8. Bivariate association between students' socio-demographic, socio-economic, health state, habits and dental health and the different severities of overjet.....	67
9. Bivariate association between students' socio-demographic, socio-economic, health state, habits and dental health and the different severities of overbite.....	69
10. Bivariate association between students' socio-demographic, socio-economic, health state, habits and dental health and the presence of a posterior crossbite.....	70
11. Bivariate association between students' socio-demographic, socio-economic, health state, habits and dental health and the different severities of irregularity index.....	71
12. Multivariate analysis showing associations between different categories of overjet and other variables.....	72
13. Multivariate analysis showing associations between overjet (continuous measurement in mm) and other variables.....	73

14. Multivariate analysis showing associations between different categories.....	74
of overbite and other variables	
15. Multivariate analysis showing associations between the presence of a posterior.....	75
crossbite and other variables	
16. Multivariate analysis showing associations between different categories of.....	76
irregularity index and other variables	
17. Percent distribution of orthodontic treatment need grades among students.....	78
aged 6-11 years by type of school	
18. Percent distribution of students aged 6-11 by malocclusion characteristics.....	79
and type of school compared with the NHANES III findings	

## ABBREVIATIONS

CI I	Class I
CI II	Class II
CI III	Class III
US	United States
UK	United Kingdom
NHANES	National Health And Nutritional Survey
WHO	World Health Organization
IOTN	Index Of Orthodontic Treatment Need
DHC	Dental Health Component
AC	Aesthetic Component
HIV	Human Immunodeficiency Virus

# CHAPTER I

## INTRODUCTION

Teeth with irregular, crowded and forward position are a major problem that Man has been trying deal with using since 1000 B.C (Corrucini & Pacciani E, 1989). Malocclusion, an abnormality that is widely common among various populations (Kelly & Harvey 1977; Proffit et al. 1998), is defined as any deviation from the norm of the arrangement of the teeth (Rønning & Thilander, 1995). These deviations can be represented by crowded or spaced teeth, malrelation between the maxillary and mandibular teeth in all the planes (saggital, vertical and frontal) and skeletal discrepancies (Proffit & Fields, 2000).

Although not considered life threatening, the poor dentofacial esthetics caused by malocclusion reduces the quality of life of subjects and leads to social and functional limitations (Bresnahan et al. 2010; Sheiham 1993; Lewis et al. 1982). Moreover, Bollen (2008) found that although malocclusion does not cause periodontal disease, it is associated with its development.

Treatment of malocclusion using orthodontics is initiated usually between the ages of 9 and 14([www.aaomembers.org](http://www.aaomembers.org)). However, some orthodontic problems are easier to correct if they're treated earlier. In fact, the American association of orthodontists recommends the first orthodontic checkup to be done at an age no later than 7 years. This gives the orthodontist an opportunity to: guide jaw growth, decrease the risk of incisors

trauma, correct detrimental oral habits, and guide permanent teeth into a more favorable position and prevent social and functional limitations ([www.aaomembers.org](http://www.aaomembers.org))

The incidence of malocclusion has been increasing with time and it has been described as “Disease of civilization” (Corruccini and Kaul 1984). In fact, malocclusion is more prevalent in populations of the 21<sup>st</sup> century compared to ancient populations. This increase was mainly attributed to a higher consumption of softer foods leading to a decrease in the jaw size (Proffit & Fields, 2000).

In Lebanon, dentistry was introduced by the American University of Beirut when the latter founded the first dental school in the Near East region and the first orthodontic department was not founded until mid-1990’s. Only two studies were conducted on malocclusion in Lebanon and none assessed rigorously the magnitude and the severity of malocclusion. Saleh (1999) described the malocclusion of a school population aged 9-15 years disregarding many other important factors such as crowding, overjet, overbite, crossbite. The study of Kassis et al. (2010) was also descriptive and the aim was to determine the prevalence of malocclusion in a sample of Lebanese orthodontic patients referred to the Department of Orthodontics Saint-Joseph University Beirut from different geographic locations. Doumit and Doughan(2002), in a survey that aimed to assess oral health included the assessment of malocclusion. However, they only described the malocclusion as being present or not without any describing it or determining its severity.

The most widely used classification for malocclusion is one created by Edward H. Angle’s in the 1890’s is still the most commonly used: Class I: Normal relationship of the molars, but line of occlusion incorrect because of malpositioned teeth, rotations, or other causes, Class II: Lower molar distally positioned relative to upper molar, line of occlusion

not specified, Class III: Lower molar mesially positioned relative to upper molar, line of occlusion not specified. Since this classification was established, the aim of the orthodontists was no longer to align the teeth but to achieve optimal occlusion (Angle 1899). Angle's classification of malocclusion took into consideration only the relationships between the molars disregarding other aspects of the malocclusion (Skeletal discrepancies, arch length discrepancy not included, vertical discrepancies were not taken into consideration...). This classification was used by Saleh (1999) and therefore it reflects an additional shortcoming of the study.

In order to overcome these limitations many orthodontists came up with new classification systems that were not used because of their complexity (Ackerman & Proffit 1969; Kelly et al. 1973).

To assess the burden of any malocclusion and justify the need of orthodontic treatment, occlusion indices are a very important tool to be used since they assess the complexity and severity of the malocclusion. Occlusal indices started to be used in epidemiological studies in the mid-20<sup>th</sup> century. The ideal occlusal index should be easy to use, reliable, valid, specific and sensitive (categorize people in need or not of treatment) (Bellot-Arcís et al. 2012).

The biggest survey to assess malocclusion was conducted in the U.S. by the National Health and Nutrition Estimates Survey (NHANES). In this survey, the major characteristics of malocclusion were measured on 7000 individuals to assess the prevalence of malocclusion and health care problems and needs in the United States in 1989-1994.

The development of malocclusion can be caused by either genetic or environmental factors. In fact many factors are affected by heredity (Stoddard 1947): arch length and width, height of the palatal vault, tooth size, number and shape, crowding or spacing, overbite and overjet, configuration of muscles, tongue size and shape, character of periodontium, congenital deformities, size and position of the jaws, variations in tooth shape. On the other hand environmental factors such as injuries, posture, metabolic factors, diseases, nutritive and non-nutritive sucking behavior, diet, dental caries, early extraction of deciduous teeth, abnormal swallowing and mouth breathing can lead to development of a malocclusion (Larsson 2001; Warren & Bishara 2002).

Moreover, people with poor socioeconomic background are also implicated in the presence and the severity of oral health in general and more precisely malocclusion (Frazão & Narvai 2006; Locker et al. 2007). This was mainly explained by an increase in: stress levels, lack of control over home and work life, social exclusion, poor social support and less access to dental care (WHO 2010).

With the presence of social inequalities in Lebanon, this study was conducted to evaluate the magnitude of the problem by assessing whether there are disparities in malocclusion severity between different social backgrounds. Moreover, we wanted to compare the need of orthodontic treatment in Lebanon to its correspondence in developed countries such as the United States of America. The measurements were conducted in elementary school children aged between 6 and 11 years, a critical age at which prevention should start. [www.aaomembers.org](http://www.aaomembers.org).

## CHAPTER II

### LITERATURE REVIEW

#### **A. Epidemiology Of Malocclusion**

##### ***I. Prevalence***

The epidemiology of malocclusion dates back to 500 years B.C. when Hippocrates talked about crooked teeth in his sixth book on epidemics. Although great epidemiological work has been done regarding classification and etiology of malocclusion, Baume (1970) found that the exploration of these conditions is still considered scarce.

The assessment of malocclusion has not been done uniformly throughout the history since each description relies on a different scoring system allowing subjective assessment (Bjork et al. 1964) which eventually leads to different reporting of orthodontic treatment need.

Prevalence of malocclusion in deciduous dentition (primary teeth) varied immensely in different studies and countries. In the US, Prevalence of malocclusion among children varies from 13 % to 50 % 49.8 % (Jones et al.,1993; Trottman and Elsbach ,1996). The range of prevalence was similar among African children 18% (Kerosuo 1990) to 51% (Kabue et al.1995) but higher among in European children (42% to 75.1%) (Visković et al.1990; Stahl and Grabowski 2003; Grabowski et al. 2007; Robke 2008). These variations in figures are due to the difference in races/ethnicity and the methodology of measurement. Wide variations exist in the percent of malocclusion in the mixed and permanent dentition among different studies. Data published by the World Health Organization (1985) on 13-14

year old children from 10 industrialized countries showed a presence of orthodontic treatment need ranging from 21% to 64%. Moreover, malocclusion in the mixed and permanent dentition has been reported to range from 39% in Indian (Dhar et al., 2007) to 98% in Tanzanian (Rwakatema et al., 2006) children.

Regarding the classification of malocclusion, fewer differences were found especially among the same ethnic groups. Proffit et al. (1998) , relying on the overjet and not the molar relationship, found that in Caucasian children aged 8-11 years, 74.8% had a CI I, 22.5% had a CI II and 2.9% had a CI III malocclusion. Based on the molar occlusion, Rodrigues de Almeida et al. (2011) reported that in 7-12 years old Brazilian children, 55.25% of the children had a Class I molar relationship, 38%, Class II, and 6.75%, Class III. Slightly different findings were reported by Alves de Souza et al. (2007); 69.9% had a CI I, 21.9% had a CI II while 3.7% had a CI III malocclusion. Gábris et al. (2006) reported a Class I occlusion in 49.1% of the subjects, 39.1% presented a CI II and 8.1% CI III malocclusion in Hungarian school children. In Indian school children aged 8-12, Mohen Das et al. (2008) found that CI I was found in 61.6% of the children, 8.4 % had a CI II and 0.6% had a CI III.

In the Middle East and northern Africa region, fewer studies have been conducted to describe the malocclusion. In Saudi Arabia, Al-Emran et al. (1990) investigated the malocclusion in 500 male Saudi Arabian children, 14-yr-old and reported that 62.4% of the children had one or more malocclusion features related. Murshir et al. (2010) in a sample of 1,024 adolescents aged 13-14 years found that 91% of the surveyed subjects exhibited some occlusal anomalies. Behbehani et al. (2005) in a population of 1,299 Kuwaitis (674 of mean age 13.2 years found that 70% of young adolescent Kuwaitis have moderate to severe

malocclusion. Farawana (1987) studied the characteristics in 200 Iraqi orthodontic patients and found that the predominant skeletal and arch relationship in Iraqi patients is Class I followed by Cl II and Cl III. Abu Affan et al. (1990) in a sample of 645 12 year old children that Cl I occlusion existed in 77.6% of children. Abu Alhaija et al. (2005) found 92% of 1003 children (13-15 years) had some type of malocclusion.

In Egypt, El Mangoury and Mostafa (1990) in a sample of 501 18-24 year olds subjects found that Cl I occlusion is predominant in the population. Moreover, they found that Cl I is more frequent in females while Cl III is more prevalent in males. Krzypoiv et al. (1974) found after examining 538 randomly picked recruits in the regular army, aged 18 to 20 years, that Cl I relationship is predominant. They also assessed other aspects of malocclusion and found that no correlation existed between malocclusions and anthropological skull measurements since these measurements differ significantly and considerably by ethnic group and sex. Alkilzy et al. (2007) found that in 234 subjects aged 2-16 years presenting for treatment at the pediatric dentistry department that 57.3% of the malocclusions affected the anterior-posterior plane, 12.4% the vertical, and 35.9% the transverse.

Kassis et al. (2010) in a sample of 410 Lebanese orthodontic patients reported that most patients presenting for orthodontic treatment suffer from a Cl II malocclusion (49.02%) and that the malocclusion was not significantly different between males and females. Saleh (1999) surveying 851 Lebanese students aged 9-15 years, found that 59.5% of the sample had some kind of malocclusion, 35.5% of which were of dental origin and 24% had skeletal discrepancy (19% Class II and 5% Class III malocclusions). Statistically

significant differences were found between males and females (CI I more in females and CI II more in males).

Disagreement in the prevalence figures between all the studies might be explained by the differences in ethnic characteristics, differences in sample sizes, as well as the age range of children surveyed. In addition, the different registration methods of the malocclusion play an important role for the variation in the prevalence figures.

## ***2. Occlusal Indices***

### **a. Introduction**

Occlusal indices are continuous or ordinal scales used as epidemiological tools to assess the severity and the burden of malocclusion. Most of them must have been developed with the following aims: classifying malocclusions; allowing easier communication between professionals; accumulating databases to facilitate epidemiological studies, classifying cases according to the complexity of their treatment, determining treatment needs and priorities; and identifying the aesthetic aspects that affect treatment need (Abdullah & Rock 2001). This allows determining treatment priority, thus singling out the subjects who will most benefit from orthodontic treatment in a governmental or non-governmental health service system.

Depending on the index, each feature of the malocclusion has a weight in the overall severity of the malocclusion based on personal experience, agreement between specialists, studies and social/administrative needs. The main shortcoming of these indices is that they do not take into consideration how the malocclusion is or will be affecting lives of subjects;

an issue that has been put into perspective in the last few years (Kok et al., 2004). Although many occlusal indices have been created, it is widely agreed that an ideal occlusal index should meet the following criteria: validity, objectivity, reliability (accuracy or reproducibility), simplicity, flexibility (in order to be modified over time) (Bellot-Arcís et al. 2012).

b. Overview of occlusal indices

Occlusal indices started to be used in epidemiological studies in the mid of the 20th century. Since then, several orthodontic treatment need indices have been introduced and used to quantify the malocclusion: the Salzmann's Handicapping Malocclusion Assessment Record (Salzmann, 1968), the Draker's HLD index (Draker, 1960, 1967) the Orthodontic Treatment Priority Index (Grainger, 1961), the Summer's occlusal index (Summers, 1971), the Swedish national board for health and welfare index or 'the Swedish Medical Board Index (SMBI)' (Swedish Medical Health Board, 1966; Linder- Aronson, 1974, 1976), the Indication Index (Lundstrom, 1977), the DAI (Cons et al., 1986), the Norwegian index of orthodontic treatment need (Espeland et al., 1992), the SCAN index (the Standardized Continuum of Aesthetic Need) (Evans & Shaw, 1987), the IOTN (Brook & Shaw, 1989), and the ICON (Daniels & Richmond, 2000), index (OI), the treatment priority index (TPI), index of treatment need (IOTN), peer assessment rating index (PAR), index of complexity outcome and need (ICON), the national health and nutrition examination survey criteria (NHANES III) and the Bjork criteria. These indices are based on the amount of discrepancy between the teeth in the sagittal, vertical and transverse dimensions and were classified into

five different categories (Shaw et al., 1995): diagnostic, epidemiologic, orthodontic treatment need, treatment outcome, and Orthodontic treatment complexity indices.

In this study we used the IOTN index since it is one of the most commonly used occlusal indices that assesses the orthodontic treatment need among children and adults.

The IOTN has two separate components: the Dental Health Component (DHC) and the Aesthetic Component (AC). These two components and both are recorded separately. The DHC of the IOTN is similar to the index used by the Swedish Medical Health Board 'the Swedish Medical Board Index (SMBI)' (Swedish Medical Health Board 1966; Linder-Aronson 1974, 1976). Originally the Swedish index was developed having 4 categories of need (grade 1 to 4). Later on, Linder-Aronson et al. (1976) revised the added the grade zero referring to subjects with no need for treatment.

The DHC has five grades ranging from grade one, 'no need', to grade five, 'very great need'. Depending on the worst single occlusal trait, each malocclusion will be given a grade. In the IOTN, the aspects of malocclusion that are taken into consideration are the following: missing teeth, overjet, crossbites, displacement of contact points, and overbite (including open bite). The Aesthetic Component (AC) comprises a 10-point scale illustrated by a series of photographs that are organized for attractiveness (Evans & Shaw, 1987). The validity and reliability of the IOTN have been tested previously (Richmond et al. 1993; Burden & Holmes 1994; Burden et al., 1994). The modified IOTN is divided into a scale of two-grades: need and no definite need), replacing 5 grades. The modified IOTN, used in most epidemiological studies, was intended to simplify identifying who is in need of treatment and improving the reliability and validity of the index (Burden et al., 2001). By

using the modified IOTN, every case with IOTN DHC  $\geq 4$  and/or IOTN AC  $\geq 8$  is classified as being in need of treatment.

Some disadvantages of this index were reported. In fact, Evans and Shaw (1987) observed was that the aesthetic scale failed to represent the discrepancies in the antero-posterior plane. In addition, Ghafari et al. (1989) stated that even though occlusal indices help describing the general need for treatment in a given population, they should not be applied to the individual patient since problems involving a single tooth or minimally affecting an individual's well-being are ranked last while functional problems tend to have a higher weight.

c. Epidemiological surveys using the IOTN

The use of the IOTN index in epidemiological surveys is very frequent. These studies, reported IOTN grades of 4 and 5 reflecting (modified IOTN) to report the need of treatment. Proffit et al. (1998) using data of the NHANES III survey found that the need of treatment increases with age starting at 10.2% in American Caucasian children and reaching 13.5% in teenage Americans. His findings also revealed that IOTN index is more severe in African-American subjects and less severe in Mexican-American subjects. De Olivera and Sheiham (2003) reported that 22% of Brazilian adolescents were in need of treatment. In New Zealand, Johnson et al. (2000) reported a proportion 31.3% of the studied sample that was in need of treatment.

Tuominen et al. (1995) and Kerosuo et al. (2000) found that 11 to 15% of Finnish adolescents were in need of treatment that. However, that number reached 26.1% in

Norway (Birkeland et al. 1996). The need of treatment reported by Souames et al. (2006) reached 21.3% of French children. An IOTN grade bigger than 4 was found in 26.2% of young German children and that number reached 60.2% of young German adults (Riedmann and Berg 1999; Tausche et al. 2004). Manzanera (2008) reported that out of the 655 Spanish teenagers that were screened, 17.1% were in need of treatment. Reported treatment need Turkish studies differed widely and varied between 38.8 and 74% (Uçüncü y Ertugay 2001; Esra Ertugay 2011; Dogan et al. 2010).

In the UK, different studies have shown divergent findings. In fact, Alkhatib et al. (2005) found that 15% of the British schoolchildren required treatment. This proportion increased in other studies reaching a number of 44.8% (Brook and Shaw 1989; Burden and Holmes 1994; Tickle et al. 1999; Cooper et al. 2000; Mandall et al. 2000, 2005).

In Africa, Hlongwa et al. (2004) found that 3-13% of Tanzanian children were in need of treatment; the findings of Otuyemi et al. (1997) in Nigerian children were similar (12.6%). An IOTN bigger than 4 was reported in 22% of the children by Mugonzibwa et al. (2004); the number reached 42.6% in the study of Ngom et al. (2006).

Most studies conducted in East Asia reveal much higher need of treatment. The DHC of the IOTN of grades 4 and 5 was found in 30 to 54% (Abdullah and Rock 2001; So and Tang 1993; So and Tang 1993 and 1995; Soh et al. 2005).

In the Arab region, proportion of subjects requiring orthodontic treatment was homogenous between different studies. In fact, the range of treatment need was between 28 and 34% of all subjects (Abu Alhaija et al. 2004; Al-Azemi 2009; Hassan and Amin 2010; Hamdam 2001; Kerosuo et al. 2004). However, the proportion varied from 18% (Puertes-Fernández et al. 2010) to 71 % ( Hamdam 2004; Hassan 2006).

<b>Authors (publication year)</b>	<b>Country</b>	<b>zn</b>	<b>Age</b>	<b>DHC(4-5)</b>
Hlongwa et al. (2004)	Tanzania	643	15-16	3-13%
Tuominen et al. (1995)	Finland	89	16-19	11.20%
Otuyemi et al. (1997)	Nigeria	704	12-18	12.60%
Kerosuo et al. (2000)	Finland	281	18-19	15%
Alkhatib et al. (2005)	UK	3500	12-14	15%
Manzanera(2009)	Spain	655	12 & 16	17.10%
Mandall et al. (2000)	UK	434	14-15	18%
Puertes-Fernández et al. (2010)	Algeria	248	12	18.10%
Cooper et al. (2000)	UK	142	19	21%
Souames et al.(2006)	France	511	9-12	21.30%
De Olivera and Sheiham (2003)	Brazil	1675	15-16	22%
Mugonzibwa et al. (2004)	Tanzania	386	9-18	22%
Birkeland et al. (1996)	Norway	359	11	26.10%
Tausche et al. (2004)	Germany	1975	6-8	26.20%
Tickle et al. (1999)	UK	7888	14	26.20%
Hamdam (2001)	Jordan	320	14-17	28%
Kerosuo et al. (2004)	Kuwait	139	14-18	28.10%
Hassan and Amin (2010)	Saudi Arabia	366	21-25	29.20%
Abdullah and Rock (2001)	Malaysia	5112	12-13	30%
Al-Azemi (2009)	Kuwait	1481	13-14	31.10%
Johnson et al. (2000)	New Zealand	294	10	31.30%
Burden and Holmes (1994)	UK	874 955	11-12	31%
Brook and Shaw (1989)	UK	222	11-12	32%
Cooper et al. (2000)	UK	314	11	32.70%
Abu Alhaija et al. (2004)	Jordan	1002	12-14	34%
Uçüncü y Ertugay (2001)	Turkey	250	11-14	34%
Esra Ertugay (2011)	Turkey	250	11-40	38.80%
Ngom et al.(2006)	Senegal	665	12-13	38.80%
Mandall et al. (2005)	UK	525	11-12	42.60%
Soh et al. (2005)	Singapore	339	17-22	44.80%

So and Tang (1993)	China	100	20	50.10%
So and Tang (1993)	Hong Kong	100	19-20	52%
Tang and So (1995)	Hong Kong	105	18-22	53%
Riedmann and Berg (1999)	Germany	88	20	54.20%
Hamdam (2004)	Jordan	103	15	60.20%
Hassan (2006)	Saudi Arabia	743	17-24	71%
Dogan et al.(2010)	Turkey	208	9-18	71.60%

## **B. Factors Associated With Malocclusion**

It is not yet established that any genetic or environmental factor causes malocclusion. However, many factors have been associated with the presence of malocclusion and its severity.

### **1. Genetic**

Many contradictions have been found in the literature about the role of genetics in the establishment of malocclusion. In fact, there is confusion in the literature between the skeletal and dental causes of malocclusion (Ackerman and Proffit, 1969). Stoddard (1947) attributed the presence of malocclusion to factors affected by heredity: arch length and width, height of the palatal vault, tooth size, number and shape, crowding or spacing, overbite and overjet, configuration of muscles, tongue size and shape, character of periodontium, congenital deformities, size and position of the jaws, variations in tooth shape. Other authors related the homogeneity of a population to the installment of the malocclusion. Lombardi (1982) observed that more primitive populations tend to have a decreased prevalence of malocclusion compared to populations in industrialized countries

and he related it to the fact that the former populations are more homogenous thus there is a higher concordance between tooth and jaw size. Mossey (1999) had similar interpretations. Furthermore, Lombardi (1982) observed that in isolated populations, malocclusion is almost nonexistent. However in heterogeneous populations, the incidence of jaw discrepancy and occlusal disharmonies are significantly greater. Smith and Bailit (1977) attributed a great role to heredity in the development of malocclusion. The development of malocclusion can be caused by either genetic or environmental factors.

An additional finding of Mossey in 1999 is that an association of genetic and environmental factors is responsible of narrower maxillary arches and greater crowding. Moreover, he highlighted the fact that certain genetically determined conditions such craniofacial types are more vulnerable towards being affected by environmental factors tend to show a greater susceptibility to certain environmental factors.

## ***2. Environmental***

Environmental factors have been shown to play an important role related to malocclusion. Schopf (1981) found that in 75% of the subjects, the occurrence of anomalies had been encouraged by environmental factors such as caries in deciduous teeth, early loss of teeth, and biting habits. Moreover, Harris and Smith (1980) environmental factors are more important genetic parameters for occlusal variables such as overjet, overbite, molar relationship, crowding, and rotations.

Diet is important factor that in the installment of malocclusion. Associations have been found between a decreased prevalence of crowding and quality of food. Begg (1954)

tendency towards an increase in the consumption of softer foods is leading into a decrease in interstitial attrition causing more crowding in modern man. He also observed that among Australian aborigines consuming a primitive diet, almost 11 mm of arch length could be lost to interproximal wear. Begg explained this finding by a positive correlation between interproximal wear and chewing force required by the diet.

In another study, the interproximal wear was found to be around 21 mm in Australian aborigines and other primitive populations (Wolpoff 1971). Lombardi (1982) attributed the low incidence of crowding in primitive populations to the high degree of interproximal attrition and not from a more harmonious concordance of tooth and jaw size.

Sucking habit, a common behavior among young children, has been associated with the presence of some aspects of malocclusion. Many studies found that prolonged sucking habit leads to maxillary arch width and increased mandibular arch width, with a correspondingly higher prevalence of posterior crossbite and anterior open bite (Øgaard et al., 1994, Karjalainen et al., 1999, Larsson, 2001, Warren and Bishara, 2002). This was explained by the fact that sucking habits tend to initiate tongue thrust and abnormal swallowing pattern (Rønning and Thilander, 1995).

Conflicting findings were reported in other studies revealing that sucking habits have no or minimal association with the presence of certain parameters of malocclusion (Farsi and Salama, 1997; Warren and Bishara, 2002).

### ***3. Social determinants of oral health***

Few studies have directly related malocclusion and its severity to the social status of the subjects. Tickle et al. (1999) found that in British children with relatively poor lifestyle have a higher orthodontic treatment need compared to their counterparts with wealthier lifestyle. Moreover, Doğan et al. (2010) found that there is a negative correlation between the family income and the orthodontic treatment need. Mtaya et al. (2009) found that less socio-economically privileged Tanzanian children tend to have an increase in the incidence of open bite and that was related to increase in sucking habits duration. In addition, social status can affect malocclusion indirectly. In fact, people underprivileged people have an unhealthy lifestyle thus they are more exposed to risk factors that affect oral health: unhealthy diet, use of tobacco, excessive consumption of alcohol, poor sanitation and water, poor oral hygiene and infection with HIV (WHO 2005). Moreover, Gratrix and Holloway (1994) have shown that the incidence of dental caries is higher among people with social and financial problems.

Other studies (Melsen and Terp 1982; Frazão and Narvai 2006) found that poor oral health leads to caries and early tooth loss and causes the development of malocclusion and increases the need for orthodontic treatment.

### **C. Significance**

The available data on malocclusion in Lebanon concerns the age frame from 9-15 years. Prevention is usually done at an earlier stage thus the importance of assessing the prevalence of malocclusion in elementary school children aged between 6 and 11 years and

relating it to factors in early childhood will help in preventing or decreasing the severity of the malocclusion specially that most orthodontic patients present for treatment in later stages when opportunities of earlier intervention have been missed.

This information is important to public health workers to plan a well-organized orthodontic service and build up intervention programs based and highlighting the importance of early orthodontic screening.

#### **D. Objectives**

1. Assess and compare the prevalence of malocclusion and its severity between private and public schools.
2. Associate socio demographic factors, (age, gender, socio-economic status, education of parents, occupation, and annual income of the parents) and selected behavioral background factors of both children and parents to the prevalence of malocclusion and its severity.
3. Estimate the orthodontic treatment need in Lebanese school children and compare it to other countries.
4. Build up a cohort for subsequent follow-up on oral health in general and malocclusion in specific and oral health surveys.

## CHAPTER III

### METHODOLOGY

#### **A. Research Design**

The study was a comparative cross-sectional study of elementary school children aged 6-11 years old, grades 2 to 5, in public and private schools in Beirut-Lebanon. The data was collected through an oral exam and a self-administered questionnaire sent to parents/guardian. The units of observation were both the child and the parents.

#### **B. Participants**

##### ***1. Public Schools***

From a total of 30 public schools in Beirut served by a local Non-Governmental Organization (NGO, Ajjalouna) 2 public schools were chosen based on a timetable provided by NGO to indicate the readiness of schools for the current survey. Ajjalouna is a non-governmental organization that was established in 1995 in Beirut under the notification of association #41/D. Its main goals are to work on improving life standards at many levels by engaging in multiple projects such as school health, health education programs, orphan sponsorship and others. Ajjalouna provide free dental care for students older than 7 years that are enrolled in affiliated public schools.

A total of 530 school children were reached for oral examination in the 2 public schools: Mohammad Shamel Public School in Tarik Jdide (n= 350) and Tarik Jdid public school for boys and girls (n=180). However, 325 students were part of the current research

study as the parents for the remaining children did not consent for participation yielding a response rate of 61.3 %. From the consented children, 319 approved on being followed up.

## **2. *Private Schools***

Private schools were approached based on their location (Beirut and suburbs) and their middle to high social level. Out of 12 schools approached, 5 only agreed to have their students' parents approached: Sagesse Brazilia Baabda (n=604), Collège du Sacré-Coeur Gemmayzé (n=231), L'Elysee Baabda (n=171), Besancon School Beirut (n=83) and Al Ahlia School Beirut (n=110). Out of a total of 1119 parents that were approached, only 330 agreed to have their child participate in the study leading to a response rate of 29.4%. The latter was relatively low since in some of these private schools, dental screening had already been performed in the beginning of the year or a large proportion of the children were regularly followed up by their private dentist. This discouraged the parents into signing the consent form. Moreover, after having the approval of the school's administration in 2 other private institutions, the dentist in one school refused the screening process stating that it was not appropriate to have a dental screening when another one has already been done. While in the other school, the school's administration revised the issue and decided not to allow the screenings to be done claiming that it will lead into loss of school's personal's time and effort. Out of the 330 students that participated in the study, 327 agreed on being followed up for future research. The total sample size including both private and public schools was equal to 665.

### **C. Exclusion Criteria**

Subjects were excluded if they had undergone or were undergoing interceptive orthodontic treatment such as the use of any type of appliances to enhance differential growth, appliances to expand the maxilla or braces used for any type of tooth movement. This study, 3 school children were excluded from the study. All of them were from private schools.

### **D. Calibration**

Data collection was preceded by clinical calibrations of the examiners to minimize all subjective interpretation and ensure validity and reliability of measures. Measurements were done on 10 study models by each examiner and an experienced orthodontist (RH). The Spearman's Correlation Test revealed very high correlation ( $>0.94$ ) for all the quantitative measurements performed. As for the categorical outcomes the calculated Kappa statistic and percent agreement also revealed high correlations (0.85, 0.87 respectively).

### **E. Measures**

The National Health National Health and Nutrition Estimates Survey (NHANES) malocclusion assessment included the evaluation of 5 factors: crowding, midline diastema, posterior crossbite, overjet, overbite and the molars relationship. We modified the use of this criterion to have a more complete description of the malocclusion. The molar occlusion was divided it into 5 categories based on half cusp deviation, the overbite percentage reflected not only how many millimeters the maxillary incisors cover the mandibular ones

but also the percentage of the mandibular incisors that is being covered by the maxillary ones. The presence an impinging bite suggesting trauma on the palatal mucosa of the maxillary incisors was added to the indicator.

In the study, the maxillary irregularity index was not recorded since the sample age bracket (6-11 years) is less than the one used in the NHANES study (8-11 years) thus we anticipated having a lot of children with non-erupted maxillary lateral incisors. Moreover, Proffit (1998) found that there is a high correlation between the maxillary and mandibular irregularity score with the latter increasing more from childhood to adulthood. This provided us with some confidence of using only the mandibular irregularity score to represent the amount of crowding present.

Outcome was classified into either an ordinal variable (crowding, overjet, and overbite) reflecting the severity, quantitative measurements (number of teeth in crossbite and percentage of overbite) or nominal measurements (Molar and canine occlusion).

## ***1. Occlusal Indices***

### ***a. Occlusion***

The occlusion was assessed on the molars and the canines and classified based on the relationship between the mesial cusp of the maxillary first molar and the mesial fossa of the mandibular first molar (molar occlusion) and the relationship between the maxillary canine and its correspondent in the mandibular arch (canines occlusion). A CI I was recorded if the cusp of the maxillary 1<sup>st</sup> molar was in the mesial fossa of the mandibular one and if the cusp-tip of the maxillary canine was in the embrasure formed by the mandibular canine and 1<sup>st</sup> premolar.

If the maxillary reference point deviated half a cusp of a full cusp mesially relative to the mandibular reference point, it was considered as CI II end-on and Full CI II respectively.

If the maxillary reference point deviated half a cusp of a full cusp distally relative to the mandibular reference point, it was considered as CI III end-on and Full CI III respectively (figure 1).

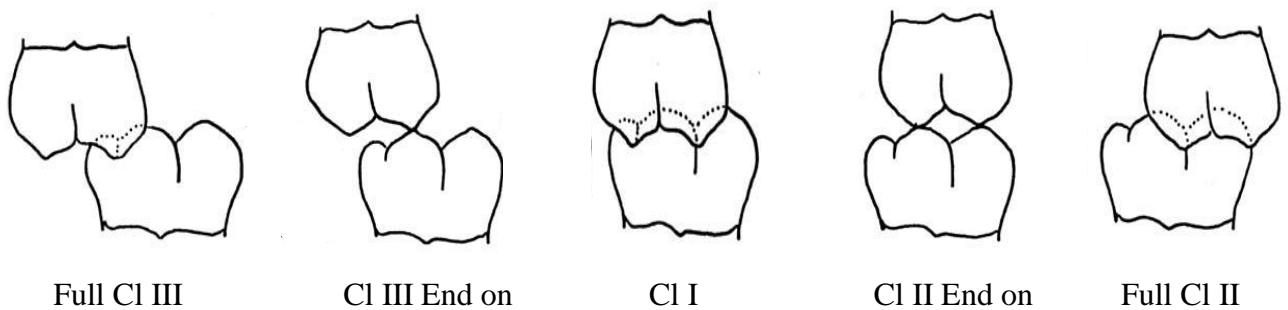


Figure 1: Progression of a molar relationship from a full CI III to a full CI II (drawing adapted from Aisha Bataringaya; 2004)

In case the permanent molars were not erupted, the occlusion on the primary molars was evaluated based on the terminal plane (flush, mesial step and distal step).

The canine occlusion was registered whether the canines were permanent or primary.

b. Overjet:

The overjet was measured from the most labial point of the incisal edge of maxillary right central incisor to the most labial surface of the corresponding mandibular incisor using a periodontal probe (figure 2). In case the maxillary incisors were not present, the overjet was recorded as missing data. It was categorized into groups reflecting severity of overjet, ranging from ideal to extreme:

- Overjet (mm)
- a) >10 [extreme]
  - b) -7-10 [severe]
  - c) 5-6 [moderate]
  - d) 3-4 [mild]
  - e) 1-2 [Ideal]



Normal overjet



Increased overjet



Anterior crossbite

Figure 2: Variations in horizontal overjet

c. Anterior crossbite:

The anterior crossbite was represented by the number of teeth presenting a negative overjet (figure 2) and by the amount of the anterior crossbite in millimeters. In case, the anterior teeth present different amount of crossbite, the most severe measurement was recorded.

d. Overbite:

The vertical overlap of incisors was measured in millimeters vertically from the incisal edge of the maxillary central incisors to the incisal edge of the corresponding mandibular ones (figure 3). To measure the percentage of overbite, the height of the mandibular central incisors was gaged and then the vertical overlap of incisors in millimeters was divided by the height of the mandibular incisors to obtain the percentage of overbite. In case the mandibular incisors had different heights, the longest mandibular incisor was measured.

An impinging bite was noted in case the incisal edge of the mandibular incisors was hitting the palatal mucosa of the corresponding maxillary incisors. It was categorized into groups reflecting severity of the bite, ranging from ideal to extreme:

Deep bite (mm)

- a) 0-2 [Ideal]
- b) 3-4 [moderate]
- c) 5-7 [severe]
- d) >7[extreme]

e. Open bite

The anterior open bite was recorded when no vertical overlap of fully erupted anterior teeth was present (figure 3). In case, the anterior teeth present different amount of open bite, the most severe measurement was recorded. The severity of the open bite was also classified in categories

Open bite (mm)

- a) >-4[extreme]
- b) -3 to -4[severe]
- c) 0 to -2[moderate]
- d) 0-2 [Ideal]



Normal overbite



Increased overbite  
(Deep bite)



Absence of overbite  
(Open bite)

Figure 3: Variations in vertical overbite

f. Posterior crossbite

The number of teeth in posterior crossbite was recorded. Posterior crossbite exists when the maxillary posterior teeth are lingually positioned relative to the mandibular teeth (figure 4).



Figure 4: Recording of posterior crossbite

g. Midline Diastema

The midline diastema was recorded in millimeters if a space was present between the maxillary central incisors (figure 5).



Figure 5: Measurement of midline diastema

h. Irregularity Index

The irregularity index is calculated by summing the horizontal linear distance between anatomic contacts of the mandibular incisors in the labiolingual direction parallel to the occlusal plane, starting from and ending at the mesial anatomic contacts of the canines (figure 6). The sum of the 5 measurements is the irregularity score. The latter was divided into 5 categories each one reflecting the severity of the crowding:

Crowding (Irregularity Index) (mm):

- a) 0-1 [ideal]
- b) 2-3 [mild crowding]
- c) 4-6 [moderate]
- d) 7-10 [severe]
- e) >10 [extreme]

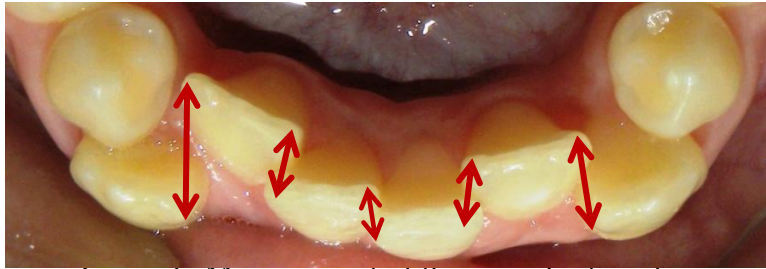


Figure 6: Measurement of the irregularity index

i. Additional findings

Any additional finding that required reporting besides the malocclusion characteristics that were previously detailed was noted on the examination sheet separately. Some of these findings included: Missing teeth, Supernumerary teeth, and impeded eruption of teeth.

The DMFT (Decayed Missing and Filled Teeth) along with the plaque index were recorded for each child by another investigator in a different part of the study.

j. Index of orthodontic treatment need (IOTN)

The dental health component (DHC) of the IOTN was calculated based on the following factors: missing teeth, overjet, crossbite, displacement of contact points and overbite. Each parameter has a weight in the total IOTN score depending on its presence

or not, and its severity if present. Subject will have a grade of malocclusion severity depending on the worst malocclusion parameter present:

- **Grade 1** is almost perfection (no treatment need)
- **Grade 2** (minimal treatment need) is for minor irregularities such as:
  - 2.a Increased overjet greater than 3.5 mm but less than or equal to 6 mm with competent lips
  - 2.b Reverse overjet greater than 3.5 mm but less than or equal to 1 mm
  - 2.c Anterior or posterior crossbite with a discrepancy of less than or equal to 1 mm between retruded contact position and intercuspal position
  - 2.d Contact point displacements greater than 1 mm but less than or equal to 2 mm
  - 2.e Anterior or posterior open bite greater than 1 mm but less than or equal to 2 mm
  - 2.f Increased overbite greater than or equal to 3.5 mm without gingival contact
  - 2.g Pre-normal or post-normal occlusions with no other anomalies (includes up to half a unit of discrepancy)
- **Grade 3** (moderate treatment need) is for greater irregularities which normally do not need treatment for health reasons.
  - 3.a Increased overjet greater than 3.5 mm but less than or equal to 6 mm with incompetent lips
  - 3.b Reverse overjet greater than 1 mm but less than or equal to 3.5 mm

- 3.c Anterior or posterior crossbites with a discrepancy of more than 1 mm but less than or equal to 2 mm between retruded contact position and intercuspal position
- 3.d Contact point displacements greater than 2 mm but less than or equal to 4 mm
- 3.e Lateral or anterior open bite greater than 2 mm but less than or equal to 4 mm
- 3.f Deep overbite complete on gingival or palatal tissues but no trauma
- **Grade 4** (definite treatment need) is for more severe degrees of irregularity and these do require treatment for health reasons.
  - 4.h Less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for a prosthesis
  - 4.a Increased overjet greater than 6 mm but less than or equal to 9 mm
  - 4.b Reverse overjet greater than 3.5 mm with no masticatory or speech difficulties
  - 4.m Reverse overjet greater than 1 mm but less than 3.5 mm with recorded masticatory and speech difficulties
  - 4.c Anterior or posterior crossbite with a discrepancy of more than 2 mm between retruded contact position and intercuspal position
  - 4.l Posterior lingual crossbite with no functional occlusal contact in 1 or both buccal segments
  - 4.d Severe contact point displacements greater than 4 mm
  - 4.e Extreme lateral or anterior open bite greater than 4 mm

- 4.f Increased and complete overbite with gingival or palatal trauma
- 4.t Partially erupted teeth, tipped and impacted against adjacent teeth
- 4.x Presence of supernumerary teeth
- **Grade 5** (definite treatment need) is for severe dental health problems I when teeth cannot come into the mouth normally because of obstruction by crowding, additional teeth or any other cause.
  - 5.i Impeded eruption of teeth (except for third molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth and any pathological cause
  - 5.h Extensive hypodontia with restorative implications (more than 1 tooth missing in any quadrant) requiring pre-restorative orthodontics
  - 5.a Increased overjet greater than 9 mm
  - 5.m Reverse overjet greater than 3.5 mm with reported masticatory and speech difficulties
  - 5.p Defects of cleft lip and palate and other craniofacial anomalies
  - 5.s Submerged deciduous teeth

## **F. Procedures**

Data collection originated from two sources: a dental examination where the children were screened and oral health assessed and a questionnaire in Arabic that was sent to the parents.

## ***1. Dental Screening***

Dental examination was divided into two parts: the first was to collect data on occlusion indices and this was performed by the study principal investigator (AH); the second done by another dentist who examined the kids for their oral hygiene (plaque and DMFT). All measures were done by the same investigator using non-invasive dental instruments including mouth mirrors, probes and periodontal probes (ZFA043 #11). All these instruments were sterilized and disposable to reduce the risk of cross-infections. Disposable latex gloves and facial masks were also used during the clinical examination. On average of 35-40 children were examined every day and each examination required around 5 minutes.

The screenings were performed in a separate isolated room with the child sitting on a chair facing a window providing natural light with his head lied back. Trained assistants helped in filling out the charts during the examination time. Identifiers (serial numbers) were used for schools, children and examiners to protect privacy and ensure confidentiality.

## ***2. Questionnaire***

The questionnaire that was sent to the parents along with the consent forms was in Arabic and included 41 questions. In case the parents or legal guardians were illiterate or visually impaired, information and consent were given orally and a member of the research team registered the information (Appendix I). This process was possible since phone numbers of the research team were provided in the consent form. The questionnaire aimed

on collecting data on factors associated with the outcome variable (malocclusion) and it was divided into the following 5 different categories:

a. The socio-demographic background of child and parents

In this section data we collected data on:

- a. Family status of the respondent (married, single or divorced)
- b. Educational background of the respondent. This was divided in 6 categories covering all levels between illiteracy and college degree.
- c. Monthly income of the family divided into 4 categories going from less than 500,000 LL to more than 3,000,000 LL per month.
- d. The child's birth order.

b. The general health status of the child

This section comprised:

- a. The presence or not of any types of chronic diseases (heart problems, blood abnormalities, diabetes, cancer, pulmonary complications and others) and if present whether or not any member in the family has it.
- b. The breathing mode of the child (mouth, nose or both) and whether the child had treatment and at which age in case he has a mouth breathing pattern.
- c. The smoking status of the mother during pregnancy. We collected data on what the mother smoked (cigarettes or arguileh), during which trimester of the pregnancy and how much did she smoke (1-10, 11-20 or more than 20 cigarettes per day).

c. Sucking habits of the child

This section included data on:

- a. What object did the child suck: finger, lip or any other object.
- b. The duration of the habit (what age the child started and what age he stopped).
- c. The intensity of the duration each day: from less than 1 hour to more than 6 hours.
- d. Feeding methods of the child

Data was collected in this section included:

- a. Feeding mode of child during infancy (breast or bottle feeding) in addition to the duration of the breast/bottle feeding (less than 6 months to more than 2 years).
  - b. How often did the child consume detrimental eating habits (sugars and soda), along with the frequency (more than once per day to occasional consumption) and the timing of consumption during the day.
- e. Oral health behaviors

In this section we collected data on habits comprising:

- a. Information on brushing habits particularly the frequency of brushing (more than once per day to never brushing) and what kind of substance is used with the tooth brush.
- b. When was the last visit to the dentist if the child had ever been to a dentist and for what reason the visit was done (checkup, cleaning, decays, pain...).

Moreover, we the questionnaire included 2 questions to assess the perception of the parents towards their child's oral health (Malocclusion and decays).

## **G. Ethics**

### ***1. Respect For Person***

In order to protect subjects' privacy and assure full confidentiality, all dental examination sheets and questionnaires were coded using serial numbers as identifiers.

### ***2. Beneficence/Non-Maleficence***

#### ***a. Public schools***

The examination of the children was facilitated by Ajjalouna NGO. This organization has clearance from the Ministry of education and from the schools' administrations to examine the children. Therefore we were able to examine all children in selected public schools. However, in order to use the data from the screening, we had to get the authorization of the parents. Therefore, after the examination, a paper was sent to the parents via the child. The paper includes all information regarding the study, a consent to fill out a questionnaire, a consent allowing us to follow up in case additional data is needed in the coming few years, a consent to have the use the data of the examination and the questionnaire to be filled out (Appendix II).

#### ***b. Private schools***

In private schools, after having the schools' permission and prior to the oral screening, a paper with similar information then the one used for the public schools was sent to the parents via the children (Appendix III). We only examined subjects when we had the parent's authorization.

c. Child's assent

As required by the Institutional Review Board at AUB, all children were assented orally before starting the examination by explaining to them what will be the procedure and whether they agree or not on having it. Children aged more than 7 years signed the assent form (Appendix IV).

d. Examination procedure

The examination of the child was done with his mouth opened using non-invasive, sterile and disposable instruments that included an intraoral mirror and a periodontal probe

e. Referral

After the dental screening, recommendations concerning the child's oral health and treatment were sent to the parents or legal guardian(s). Essential information contacts of nearby specialized dental centers with reasonable treatment cost were provided to the parents in case the child was not being followed up by a private dentist.

### **3. *Justice***

The sample of elementary school children was selected as a representative random sample in the Beirut area in both private and public schools. All children had the same probability of being included in the study. Moreover, the malocclusion in all school children was assessed following the same examination protocol.

## **H. Statistical Analysis**

After data entry, data cleaning was performed to guarantee that all potential errors done during the data entry were corrected. Frequency distributions were generated for all variables to check for variability and outliers and to decide on regrouping of data. Descriptive statistics were generated for all outcome and independent variables by type of school.

The association was tested using chi-square tests and independent sample t-tests. To test our hypothesis, one outcome indicator was chosen to represent each plane of space. The overjet was chosen since it represented the main difference in the saggital plane between public and private school children, overbite and posterior crossbite were chosen because they were more frequent than the presence of an openbite and a midline diastema respectively. Chi square tests and independent sample t-tests were used to test the bivariate association between each dependent variable and the study covariates; in addition, difference in the IOTN grades was tested across both types of schools.

Multivariate analysis was performed using Generalized Estimated Equations (GEE) and Generalized Linear Models (GLM). GEE was used to estimate coefficients and odds ratios by fitting regression models with continuous (overjet in mm) and binary outcomes (presence or not of posterior crossbite) adjusted for clustering effect. Since GEE does not model multinomial outcome variables, GLM were used to estimate Relative Risk Ratios (RRR) by fitting multinomial logistic regression models for outcome variables having more than two categories (overjet severity, overbite severity and irregularity score severity),

clustering effect was adjusted for in the variance-covariance matrix structure and robust standard errors were reported. The multinomial regression was used instead of the ordinal logistic regression since the proportional odds assumption did not hold.

All covariates that were statistically associated with outcome variables at  $p\text{-value} < 0.2$  were included in the multivariate analysis. For all parameters, 95 % CI and two-sided  $p$ -values were reported.  $P\text{-value} < 0.05$  was considered as statistically significant. All analyses were completed in Stata SE 10.1.

## CHAPTER IV

### RESULTS

#### **A. Introduction:**

In this chapter, we will display the results of the univariate and multivariate analyses of data extracted from the parents' questionnaires and the dental examinations of 325 school children from public schools and 330 school children from private schools. The distribution of all variables is compared by type of school.

Dental measures were compared between those who consented and those who did not in public schools only.

#### **B. Characteristics Of The School Children In Public And Private Schools**

##### *1. Socio-Demographic Characteristics*

Socio-demographic characteristics of children in public and private schools are displayed in table 1. No statistically significant differences were found between the children in public and private schools concerning age ( $p=0.478$ ). There was a slightly higher proportion of females in private schools ( $p=0.093$ ).

Significant Differences were found between both groups for family income ( $p<0.001$ ) and educational level ( $p<0.001$ ) where parents of private school children have higher income and educational level compared to those in public schools.

In fact, most parents of public school children reported an income less than a million L.L, with almost a third having an income <500,000 L.L. While parents of private school children mostly had an income more than 1,000,000 L.L. (57.6% of parents have an income

between 1,000,000 and 3,000,000 L.L. and 26.4 % had an income more than 3,000,000 L.L.). The overwhelming majority of public school children's parents had an educational level below secondary (89.5%), while the highest proportion of parents in private schools had reached college or university level (72.4%).

## **2. *Health Status Of The Children***

Table 2 displays the percent distribution of students aged 6-11 by health state and type of school. The two groups were slightly different with respect to the presence of chronic diseases and mouth breathing as reported by the parents, and these differences were of borderline significance. However, major differences were found between both groups in the proportion of mother that smoked during pregnancy ( $p < 0.001$ ). This proportion reached 20.4% in mothers of public school children compared to only 7% in mothers of private school children.

## **3. *Habits***

No differences were noted between public and private school children concerning nutritional habits. On the other hand, sucking habits were different between the two groups ( $p = 0.03$ ); Almost one fifth (19.6%) of public school children have reported sucking habits during infancy compared to 14.9% in private school children. (Table 3)

## **4. *Parents' Perception Of Orthodontic Treatment Need.***

When asked whether the parents think their child was in need or not of orthodontic care, 36.9% of public school children's parents and 35.9% of the private ones perceived need of treatment for their child. These proportions were not statistically significantly different between the two groups ( $p=0.96$ ).

### **C. Malocclusion Measures Of The School Children In Public And Private Schools**

Thirteen measurements representing saggital, transversal and vertical planes of the malocclusion were taken during a thorough dental exam.

Regarding all aspects of malocclusion no statistically significant differences were found between the consented and the non-consented public school children.

#### ***1. Saggital Measures***

Saggital measures (table 4) comprise the molar and canine occlusion, overjet, and anterior crossbite.

##### **a. Molar occlusion**

The largest proportion of both public and private school children had CI I occlusion, and around one third (32% to 35%) presented a CI II malocclusion. CI III existed only in 3 % of participants. No statistically significant differences were found between the two groups ( $p=0.2$ ).

##### **b. Canine occlusion**

Occlusion based on the maxillary and mandibular canine relationship was similar to the occlusion based on the molar relationship with no statistically significant differences between private and public school children

c. Overjet (OJ)

Most of the school children had a mild OJ (3-4mm). Statistically significant differences were found between public and private schools ( $p= 0.022$ ) at the level of the mild and more severe OJ; Public school children had more severe OJ compared to private school children (26.4% and 18.7% respectively). Moreover, the mean OJ in public school ( $3.71\pm 1.77$  mm) was found to be significantly higher ( $p=0.032$ ) than in private schools ( $3.41\pm 1.7$  mm).

If the occlusion was classified based on the OJ (OJ 1-4(ideal) = CI I, OJ>4=CI II, Reverse OJ= CI III) different results were found compared to the occlusion based on the maxillary and mandibular molars and canines relationships. Based on the OJ, most of the school children had a CI I occlusion (72.93% and 77.57% in public and private school children respectively), a CI II was present in 23.69% of the public school children compared to 16.96% in the private school children while the latter had more CI III malocclusion compared to the public school children (5.45% and 3.38% respectively). The occlusion based on the OJ was statistically different between the two groups ( $p=0.002$ ).

d. Anterior crossbite

In CI III patients the amount of anterior crossbite was significantly different between the two groups ( $p=0.008$ ). Severe anterior crossbite was very rare in both groups.

However, milder anterior crossbite was almost five times more present in public school children compared to private school children (5.23% and 0.9% respectively) while a moderate crossbite has the same prevalence in both groups.

## **2. Vertical Measures**

Vertical measures (table 5) include both open bite measurement and overbite in mm and in percentage.

### **a. Open bite**

The presence of an anterior open bite was not common (7.3 % and 4.8 % in public and private schools respectively) and its severity was similar between both groups. In fact, 7.3% public school children presented an open bite and in most of them (4.9%) it was moderate (<2mm). On the other hand, out of 4.8% of private school children with an anterior open bite, 3% had a moderate severity.

### **b. Overbite**

Public and private school children had comparable severity of overbite, with more than half in both groups having moderate or severe overbite (> 3 mm). The deep bite percentage was also similar between both groups, maxillary incisors covering on average 34.15% of mandibular incisors in public school children and 32.81% in private school children. Moreover, an impinging bite was present in 24.4 % in the first group

compared to 24.8% in the second group and the difference was not statistically different.

### **3. *Transverse Measures***

Transverse measures comprise two variables: the presence of a posterior crossbite and of a midline diastema (table 5).

Posterior crossbite was present in 16.9% of public school children and was not statistically significantly different compared to 14% in private school children. Midline diastema was more prevalent in public schools (16.1%) compared to private schools (10.5%) and the difference was statistically significantly different ( $p=0.036$ ).

### **4. *Contact Point Displacement***

The contact point displacement represented by the irregularity index was comparable between the two groups. Around half of the children had an ideal irregularity index; around 21% had a mild irregularity index while 26-28% presented a more severe score.

### **D-Bivariate Associations**

Bivariate analyses were conducted to investigate how different aspects of the malocclusion vary depending on selected characteristics (gender, age, education of the informant, family income, the presence of chronic diseases, mouth breathing, smoking during pregnancy, sucking habits, feeding methods, the DMFT score and the Plaque index).

## **1. Overjet**

Overjet was only associated with age ( $p=0.033$ ) and DMFT score ( $p=0.030$ ). Almost one fourth of older children (23.8 %) had severe overjet compared to less than one fifth (19.5%) among children younger than 8 years old. Results regarding associations of age and overjet for different school types are displayed in graph 1. Overjet is more severe in public schools as compared to private ( $\beta=0.14$  vs.  $\beta=0.18$ ;  $p<0.001$ ).

Moreover, DMFT scores were significantly higher in children with more severe overjet. On average, DMFT score was  $6.18 \pm 4.12$  in subjects with severe overjet compared to  $5.36 \pm 4.24$  with mild overjet and  $4.79 \pm 3.98$  in children with ideal overjet. The post-hoc test revealed significantly different results only between the groups with the ideal overjet and the severe overjet ( $p=0.009$ ). Graph 2 reveals that the DMFT correlates positively with overjet. In fact, DMFT correlated positively with the overjet being also more severe in public school children.

## **2. Overbite**

Overbite was significantly associated with age and plaque index (table 9). A higher proportion of older children had severe overbite compared to younger ones (23.8 % compared to 11.8 %). It was more severe in older subjects with almost one fourth (23.8%) of 11.8 %).

Moreover, the mean plaque index was found to be higher in subject with deeper bite. On average, the plaque index was 1.3, 1.24, and 1.27 in subjects with deep, moderate and ideal

overbite respectively. The post-hoc test showed the statistically significant difference existed between the subjects with moderate and deep bite ( $p=0.043$ ).

### **3. *Posterior Crossbite***

Table 10 shows that posterior crossbite was only statistically associated with sucking habit ( $p=0.005$ ). Children with sucking habits were almost two times more likely than those with no sucking habit to have at least one tooth in posterior crossbite (24.2% vs. 13.1%).

### **4. *Irregularity Index***

None of the variables were associated with the amount or the severity of the irregularity index (table 11).

## **E. Multivariate Analysis**

For all indicators of malocclusion (crowding, midline diastema, posterior crossbite, overjet, overbite and the molars relationship), multinomial regression models were used to investigate associated risk factors. Overjet was also considered as continuous variable and a multiple linear regression was performed. Results between multinomial and multiple linear regressions were compared to investigate whether they produce different associations if the overjet was to be considered as categorical outcome vs. a continuous measure.

Regression models were adjusted for clustering effect based on the school ID using Generalized Estimated Equation (GEE) models for continuous outcome variables (overjet) and using cluster robust standard errors for all multinomial regression models.

The clustering by school did not appear to have any effect on the regression outcome of the overjet, overbite, and irregularity index. However, for the posterior crossbite, age only became significant when we adjust for clustering.

## **1. Overjet**

### **a. Categorical outcome**

Table 12 displays the Relative Risk Ratio (RRR) of reporting mild and severe as opposed to ideal overjet. Adjusting for gender, school type, educational level, sucking duration, DMFT score and plaque index results have shown that a subject older than 8 years is at higher risk to have a mild rather than an ideal overjet (RRR:1.35; 95%CI:1.04; 1.28). Moreover children with higher plaque index were at a lower risk of having a sever overjet (RRR: 0.93; 95%CI: 0.88; 0.98).

### **b. Continuous outcome**

Table 13 displays the results of the regression model using overjet as a continuous outcome and adjusting for the same covariates used in the multinomial model.

Age was positively correlated with overjet ( $\beta$ : 0.14; 95%CI: 0.046; 0.249).

Students in private schools were more likely to have a lower overjet than those attending a public school ( $\beta$ : -0.10; 95%CI: -0.185; -0.026). Increased family income was found to be positively associated with overjet. Compared to students coming from families with a monthly income of less than 500,000 LL, the overjet was more likely to increase by 0.20 mm ( $\beta$ : 0.20; 95%CI: 0.069; 0.346) and 0.28 mm ( $\beta$ : 0.28; 95%CI:

0.197; 0.370) for those coming from families with an average family income of 500,000 – 999,999 L.L and 1,000,000-3,000,000 L.L respectively.

Graph 3 shows the linear association between age and overjet segregated by type of school after adjusting for appropriate variables. A positive correlation between age and overjet could be observed for the two types of schools with a more severe overjet for subjects in public as opposed to those in private schools.

Graph 4 shows the linear association between DMFT and overjet after adjusting for the covariates of interest. In public schools, the slope has a negative value suggesting that the DMFT decreases with the increase of the OJ. However, in private schools, the graph shows a positive association between DMFT and overjet.

## **2. *Overbite***

Table 14 displays the Relative Risk Ratio (RRR) of reporting mild and severe as opposed to ideal overbite. Subjects aged between 8 and 11 years were at a higher risk of having mild (RRR: 1.71; 95%CI: 1.21; 2.39) and moderate to severe overbite (RRR: 2.23; 95%CI: 1.03; 4.83). Children with increased sucking habit duration (RRR: 0.98; 95%CI: 0.97; 0.99) and higher DMFT score (RRR: 0.93; 95%CI: 0.86; 0.99) were at a lower risk of reporting moderate to severe overbite.

## **3. *Crossbite***

Table 15 displays the Odds Ratio (OR) of reporting presence or not of posterior crossbite. The odds of having posterior crossbite in subjects aged between 8 and 11 years

and those with increased sucking habit duration were 1.29 (95%CI: 1.18; 1.39) and 1.01 (95%CI: 1.01; 1.18) respectively.

#### **4. Irregularity Index**

Table 16 displays the Relative Risk Ratio (RRR) of reporting mild and severe as opposed to ideal irregularity index. Subjects with a mouth breathing habit, were at a higher risk of having a mild irregularity index (RRR: 2.61; 95%CI: 1.99; 3.42). Male subjects (RRR: 1.69; 95%CI: 1.36; 2.1) and children with higher DMFT score (RRR: 1.04; 95%CI: 1.03; 1.06) were at a higher risk of reporting moderate to severe irregularity index.

#### **F. Index Of Orthodontic Treatment Need (IOTN).**

Tables 17 shows the IOTN score, build to measure the orthodontic treatment need, was similar between public and private school children. The highest proportion of children (38-39%) in both types of schools have a moderate/borderline treatment need while the rest is symmetrically distributed between no or little need of treatment (32-35%) and severe or extreme need of treatment (25-27%). Graph 5 shows the distribution of orthodontic treatment need; most school children regardless of the school type have a moderate need of treatment.

# CHAPTER V

## DISCUSSION

### **A. Summary And Discussion Of Major Findings**

This study, based on a sample of 6-11 years Lebanese school children from both genders and different social backgrounds, assessed for the first time the magnitude of malocclusion conditions, their severity and the orthodontic treatment need comparing children in public and private schools. The study also shed the light on factors associated with a wide range of malocclusion features to explore some potential risk factors of malocclusion

#### ***1. Prevalence Of Malocclusion***

The aspects of malocclusion we chose to evaluate were: molar and canine occlusion, overjet, overbite, posterior crossbite and irregularity index. The most prevalent malocclusion problem in our sample is the overjet, which was found to be in the higher category of severity in at least one out of five children in our sample.

This study showed a considerable degree of malocclusion severity and most importantly, it revealed varying magnitude of disparities in severity between the two groups of schools depending on the malocclusion variable.

The two major differences in socio-economic status between the two types of schools were family income and education of the informant. In addition, sucking habits were found to be more prevalent in public school children. An increase in sucking habits was found to

be more prevalent in child feeling insecure, lonely or stressed (Van Norman, 1997). The other major finding was the proportion of mothers in public schools that smoked during pregnancy being three times higher than in private schools. This finding is concurrent with the studies of Chaaya et al. (2003) and Bachir & Chaaya (2008) who also reported that smoking during pregnancy is negatively correlated with educational level and socio-economic status.

Findings regarding malocclusion were compared with the NHANES III data (National Health and Nutritional Survey), USA. This survey was carried out in the US from 1988 to 1999 comprising around 7000 individuals from different racial/ethnic backgrounds and age groups (Proffit et al., 1998) (table 18). The molar occlusion based on Angle's classification was not registered in the NHANES III survey, and malocclusion was stratified based on the overjet. Our findings regarding molar occlusion are consistent with many studies of Caucasian children (Rodrigues de Almeida et al., 2011; Alves de Souza et al., 2007). When the malocclusion was stratified based on the overjet, more similarities were found between our findings and the literature (Gardiner, 1982; Proffit, 1998). In addition, occlusion in public school children was more similar to the NHANES III compared to private schools. Moreover, less CI II malocclusion and more CI I was found in the private schools compared to both NHANES III and public schools. Molar occlusion is classified into three categories. However, in some cases, the relationship between the maxillary and mandibular molars can be in between these three categories, therefore, in epidemiological studies, there is a need to have a better identification of the molar occlusion. A more precise tool to classify the occlusion could be the overjet. In our sample, we found that more than 9 out of 10 subjects

with and overjet more than 6 mm have a CI II molar relationship. This finding is consistent with other studies in the literature (Tulloch et al., 2004).

Regarding overjet and overbite severity, findings of the NHANES III survey, fall in the middle range of the proportions of moderate to severe overjet, in public and private schools. This might be interpreted by the fact that the sample in the US survey comes from a wider range of socio-economic backgrounds compared to our sample which consists of private and public school children coming from high and low socio-economic background respectively.

In other aspects of malocclusion, more severe characteristics were found in Lebanese school children compared to the NHANES III survey. We reported in our study higher prevalence of open bite, posterior crossbite and crowding in both types of schools. Since these characteristics are associated with non-nutritive digit sucking, the higher prevalence of the malocclusion traits in our study might be associated with a higher prevalence/severity of sucking habits in our sample compared to the NHANES III sample.

## ***2. Associations***

The multivariate analysis showed that being in a private school is protective against having an increased overjet. Many authors have showed association between sucking habits in the primary dentition and increased overjet (Fukata et al., 1996; Adair et al., 1992). However, in our sample, no associations were found between sucking habits/duration and the increase in overjet. One possible explanation of the increased overjet in public school is that public school children might have had a higher prevalence and intensity of sucking

duration in an earlier age. An explanation of the increased overjet in public schools might be the difference in environment. Even though, all selected schools were from the Greater Beirut area, we noticed that public schools were in areas that tend to be more polluted and more crowded compared to private school areas. This might explain partially the increased overjet in public school children.

To rationalize this finding, further research should be done to investigate which other parameters may be associated with an increase in the overjet and if their prevalence is higher in public schools compared to private schools. Furthermore, regression results showed that, adjusting for other variables, overjet is positively correlated with the family income. This result was not expected since overjet was more severe in public school children. Further research is needed to determine whether this finding is replicated.

After adjusting for appropriate variables, overbite was found to be negatively associated with DMFT score and sucking duration. Although, the first finding was not reported in the literature, it might be partially explained by the fact that mouth breathing (usually associated with open bite) increases the risk of caries since the subject has to keep his mouth open more often. This reduces the salivary flow that helps in protecting the teeth against decays.

The association between overbite and sucking duration was also reported in the literature (Øgaard et al., 1994, Karjalainen et al., 1999, Larsson, 2001, Warren and Bishara, 2002). This finding was explained by Rønning and Thilander (1995) who associated sucking habits with tongue thrust and abnormal swallowing pattern. Moreover, many studies such as Katz et al. (2004) and Cozza et al. (2005) have found that prolonged sucking

habits are associated with hyperdivergent patterns an increased risk of an anterior open bite. These findings might explain the negative association between sucking duration and overbite.

The increase in overbite and overjet during the early years of mixed dentition is a consistent finding with other studies (Björk, 1953; Moorrees, 1959; Leighton, 1969; Bergersen, 1988; Sinclair and Little, 1983 and Heikinheimo et al., 2012). Stahl and Grabowski (2003) have partially associated the increase in overjet and overbite in the mixed dentition with the eruption of the permanent maxillary incisors that erupt more buccal and more vertical compared to the primary central incisors.

The bivariate analysis revealed a positive association between the presence of a posterior crossbite and the presence of a sucking habit. However, the association was replaced by the duration of the sucking habit instead of its presence or not at the multivariate level. Moreover, posterior crossbite was also associated with age. Both associations are similar to literature. Macena et al. (2009) and Melink et al. (2010) suggest that the prevalence of a posterior crossbite increases with age and with sucking habits. In addition, although not statistically significantly different, posterior crossbite was positively associated with mouth breathing habits. Previous findings (Bresolin et al., 1983; Khurana, 1986) have shown that mouth breathing is associated with a constricted maxilla and the presence of a posterior crossbite. The lack of statistical significance could be due to lack of power as mouth breathing frequency is not common.

The preponderance of males among those with Irregularity Index is similar to the NHANES III, and inconsistent with other studies that found no differences (Kelly et al. 1977) or a higher proportion of irregularity among females (Sinclair et al., Bishara et al.,

1994; Hunter et al., 1977). In addition, irregularity of incisors was positively associated with DMFT score; a finding that also is consistent with other studies (Szyzka-Sommerfeld et al., 2010; Buczkowska-Radlinska et al., 2012). One final finding was the association between mouth breathing and increased irregularity score of the mandibular incisor. This finding was not investigated properly in the literature and Solow and Sonnesen (1998) related it to an increased cranio-cervical angle that is present in mouth breathers resulting in soft tissue stretching and increased muscular pressure on the mandibular incisors. More studies are needed to establish this association.

### ***3. Orthodontic Treatment Need***

Our original criteria of choosing what characteristics of malocclusion to assess were based on the NHANES III survey. In addition to these characteristics, we noted for each patient any abnormal additional findings regarding malocclusion. This allowed us to calculate the index of orthodontic treatment need.

One major shortcoming of the index was that some aspects of malocclusion such as impaction and agenesis of teeth cannot be assessed in a clinical examination and requires additional records such as radiographs. This shortcoming, also common among most of the occlusal indices, might have contributed to an undervaluation of the proportion of children that are in need of treatment.

The study revealed that more than one in four Lebanese school children are in urgent need of treatment. When the moderate need is added to the great need, 2 out of three

children are found to be in need of treatment. This proportion was similar to the finding of Brook and Shaw (1989).

The IOTN index was not statistically significantly different between both types of schools and. In the NHANES III study, the IOTN index revealed a treatment need in 8-11 year old Caucasian children of 10.2%. This huge difference could be attributed to the proportion of subjects in the mixed dentition who had received some kind of treatment in the NHANES being seventeen times higher than the proportion in our sample.

The proportion of orthodontic treatment need in Lebanese school children is closer to rates reported in Europe. In fact, the latter fluctuates around an average of 21% (IOTN grades >4 from UK, Norway, Germany, Spain & Finland). Although this number is closer to our finding, one major factor to be considered is age. In fact, all European studies were done in children and adolescents from a starting age of 11 years. This suggests that, if European studies were done on a younger sample starting in the early mixed dentition, lower IOTN scores would have been expected since malocclusion tends to be more severe with age.

In addition, studies conducted in Arab countries have shown that on average, the orthodontic treatment need is around 30% of children (Abu Alhaija et al. 2004; Al-Azemi 2009; Hassan and Amin 2010; Hamdam 2001; Kerosuo et al. 2004). The slight difference in proportions might be explained by the fact that Arab studies were also done on higher ages compared to our study. This suggests that our findings are consistent with most Arab findings concerning orthodontic treatment need.

## **B. Strength Of The Study**

To this day, our study is the first to assess not only the prevalence of malocclusion, but also to quantify its severity and associate it with variables that concern one's lifestyle and background. These associations and evaluations were possible because of our large sample size of 655 Lebanese school children. A smaller sample size might not have allowed detecting sensitive associations linking malocclusion to other factors. In addition, in public schools, the malocclusion characteristics of the 205 children that did not consent were similar to the 325 public school children that consented. This reduced the possible risk of having bias in the selection of our sample.

Calibration against an experienced orthodontist was done prior to the initiation of the data collection and results of this process showed high correlations between the examiner and the orthodontist. This confirms the high accuracy of methods that were used to assess the malocclusion thus reducing information bias.

An additional strength of this study lies in the statistical analysis part. In fact, in our analysis, at the multivariate stage, we accounted for the cluster effect by using the Robust standard error for multinomial regression and the GEE for linear regression.

Finally, the characteristics of our sample especially the young age will allow further research and follow up. This will allow creating a cohort with the possibility of finding more associations on a higher hierarchy of evidence.

## **C. Limitations Of The Study**

Some difficulties were encountered during some stages of our study. At the level of our team approaching the parents for consent, it would have been better if we had the chance to

be in in direct contact with the parents allowing a more explanation about our procedure and the general aim of our study. This was frequently encountered in private schools when parents did not allow their children to be part of the study claiming that they have their own dentist. Approaching the parents directly may have allowed us to increase our sample size. An additional limitation in the study is the self-administered questionnaire. Self-reporting might have affected the accuracy of/underreported some variables because of recall bias or misinterpretation of the question.

Finally, an important shortcoming of this study was that we did not have access to private schools that represent higher living standards thus examining school children with higher socio-economic level. This might have altered some of our findings and allowed detection of larger differences between both type of schools and more associations with social background and lifestyle.

## CHAPTER VI

### CONCLUSION AND RECOMMENDATIONS

#### **A. Conclusion**

Malocclusion among school children tends to be more severe in people with lower socio-economic background especially overjet, indicating social disparities in oral health. The incidence of overjet, overbite and posterior crossbite tends to increase with age. Moreover, sucking habits, a variable more prevalent in public school children, is positively associated with open bite tendency and posterior crossbite incidence.

Crowding of the mandibular incisors was more severe in males compared to females and was associated with DMFT score, suggesting that subjects with higher irregularity score tend to have more caries because of inability to brush properly.

Compared to the NHANES III findings, overbite and overjet are more severe in public school children. However, Lebanese school children have an increased prevalence of posterior crossbite and mandibular incisors crowding.

In addition, the orthodontic treatment need in Lebanon is 2.7 times higher than in the US, is on average 6% higher than in Europe while it remains close to the treatment need in Arab countries.

#### **B. Recommendations**

There is a great need to reduce social disparities in oral health. This inequality comes in the form of poor living conditions and unequal access to valuable resources, such as

education and dental care. Dealing with this problem necessitates short and long term strategies in addition to selective intervention/approach to address specific factors related to malocclusion.

### ***1. Short Term Recommendations***

The orthodontic treatment need based on IOTN is lower than that reported by parents where 36 % perceive that their child requires treatment. This confirms that parents are acknowledging that the problem is present. On the other hand only 1.8% of the school children had some kind of interceptive orthodontic treatment. This might suggest that the problem lies on 2 basic levels:

- 1) Parents do not have access to proper and affordable orthodontic care
- 2) Parents are not aware that screenings for orthodontic care should be performed should be done at an early age.

These assumptions justify the need of education campaigns for the parents in order to have their children screened by a certain age. However, educational campaigns are not sufficient but should be done in parallel with other procedures and interventions.

We propose integrating orthodontic screening with the regular dental screening on an annual basis. This is easily done and does not require any human or financial resources since the examination involves one trained orthodontist and basic screening tools. However, finding human resources to complete this process might be challenging. Not many orthodontists would accept volunteering and taking time out of the private practice to perform dental screenings. A possible solution for this problem is the coordination with

orthodontic residency programs. Second and third year orthodontic residents in different universities should perform screenings for the children. This will also allow the resident to gain experience in the orthodontic and public health field. Since orthodontic screening won't require any major resources, the ministry of education should implement new regulations that require each school to have once per year an orthodontic/dental screening starting from the age of 7 years.

Moreover, during the child's regular medical screening, we propose that mouth breathing and sucking habits to be noted by the physician and to refer or personally treat these issues. This will help in decreasing the prevalence /severity of certain aspects of malocclusion (posterior crossbite, irregularity index) and indirectly improving oral health since our results show that dealing with some of the malocclusion factors will lead to decreasing the incidence of caries. To have each pediatrician note these habits, a modification in the screening protocol should be done during the pediatrician's residency. In the meantime, pediatricians that are helping NGO's such as Ajjalouna should be aware of the importance of referring subjects with mouth breathing and/or sucking habits to start controlling these factors immediately.

## ***2. Long Term Recommendations***

Currently, insurance schemes do not cover orthodontic treatment. Affordable access to orthodontic care is limited to orthodontic residency training programs that are limited to the Beirut area.

In developed countries such as the U.S., oral health care is provided via private dental insurance and poorly funded public oral care. Although federal programs such as Medicaid were created to reduce cost of insurance, many dentists refuse to participate in these programs (Capilouto, 1988). In Europe, particularly Scandinavian countries characterized by their universal coverage of health care, severe malocclusion is treated for free until a certain age (usually 18 years) and is at a very low cost above that age (Patrick et al., 2006). However, these countries are the wealthiest countries in the world and their policies might not be cost effective in Lebanon. For that, a pilot study should be done in Lebanon to weigh the cost effectiveness of any prevention program before being implemented. King et al. (2012) showed in a recent study in Medicaid patients, that interceptive orthodontic treatment in most cases is effective in reducing malocclusion severity and in some cases subjects might not require additional comprehensive orthodontic treatment at later stages. This might suggest studying the feasibility of creating preventive/interceptive orthodontic care centers with affordable cost targeting children from socially disadvantaged communities. This might help in reducing disparities found between children with different socio-economic levels.

In addition, long term follow up should be done on the screened subjects. This might not only help in establishing already proven associations but also reveal new associations between some variables and malocclusion.

For future oral health surveys, we recommend that all screenings be done in the beginning of the school year. This will avoid having the children screened twice (once by the school's dentist if present and another by the research team) allowing more response from the parents and more effective use of the school's and the school dentists resources.

## TABLES

Table 1: Percent distribution of students aged 6-11 by socio-demographic and socio-economic characteristics and type of school

Characteristics	School type		P-value
	Public (n=325) %	Private (=330) %	
<b>Age</b>			
Years	8.49 ±1.59	8.57±1.31	0.478
<b>Gender</b>			
Males	52.8	46.2	0.093
Females	47.2	53.8	
<b>Family Income (LL)</b>			
<500,000	33.6	1.4	<0.001
500,000-999,999	49.4	14.2	
1,000,000-3,000,000	15.1	57.6	
>3,000,000	2.1	26.4	
<b>Education of informant</b>			
Low (Illiterate-Primary-Elementary)	45.4	7.7	<0.001
Average (Secondary-Intermediate)	44.1	20.0	
High (College / university)	10.5	72.4	

Table 2: Percent distribution of students aged 6-11 by health state and type of school

Characteristics	School type		P-value
	Public (n=325) %	Private (=330) %	
<b>Chronic Diseases</b>			
Yes	13.4	9.1	0.130
No	86.6	90.9	
<b>Mouth breathing</b>			
Yes	9.8	7.7	0.092
No	90.2	92.3	
<b>Maternal smoking during pregnancy</b>			
Cigarettes	20.4	7.0	<0.001

Table 3: Percent distribution of students aged 6-11 by nutritive and non-nutritive habits and type of school

Characteristics	School type		P-value
	Public (n=325) %	Private (=330) %	
<b>Sucking Habits</b>			
Yes	19.56	14.9	0.03
No	80.43	85.1	
<b>Feeding Method</b>			
Breast	53.3	31	0.324
Bottle	22.7	24.2	
Both	24.0	44.8	

Table 4: Percent distribution of students aged 6-11 by sagittal characteristics of malocclusion and type of school

Sagittal measures	School type		P-Value
	Public (n=325) %	Private (=330) %	
<b>Molar Relationship</b>			
I	60.8	63.9	0.2
II	35.8	32.7	
III	3.5	3.4	
<b>Canine Relationship</b>			
I	60.3	65.1	0.6
II	37	32.1	
III	2.3	2.8	
<b>Overjet</b>			
1-2 [Ideal]	27.4	36.3	0.022
3-4 [mild]	46.2	45.0	
4<[mod-sev]	26.4	18.7	
<b>Mean OJ</b>	3.71±1.77	3.41±1.7	0.032
<b>Occlusion stratification based on OJ *</b>			
I	72.93	77.57	0.002
II	23.69	16.96	
III	3.38	5.45	
<b>Anterior Crossbite (CI III)</b>			
0[mild]	5.23	0.9	0.008
-1to-2 [moderate]	5.5	6.6	
-3 to-4[severe]	0.3	0.9	
>-4 [extreme]	0.0	0.0	

\*CI I CI II and CI III were classified based on the OJ → OJ 1-4(ideal) = CI I, OJ>4=CI II, Reverse overjet= CI III

Table 5: Percent distribution of students by aged 6-11 vertical characteristics of malocclusion and type of school

Vertical measures	School type		P-Value
	Public (n=325) %	Private (=330) %	
<b>Open bite(mm)</b>			
0 to -2[moderate]	4.9	3.0	0.395
3 to -4[severe]	1.8	1.8	
>-4[extreme]	0.6	0.0	
<b>Deep bite(mm)</b>			
0-2 [Ideal]	52.8	55.3	0.066
3-4 [moderate]	23.4	28.8	
5-7 [severe]	22.2	15.3	
>7[extreme]	1.6	0.6	
<b>Impinging bite</b>	24.4	24.8	0.900
<b>Deep bite percentage</b>			
%	34.15	32.81	0.606

Table 6: Percent distribution of students by aged 6-11 transverse characteristics of malocclusion and type of school

Transverse measures	School type		P-Value
	Public (n=325) %	Private (=330) %	
<b>Post. crossbite</b>			
(>1tooth)	16.9	14.0	0.306
<b>Midline Diastema</b>			
Present(>2mm)	16.1	10.5	0.036

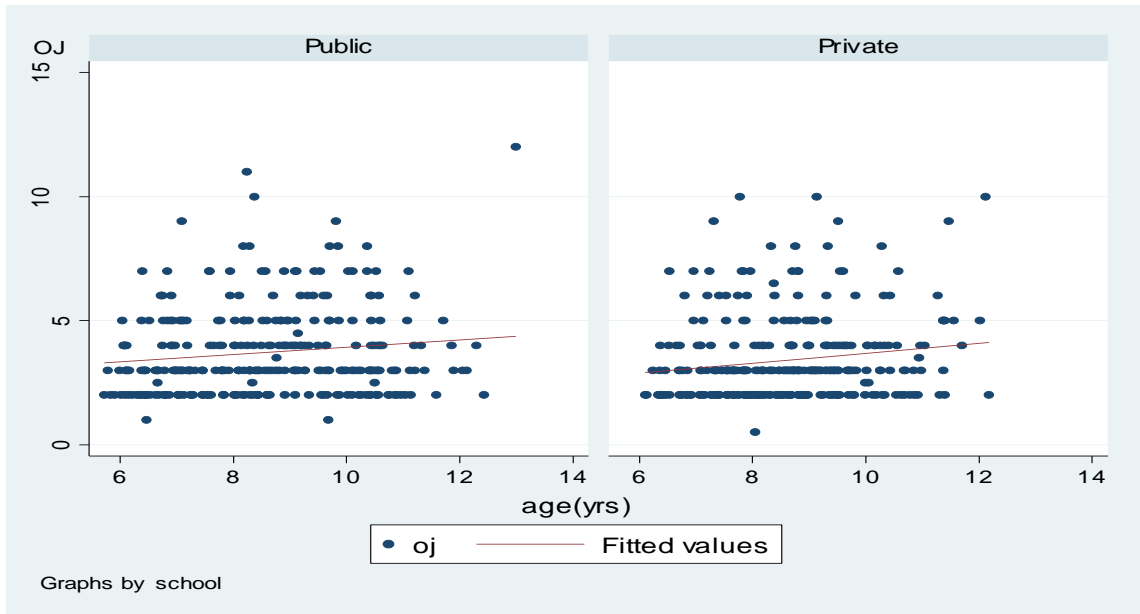
Table 7: Percent distribution of students' intra-arch contact point displacement and type of school

<b>Irregularity Index</b>	<b>School type</b>		<b>P-Value</b>
	<b>Public (n=325)</b> %	<b>Private (=330)</b> %	
0-1 [ideal]	52.9	49.4	0.663
2-3 [mild]	21.1	22.6	
>4[mod-sev]	26.0	28.0	

Table 8: Bivariate association between students' socio-demographic, socio-economic, health state, habits and dental health and the different severities of overjet

<b>Overjet</b>				
<b>Variables</b>	<b>1-2 [Ideal] (%)</b>	<b>3-4 [mild] (%)</b>	<b>4&lt; [mod-sev] (%)</b>	<b>P-Value</b>
<b>Gender</b>				
Male	33.9	45.4	20.7	0.459
Female	30.0	45.8	24.2	
<b>Age</b>				
6-7	38.6	41.9	19.5	0.033
8-11	28.2	48.0	23.8	
<b>Education of informant</b>				
Low	25.5	29.5	35.4	0.142
Average	50.3	43.9	46.3	
High	24.1	26.6	18.3	
<b>Family income</b>				
<500,000	29.3	47.8	22.8	0.130
500,000-999,999	27.0	46.0	27.0	
1,000,000-3,000,000	29.2	50.8	20.0	
>3,000,000	43.2	40.7	16.0	
<b>Chronic disease</b>				
Yes	43.8	35.9	20.3	0.271
No	30.2	47.3	22.5	
<b>Mouth Breathing</b>				
Yes	32.7	45.8	21.5	0.841
No	29.2	50.0	20.8	
<b>Cigarettes smoking</b>				
Yes	32.4	48.6	18.9	0.830
No	31.0	46.0	22.9	
<b>Sucking habits</b>				
Yes	26.1	46.6	27.3	0.346
No	32.5	46.2	21.3	
<b>Feeding method</b>				
Breast	33.3	44.7	21.9	0.907
Bottle	28.0	50.8	21.2	
Both	32.2	45.2	22.6	
<b>DMFT</b>				
Mean	4.79±3.98	5.36±4.24	6.18±4.12	0.030
<b>PI</b>				
Mean	1.27±0.22	1.25±0.18	1.29±0.21	0.242

Graph 1: Linear association between overjet and age in public and private school children



Graph2: Linear association between overjet and DMFT in public and private school children

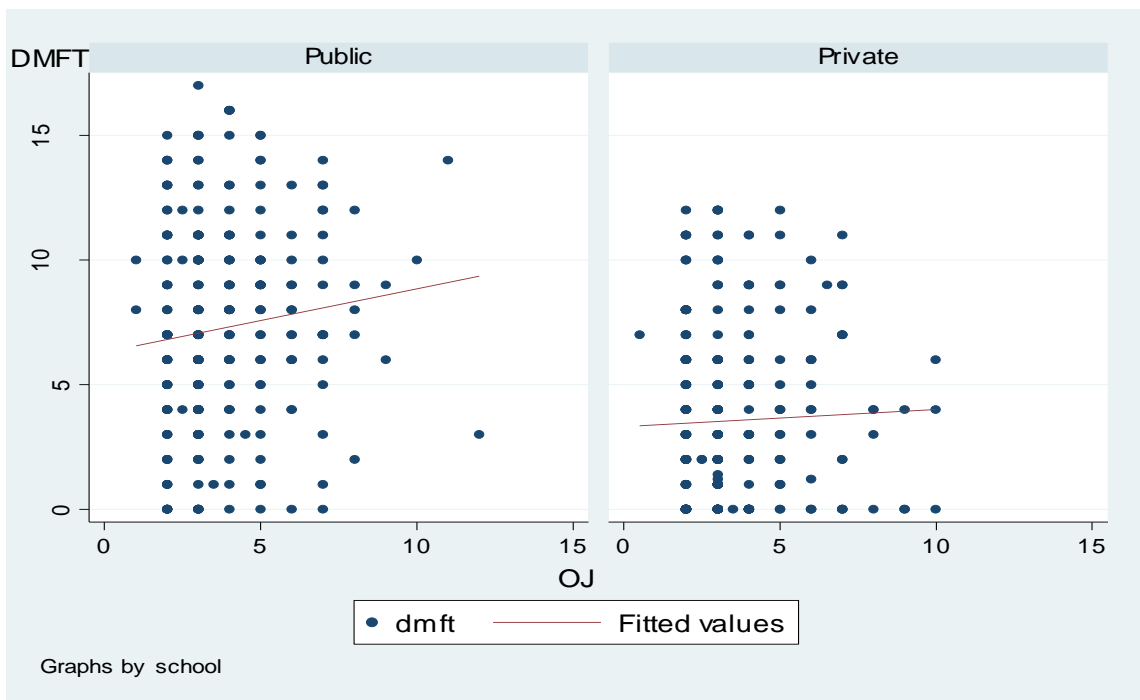


Table 9: Bivariate association between students' socio-demographic, socio-economic, health state, habits and dental health and the different severities of overbite

<b>Overbite</b>				
<b>Variables</b>	<b>0-2 [Ideal] (%)</b>	<b>3-4 [moderate] (%)</b>	<b>5&lt; [mod-sev] (%)</b>	<b>P-Value</b>
<b>Gender</b>				
Male	54.8	25.8	19.4	0.940
Female	53.4	26.4	20.2	
<b>Age</b>				
6-7	63.9	24.4	11.8	<0.001
8-11	48.7	27.4	23.8	
<b>Education of informant</b>				
Low	52.9	22.9	24.2	0.438
Average	52.7	25.8	21.5	
High	54.7	28.3	17.0	
<b>Family income</b>				
<500,000	58.2	19.4	22.4	0.702
500,000-999,999	52.0	26.8	21.2	
1,000,000-3,000,000	53.1	29.0	17.9	
>3,000,000	54.8	25.0	20.2	
<b>Chronic disease</b>				
Yes	56.9	24.6	18.5	0.887
No	54.1	25.7	20.2	
<b>Mouth Breathing</b>				
Yes	53.6	26.1	20.4	0.898
No	51.9	25.0	23.1	
<b>Cigarettes smoking</b>				
Yes	63.6	20.8	15.6	0.404
No	52.4	26.4	21.2	
<b>Sucking habits</b>				
Yes	62.4	21.5	16.1	0.227
No	52.7	26.5	20.8	
<b>Feeding method</b>				
Breast	54.9	22.6	22.6	0.198
Bottle	49.6	32.6	17.7	
Both	56.1	25.9	17.9	
<b>DMFT</b>				
Mean	5.51±4.28	5.20±4.08	5.34±4.03	0.730
<b>PI</b>				
Mean	1.27±0.21	1.24±0.16	1.30±0.22	0.049

Table 10: Bivariate association between students' socio-demographic, socio-economic, health state, habits and dental health and the presence of a posterior crossbite

<b>Posterior crossbite</b>			
<b>Variables</b>	<b>Not present (%)</b>	<b>Present (%)</b>	<b>P-Value</b>
<b>Gender</b>			
Male	84.2	15.8	0.822
Female	84.8	15.2	
<b>Age</b>			
6-7	86.5	13.5	0.225
8-11	83.0	17.0	
<b>Education of informant</b>			
Low	85.4	14.6	0.305
Average	81.8	18.2	
High	87.0	13.0	
<b>Family income</b>			
<500,000	79.2	20.8	0.351
500,000-999,999	85.5	14.5	
1,000,000-3,000,000	86.9	13.1	
>3,000,000	83.5	16.5	
<b>Chronic disease</b>			
Yes	91.2	8.8	0.235
No	83.8	16.2	
<b>Mouth Breathing</b>			
Yes	85.2	14.8	0.135
No	77.4	22.6	
<b>Cigarettes smoking</b>			
Yes	81.3	18.8	0.667
No	85.1	14.9	
<b>Sucking habits</b>			
Yes	75.8	24.2	0.005
No	86.9	13.1	
<b>Feeding method</b>			
Breast	85.4	14.6	0.757
Bottle	86.5	13.5	
Both	83.0	17.0	
<b>DMFT</b>			
Mean	5.33±4.21	5.69±3.82	0.433
<b>PI</b>			
Mean	1.26±0.21	1.29±0.22	0.244

Table 11: Bivariate association between students' socio-demographic, socio-economic, health state, habits and dental health and the different severities of irregularity index

<b>Irregularity Index</b>				
<b>Variables</b>	<b>0-1 [ideal] (%)</b>	<b>2-3 [mild] (%)</b>	<b>4&lt;[mod-sev] (%)</b>	<b>P-Value</b>
<b>Gender</b>				
Male	50.0	21.7	28.3	0.771
Female	52.3	21.9	25.8	
<b>Age</b>				
6-7	52.4	21.0	26.6	0.885
8-11	50.4	22.0	27.6	
<b>Education of informant</b>				
Low	55.1	19.6	25.3	0.695
Average	50.8	20.9	28.3	
High	48.2	24.1	27.7	
<b>Family income</b>				
<500,000	48.5	19.8	31.7	0.640
500,000-999,999	56.5	19.9	23.7	
1,000,000-3,000,000	47.6	22.6	29.7	
>3,000,000	51.8	22.4	25.9	
<b>Chronic disease</b>				
Yes	50.7	17.4	31.9	0.727
No	51.1	22.7	26.2	
<b>Mouth Breathing</b>				
Yes	52.1	21.4	26.4	0.310
No	41.5	28.3	30.2	
<b>Cigarettes smoking</b>				
Yes	53.2	13.9	32.9	0.304
No	50.9	22.8	26.3	
<b>Sucking habits</b>				
Yes	53.0	17.0	30.0	0.478
No	51.6	22.1	26.3	
<b>Feeding method</b>				
Breast	50.6	23.8	25.7	0.771
Bottle	47.9	23.3	28.8	
Both	53.2	18.3	28.4	
<b>DMFT</b>				
Mean	5.10±4.07	5.49±3.96	5.87±4.44	0.134
<b>PI</b>				
Mean	1.27±0.22	1.26±0.20	1.27±0.19	0.954

Table 12: Multivariate analysis showing associations between different categories of overjet and other variables

Ideal overjet (base outcome)	<b>RRR</b>	<b>Robust</b>	<b>95% CI</b>	<b>P-value</b>	<b>RRR</b>	<b>Robust</b>	<b>95% CI</b>	<b>P-value</b>
	<b>S.E.</b>				<b>S.E.</b>			
	<b>Mild</b>				<b>Moderate to severe</b>			
<b>Age (6-7)</b>	1.35	0.16	[1.06; 1.71]	0.013	1.47	0.38	[0.88; 2.46]	0.137
<b>Gender (Female)</b>	0.91	0.19	[0.59; 1.39]	0.673	0.82	0.16	[0.56; 1.20]	0.324
<b>School type (Public)</b>	0.87	0.37	[0.39; 2.04]	0.796	0.73	0.45	[0.22; 2.44]	0.616
<b>Educational level (Low)</b>								
Average	0.59	0.43	[0.14; 2.48]	0.474	0.82	0.49	[0.25; 2.65]	0.744
High	0.62	0.44	[0.15; 2.53]	0.512	0.62	0.36	[0.20; 1.95]	0.418
<b>Family income (&lt;500,000)</b>								
500,000-999,999	1.14	0.36	[0.61; 2.14]	0.666	1.28	0.51	[0.58; 2.82]	0.533
1,000,000-3,000,000	1.07	0.43	[0.49; 2.35]	0.851	1.32	0.58	[0.56; 3.12]	0.516
>3,000,000	0.61	0.3	[0.23; 1.63]	0.329	0.76	0.61	[0.15; 3.69]	0.734
<b>Sucking duration (months)</b>	1	0.01	[0.98; 1.02]	0.512	1.008	0.009	[0.99; 1.02]	0.355
<b>DMFT</b>	0.99	0.04	[0.91; 1.08]	0.934	1.05	0.04	[0.97; 1.13]	0.227
<b>PI</b>	0.98	0.01	[0.95; 1.007]	0.171	0.93	0.02	[0.88; 0.98]	0.009

( ) Base outcome

Table 13: Multivariate analysis showing associations between overjet (continuous measurement in mm) and other variables

<b>Variable</b>	<b><math>\beta</math></b>	<b>Robust S.E.</b>	<b>95% CI</b>	<b>P-value</b>
<b>Age</b>	0.14	0.051	[0.046; 0.249]	0.004
<b>Gender (Female)</b>	-0.08	0.157	[-0.393; 0.223]	0.589
<b>School type (Public)</b>	-0.10	0.04	[-0.185; -0.026]	0.009
<b>Educational level (Low)</b>				
Average	0.01	0.387	[-0.747; 0.770]	0.976
High	-0.47	0.283	[-1.032; .078]	0.092
<b>Family income (&lt;500,000)</b>				
500,000-999,999	0.20	0.070	[0.069; 0.346]	0.003
1,000,000-3,000,000	0.28	0.044	[0.197; 0.370]	<0.001
>3,000,000	0.18	0.123	[-0.055; 0.429]	0.131
<b>Sucking duration (months)</b>	0.003	0.002	[-0.001; 0.007]	0.187
<b>DMFT</b>	0.009	0.12	[-0.014; 0.033]	0.417
<b>PI</b>	0.044	0.491	[-0.918; 1.007]	0.928

( ) Base outcome

Table 14: Multivariate analysis showing associations between different categories of overbite and other variables

Ideal overbite (Base outcome)	RRR	Robust S.E.	95% CI	P-value	RRR	Robust S.E.	95% CI	P-value
	Mild				Moderate to severe			
<b>Age (6-7)</b>	1.71	0.29	[1.21; 2.39]	0.002	2.23	0.88	[1.03; 4.83]	0.04
<b>Gender (Female)</b>	1.07	0.07	[0.94; 1.22]	0.265	1.1	0.28	[0.66; 1.84]	0.699
<b>School type (Public)</b>	1.21	0.74	[0.37; 4.00]	0.74	0.49	0.21	[0.21; 1.15]	0.101
<b>Educational level (Low)</b>								
Average	1.05	0.27	[0.64; 1.74]	0.832	0.76	0.12	[0.56; 1.04]	0.096
High	0.969	0.32	[0.50; 1.85]	0.926	0.59	0.23	[0.27; 1.2]	0.178
<b>Family income (&lt;500,000)</b>								
500,000-999,999	1.56	0.4	[0.94; 2.58]	0.084	1.13	0.09	[0.95; 1.34]	0.144
1,000,000-3,000,000	1.28	0.63	[0.49; 3.38]	0.61	1.31	0.41	[0.70; 2.44]	0.389
>3,000,000	1	0.4	[0.45; 2.20]	0.991	1.64	0.5	[0.90; 2.98]	0.102
<b>Sucking duration (months)</b>	0.99	0.005	[0.98; 1.00]	0.05	0.98	0.004	[0.97; 0.99]	<0.001
<b>DMFT</b>	0.98	0.02	[0.93; 1.03]	0.529	0.93	0.03	[0.86; 0.99]	0.048
<b>PI</b>	0.99	0.01	[0.97; 1.02]	0.889	1	0.009	[0.98; 1.02]	0.93

( ) Base outcome

Table 15: Multivariate analysis showing associations between the presence of a posterior crossbite and other variables

<b>Variable</b>	<b>OR</b>	<b>Robust S.E.</b>	<b>95% CI</b>	<b>P-value</b>
<b>Age (6-7)</b>	1.29	0 .04	[1.18; 1.39]	<0.001
<b>Gender (Female)</b>	1.20	0.24	[0.74; 1.40]	0.427
<b>School type (Public)</b>	0.77	0 .21	[0.51; 1.18]	0.240
<b>Mouth breathing</b>	1.37	0.19	[0.95; 1.99]	0.092
<b>Presence of a sucking habit</b>	1.00	0.005	[0.99; 1.01]	0.263
<b>Sucking duration (months)</b>	1.01	0.001	[1.01; 1.18]	<0.001
<b>DMFT</b>	0.99	0.03	[0.94; 1.06]	0.984
<b>PI</b>	1.15	0 .29	[0.67; 2.03]	0.632

( ) Base outcome

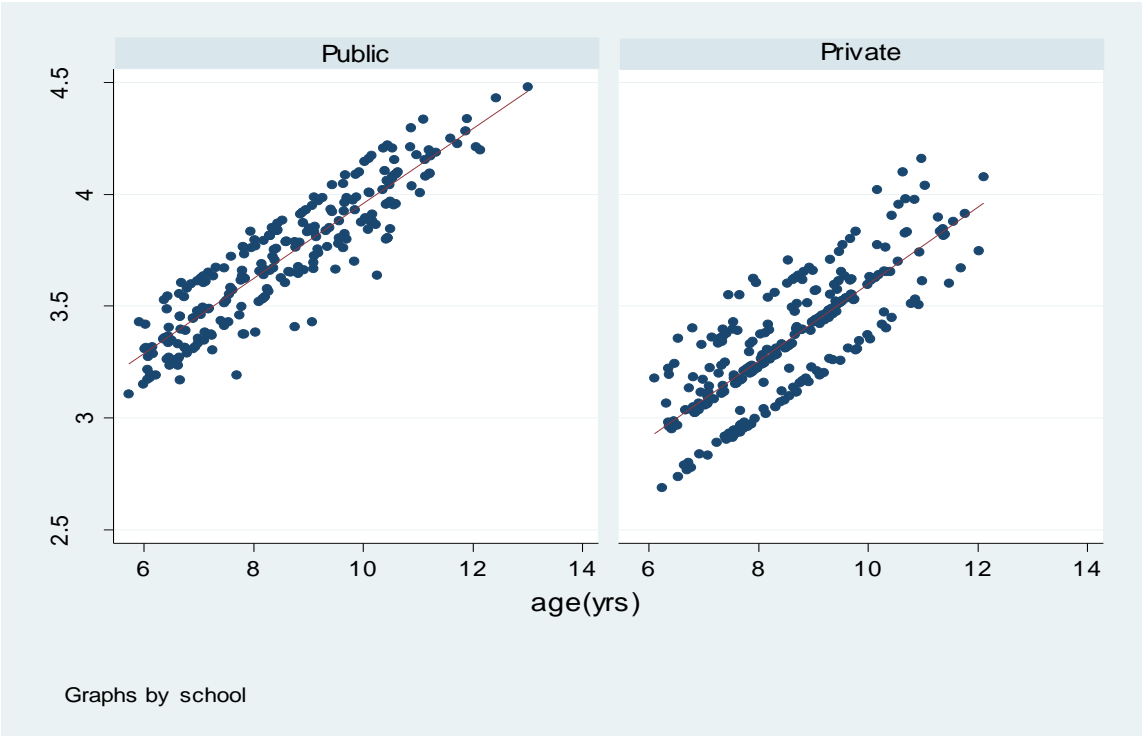


Table 16: Multivariate analysis showing associations between different categories of irregularity index and other variables

Ideal irregularity index (Base outcome)	RRR	Robust S.E.	95% CI	P-value	RRR	Robust S.E.	95% CI	P-value
	Mild				Moderate to severe			
Age (6-7)	0.94	0.17	[0.65; 1.36]	0.748	1.18	0.11	[0.97; 1.43]	0.086
Gender (Female)	1.26	0.29	[0.80; 1.99]	0.305	1.69	0.18	[1.36; 2.1]	<0.001
School type (Public)	1.02	0.23	[0.65; 1.59]	0.917	1.47	0.59	[0.66; 3.26]	0.339
Smoking during pregnancy	1.83	0.85	[0.73; 4.57]	0.193	0.95	0.24	[0.57; 1.58]	0.851
Mouth breathing	2.61	0.36	[1.99; 3.42]	<0.001	1.8	0.85	[0.71; 4.54]	0.212
DMFT	1	0.01	[0.97; 1.04]	0.589	1.04	0.008	[1.03; 1.06]	<0.001
PI	0.99	0.01	[0.97; 1.02]	0.687	0.99	0.01	[0.97; 1.01]	0.518

( ) Base outcome

Graph3: Linear association between overjet and age in public and private school children adjusting for all other variables



Graph4: Linear association between overjet and DMFT in public and private school children adjusting for all other variables

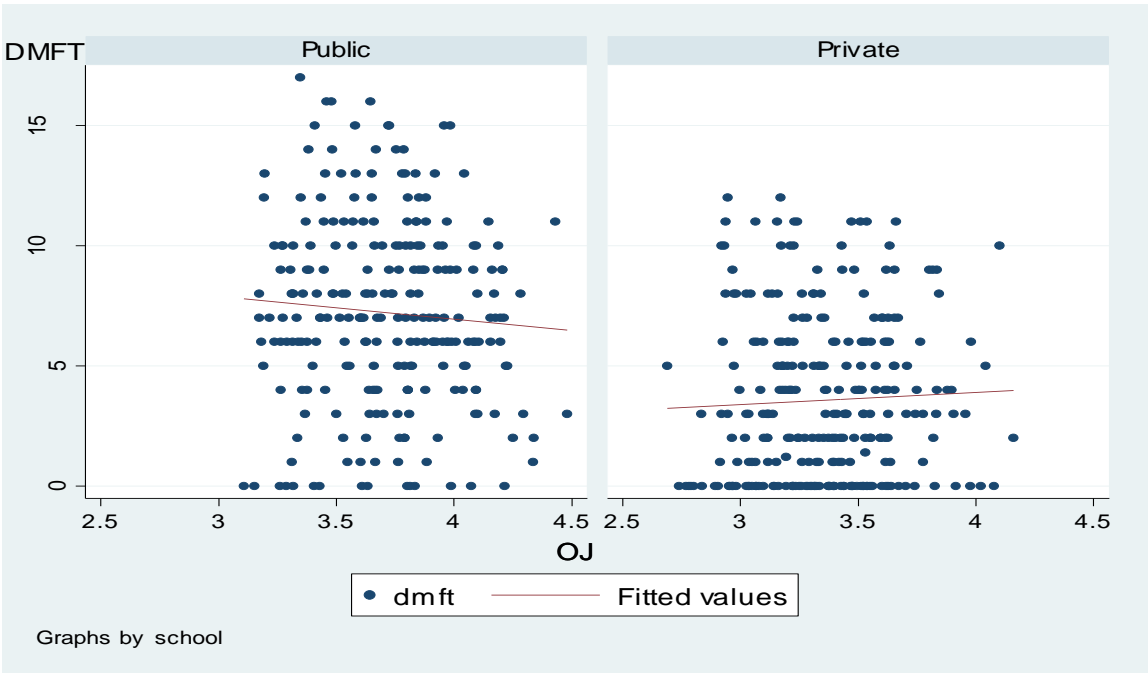


Table 17: Percent distribution of orthodontic treatment need grades among students aged 6-11 years by type of school

<b>IOTN grade</b>	<b>Public (%)</b>	<b>Private (%)</b>	<b>Total (%)</b>	<b>P-value</b>
1	12.00	12.73	12.37	0.786
2	20.31	23.33	21.83	
3	39.38	38.18	38.78	
4	25.85	24.24	25.04	
5	2.46	1.52	1.98	

Graph 5: Graphical representation of orthodontic treatment need among students aged 6-11 years by type of school

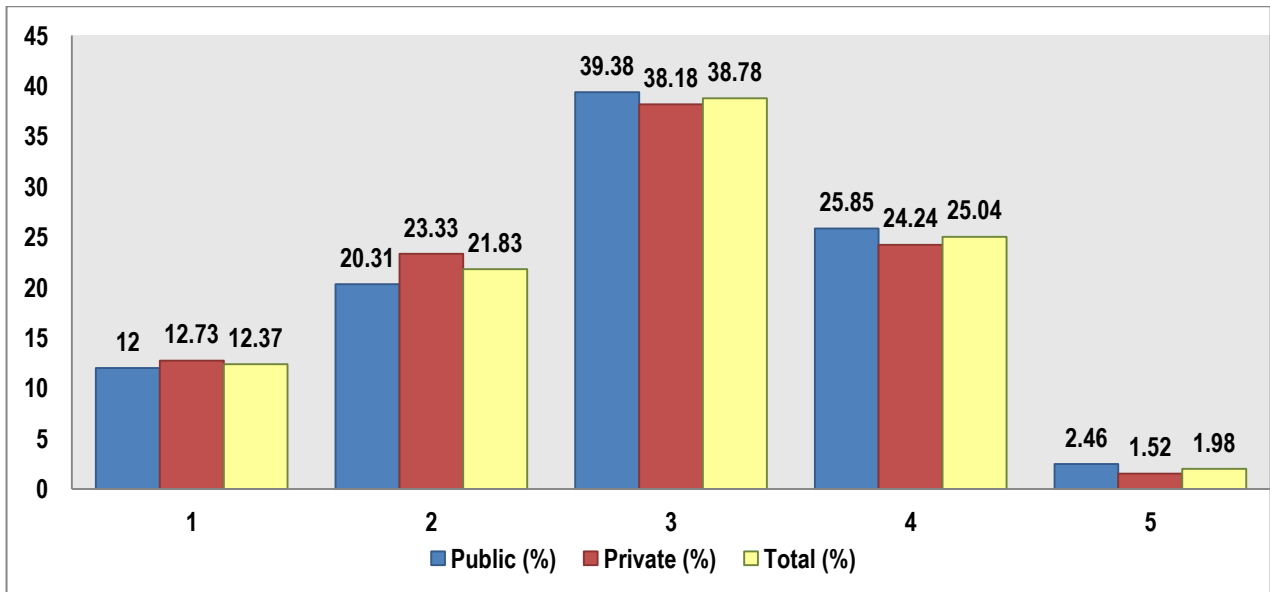


Table 18: Percent distribution of students aged 6-11 by malocclusion characteristics and type of school compared with the NHANES III findings.

Measures	School type		NHANES III
	Public (n=325) %	Private (=330) %	
<b>Saggital</b>			
<b>Overjet</b>			
1-2 [Ideal]	27.4	36.3	29.6
3-4 [mild]	46.2	45.0	45.2
4<[mod-sev]	26.4	18.7	22.5
<b>Molar Relationship based on OJ</b>			
I	72.93	77.57	74.8
II	23.69	16.96	22.5
III	3.38	5.45	2.9
<b>Anterior Crossbite (CI III)</b>			
0[mild]	5.23	0.9	2.2
-1to-2 [moderate]	5.5	6.6	0.7
-3 to-4[severe]	0.3	0.9	0.0
>-4 [extreme]	0.9	0	0.0
<b>Vertical</b>			
<b>Open bite(mm)</b>			
0 to -2[moderate]	4.9	3	2.7
3 lo -4[severe]	1.8	1.8	0.6
>-4[extreme]	0.6	0	0.3
<b>Deep bite(mm)</b>			
0-2 [Ideal]	52.8	55.3	40.2
3-4 [moderate]	23.4	28.8	36.2
5-7 [severe]	22.2	15.3	18.8
>7[extreme]	1.6	0.6	1.2

Measures	School type		NHANES III
	Public (n=325) %	Private (=330) %	
<b>Transverse</b>			
<b>Posterior Crossbite</b>			
(>1tooth)	16.9	14	7.1
<b>Midline Diastema</b>			
Present(>2mm)	16.1	10.5	26.4
<b>Irregularity Index</b>			
0-1 [ideal]	52.9	49.4	54.5
2-3 [mild]	21.1	22.6	25.0
[mod-Sev]	26	28	20.6

## REFERENCES

- Abdullah, M.S., Rock, W.P. (2001). Assessment of orthodontic treatment need in 5,112 Malaysian children using the IOTN and DAI indices. *Community Dent Health*, Vol.18, No.4, pp. 242-248.
- Abu Affan, A., Wisth,P., Boe, O.,(1990). Malocclusion in 12-year-old Sudanese children. *Odontostomatol Trop.*; 13(3):87-93.
- Abu Alhaija, E., Al-Nimri, K., Al-Khateeb, S., (2004). Orthodontic treatment need and demand in 12-14-year-old north Jordanian school children. *Eur J Orthod*, Vol.26, No.3, pp. 261-263.
- Adair, S., Milano, M., Dushku J.,(1992). Evaluation of the effects of orthodontic pacifiers on the primary dentitions of 24- to 59- month-old children: preliminary study. *Pediatr Dent*;14:13-8.
- Al-Azemi, R., Årtun, J., (2010). Orthodontic treatment need in adolescent kuwaitis: prevalence, severity and manpower requirements. *Med Princ Pract* ;19:348–354.
- Hassan, A., (2006). Orthodontic treatment needs in the western region of Saudi Arabia: a research report. *Head & Face Medicine* , 2:2.
- Ackerman, J., Proffit, W., (1969). The characteristics of malocclusion: A modern approach to classification and diagnosis. *Am J Orthod*; 56:443-53.
- Al-Emran, S., Wisth, P., Boe,O.,(1990). Prevalence of malocclusion and need for orthodontic treatment in Saudi Arabia. *Community Dent Oral Epidemiol* 1990; 18: 253-5.
- Alkhatib, M., Bedi, R., Foster, C., Jopanputra, P., Allan, S., (2005). Ethnic variations in orthodontic treatment need in London schoolchildren. *BMC Oral Health*, 27;5:8.
- Alkilzy, M., Shaaban, A., Altinawi, M., Splieth, C., (2007). Epidemiology and aetiology of malocclusion among Syrian paediatric patients. *Eur J Paediatr Dent.*; 8(3):131-5.
- Alves de Souza1, R.,Beatriz Borges de Araújo Magnani, M., Flávio Nouer, D., Lourenço Romano, F., Ribeiro Passos, M.,(2007). Prevalence of malocclusion in a Brazilian schoolchildren population and its relationship with early tooth loss. *Braz J Oral Sci.* 7(25):1566-1570.

Angle, E., (1899). Classification of Malocclusion Dental cosmos; *a monthly record of dental science*: Volume 41, Issue: 3, March, pp. 248-264.

Bachir, R., Chaaya, M., (2008). Maternal Smoking: Determinants and associated morbidity in two areas in Lebanon. *Matern Child Health J*; 12:298–307.

Baume, L.J., (1970). Commission on Classifications and Statistics of Oral Conditions. International conference on the epidemiologic assessment of dentofacial anomalies (A.D.A. – F.D.I. annual meeting, New York 1969). Introduction – The scope of problems retrospectively and prospectively. *Int Dent J*; 20: 563-569.

Begg, P. (1954). Stone Age man's dentition. *Am J Orthod*; 40: 289-312, 373-382, 462-475, 517-531.

Behbehani, F., Årtun, J., Al-Jame, B., Kerosuo, H., (2005). Prevalence and severity of malocclusion in adolescent Kuwaitis. *Med Princ Pract*; 14:390–395.

Bellot-Arcís, B., Montiel-Company, M., Almerich-Silla, M., (2012). Orthodontic Treatment Need: An Epidemiological Approach. In Farid Bourzgui (Ed.), *Orthodontics - Basic Aspects and Clinical Considerations* (pp. 3-28). Publisher: InTech.

Bergersen, E., (1988). A longitudinal study of anterior vertical overbite from eight to twenty years of age. *Angle Orthod*; 58:237-256.

Bishara, S., Treder, E., Jakobsen, J., (1994). Facial and dental changes in adulthood. *Am J Orthod Dentofacial Orthop*. 106:175–186.

Björk, A., (1953). Variability and age changes in overjet and overbite. *Am J Orthod Dentofacial Orthop*; 39:779-801.

Bjork, A., Krebs, A., Solow, B., (1964). A method of epidemiological registration of malocclusion. *Acta Odontol Scanda* 22:27-41.

Bollen, A. (2008). : Effects of Malocclusions and Orthodontics on Periodontal Health: Evidence from a Systematic Review. *Journal of Dental Education*, Volume 72, Number 8:912-918.

Bresnahan, B., Kiyak, A., Masters, S., McGorray, S., Lincoln, A., King, A. (2010); Quality of Life and Economic Burdens of Malocclusion in U.S. Patients Enrolled in Medicaid. *J Am Dent Assoc*; 141;1202-1212.

Bresolin, D., Shapiro, P., Shapiro, G., Chapko, M., Dassel, S., (1983). Mouth breathing in allergic children: Its relationship to dentofacial development. *American Journal of Orthodontics*, Volume 83, Issue 4, Pages 334-340.

Brook, PH; Shaw, WC. (1989) The development of an index of orthodontic treatment priority. *European Journal of Orthodontics*, Vol.20, pp. 309-320.

Buczowska-Radlinska, J., Szyszka-Sommerfeld, L., Wozniak, K., (2012). Anterior tooth crowding and prevalence of dental caries in children in Szczecin, Poland. *Community Dent Health*. 29(2):168-72.

Burden, DJ; Holmes, A. (1994). The need for orthodontic treatment in the child population of the United Kingdom. *European Journal of Orthodontics*, Vol.16, pp. 395-399.

Burden, DJ; Mitropoulos, CM; Shaw, WC. (1994). Residual orthodontic treatment need in a sample of 15- and 16-year-olds. *British Dental Journal*, Vol.176, pp. 220-224.

Burden, DJ; Pine, CM; Burnside, G. (2001). Modified IOTN: an orthodontic treatment need index for use in oral health surveys. *Community Dentistry and Oral Epidemiology*, Vol.29, pp. 220-225.

Chaaya,M.,Awwad, J., Campbell, O.,Sibai, A., Kaddour, A.,(2003). Demographic and psychosocial profile of smoking among pregnant women in lebanon: public health implications. *Matern Child Health J*. September; 7(3): 179–186.

Capilouto, E.,(1988). The dentist's role in access to dental care by Medicaid recipients. *J Dent Educ* 52(11):647-652.

Cons, NC; Jenny, J; Kohout, FJ. (1986). DAI: The dental aesthetic index. College of Dentistry, Iowa City, IA: University of Iowa.

Cooper, S., Mandall, N., DiBiase, D.,Shaw, W.,(2000). The reliability of the Index of Orthodontic Treatment Need over time. *J Orthod*, Vol.27, No.1, pp. 47-53.

Corruccini RS, Kaul SS. Epidemiological transition and anthropology of minor chronic non-infectious diseases. *Med Anthropol* 1984; 7:36-50.

Cozza,P., Baccetti,T.,Franchi,L., Mucedero,M.,Polimenie.,A(2005). Sucking habits and facial hyperdivergency as risk factors for anterior open bite in the mixed dentition. *Am J Orthod Dentofacial Orthop* ;128:517-9.

Daniels, C; Richmond, S. (2000). The development of the index of complexity, outcome and need (ICON). *Journal of Orthodontics*, Vol.27, pp. 149-162.

De Oliveira, C., Sheiham, A. (2003). The relationship between normative orthodontic treatment need and oral health-related quality of life. *Community Dent Oral Epidemiol*, Vol.31, No.6, pp. 426-436.

- Dhar, V., Jain, A., Van Dyke, T. E. & Kohli, A. (2007) Prevalence of gingival diseases, malocclusion and fluorosis in school-going children of rural areas in Udaipur district. *J Indian Soc Pedod Prev Dent*, 25, 103-5.
- Draker, HL. (1960). Handicapping labio-lingual deviations: a proposed index for public health purposes. *American Journal of Orthodontics*, Vol.46, pp. 295-305.
- Draker, HL. (1967). American association of orthodontists approval of the assessment record form and the definition of handicapping malocclusion, *Journal of American Dental Association*, Vol. 75, pp. 1441-1442.
- Doğan, A., Sari, E., Uskun, E., and Şahin Sağlam, A.,(2010). Comparison of orthodontic treatment need by professionals and parents with different socio-demographic characteristics. *European Journal of Orthodontics* 32; 672–676
- Doumit, D., Doughan, B., (2002). La santé bucco-dentaire des écoliers au Liban. *Cahiers d'études et de recherches francophones / Santé*. Volume 12, Numéro 2, 223-8
- El-Mangoury, N., Mostafa, Y.,(1990). Epidemiologic panorama of dental occlusion. *Angle Orthod.*;60 (3):207-14.
- Espeland, LV; Ivarsson, K; Stenvik, A. (1992). A New Norwegian index of orthodontic treatment need related to orthodontic concern among 11-year-olds and their parents. *Community Dentistry and Oral Epidemiology*, Vol.20, pp. 274-279.
- Esra Ertugay (2011).The use of the index of orthodontic treatment need (IOTN) in a school population and referred population. *JO* Vol. 28 No.1.
- Evans, R; Shaw, WC. (1987). Preliminary evaluation of an illustrated scale for rating dental attractiveness. *European Journal of Orthodontics*, Vol.9, pp. 314-318.
- Farawana, N.,(1987). Malocclusion in Iraq. *Quintessence International* Volume 18, Number 2.
- Farsi, N. M. & Salama, F. S. (1997). Sucking habits in Saudi children: prevalence, contributing factors and effects on the primary dentition. *Pediatr Dent*, 19, 28-33.
- Frazão, P., Narvai, C., (2006). Socio-environmental factors associated with dental occlusion in adolescents. *Am J Orthod Dentofacial Orthop*, 129, 809-16.
- Fukata, O., Braham, R., Yokoi, K., Kurosu, K.,(1996). Damage to the primary dentition from thumb and finger (digit) sucking. *ASDC J Dent Child*;63:403-7.
- Gardiner, H.,(1982).An orthodontic survey of Libyan school children. *Br. J. Orthod*; 1-59-61.

- Gábris, K., Márton, S., Madléna, M.,(2006). Prevalence of malocclusions in Hungarian adolescents. *European Journal of Orthodontics* 28 (2006) 467–470.
- Ghafari, J., Locke, S.A., Bentley, J.M, (1989). Longitudinal evaluation of the Treatment Priority Index (TPI). *Am J Orthod Dentofac Orthop*; 96: 382-389.
- Good Dental Health Starts Early. In *American Association of Orthodontists*. Retrieved August, 8, 2012, from <http://www.mylifemysmile.org>.
- Grabowski, R., Stahl, F., Gaebel, M. & Kundt, G. (2007). Relationship between occlusal findings and orofacial myofunctional status in primary and mixed dentition. Part I: Prevalence of malocclusions. *J Orofac Orthop*, 68, 26-37.
- Grainger, RM. (1961). Burlington Orthodontic Research Center progress report. Series 6. University of Toronto, Division of Dental Research, pp. 9-11.
- Gratrix, D., Holloway, P.,(1994). Factors of deprivation associated with dental caries in young children. *Community Dent Health*;11(2):66-70.
- Hamdan, A., (2001). Orthodontic treatment need in Jordanian school children. *CommunityDent Health*, Vol.18, No.3, pp. 177-180.
- Hamdan, A.,(2004). The relationship between patient, parent and clinician perceived need and normative orthodontic treatment need. *Eur J Orthod*, Vol.26, No.3, pp. 265-271.
- Harris, E., Smith R., (1980). A study of occlusion and arch width in families. *Am J Orthod*; 78: 155-163.
- Heikinheimo, K., Nyström, M., Heikinheimo, T., Pirttiniemi, P., Pirinen, S., (2012). Dental arch width, overbite, and overjet in a Finnish population with normal occlusion between the ages of 7 and 32 years. *European Journal of Orthodontics* 34; 418–426
- Hlongwa, P., Beane, R., Seedat, A., Owen, C.,(2004). Orthodontic treatment needs: comparison of two indices. *SADJ*, Vol.59, No.10, pp. 421-424.
- Johnson, M., Harkness, M., Crowther, P., Herbison, P., (2000). A comparison of two methods of assessing orthodontic treatment need in the mixed dentition: DAI and IOTN. *Aust Orthod J*, Vol.16, No.2, pp. 82-87.
- Hunter, W.,(1977). The dynamics of mandibular arch perimeter changes from mixed to permanent dentitions. In: *McNamara JA Jr, ed. The biology of occlusal development*. Ann Arbor: University of Michigan.

- Jones, M. L., Mourino, A. P., Bowden, T. A. (1993) Evaluation of occlusion, trauma, and dental anomalies in African-American children of metropolitan Headstart programs. *J Clin Pediatr Dent*, 18, 51-4.
- Kabue, M. M., Moracha, J. K. & Ng'ang'a, P. M. (1995) Malocclusion in children aged 3-6 years in Nairobi, Kenya. *East Afr Med J*, 72, 210-2.
- Karjalainen, S., Ronning, O., Lapinleimu, H. & Simell, O. (1999). Association between early weaning, non-nutritive sucking habits and occlusal anomalies in 3-yearold Finnish children. *Int J Paediatr Dent*, 9, 169-73.
- Kassis, A., Bou Serhal, J., Bassil Nassif, (2010). N. Malocclusion in Lebanese Orthodontic Patients: An Epidemiologic and Analytic Study. *IAJD* Vol. 1 – Issue 1, Page 35-43.
- Katz, K., Rosenblatt, A., Gondim, P., (2004). Nonnutritive sucking habits in Brazilian children: Effects on deciduous dentition and relationship with facial morphology. *Am J Orthod Dentofacial Orthop*; 126:53-7.
- Kelly, J., Harvey, C. (1977). An Assessment of the Teeth of Youths 12-17 Years. Washington, DC: National Center for Health Statistics;. DHEW Pub No. (HRA) 77-1644.
- Kelly, J., Sanchez, M., Van Kirk, L., (1973). An Assessment of the Occlusion of Teeth of Children. Washington, DC: National Center for Health Statistics; *DHEW Publication No. (HRA) 74-1612*.
- Kerosuo, H. (1990) Occlusion in the primary and early mixed dentitions in a group of Tanzanian and Finnish children. *ASDC J Dent Child*, 57, 293-8.
- Kerosuo, H., Al Enezi, S., Kerosuo, E., Abdulkarim, E., (2004). Association between normative and self-perceived orthodontic treatment need among Arab high school students. *Am J Orthod Dentofacial Orthop*, Vol.125, pp. 373-378.
- Khurana, A., Arora, M., Gajinder S., (1986). Relationship between adenoids and malocclusion. *J Indian Dental Ass.* 58:143-145.
- King, G., Spiekerman, C., Greenlee, G., Huang, G., (2012). Randomized clinical trials of interceptive and comprehensive orthodontics. *JDR Clinical research supplement*. vol.91; suppl No1.
- Kok, Y.V.; Mageson, P.; Harradine, N.W., Sprod, A.J. (2004). Comparing a quality of life measure and the Aesthetic Component of the Index of Orthodontic Treatment Need

(IOTN) in assessing orthodontic treatment need and concern. *J Orthod*, Vol.31, No.4, pp. 312-318.

Krzywoiv, A., Liebermaan, M., Modan, M., (1975). Prevalence of malocclusion in young adults of various ethnic backgrounds in Israel. *J Dent Res*. Vol 54 No. 3.

Larsson, E., (2001). Sucking, chewing, and feeding habits and the development of crossbite: a longitudinal study of girls from birth to 3 years of age. *Angle Orthodontist*; 71:116-9.

Leighton, B., (1969). The early signs of malocclusion. *Trans Eur Orthod Soc*;45:353-368.

Linder-Aronson, S. (1974). Orthodontics in the Swedish public dental health service. *Transactions of the European Orthodontic Society*, pp. 233-240.

Linder-Aronson, S. (1974). Orthodontics in the Swedish public dental health service. *Transactions of the European Orthodontic Society*, pp. 233-240.

Linder-Aronson, S; Fridh, G; Jensen, R. (1976). Need of orthodontic treatment and orthodontic specialists in Sweden. *Swedish Dental Journal*, Vol.68, pp. 383-402.

Linder-Aronson, S; Fridh, G; Jensen, R. (1976). Need of orthodontic treatment and orthodontic specialists in Sweden. *Swedish Dental Journal*, Vol.68, pp. 383-402.

Locker, D., Jokovic, A., Tompson, B. & Prakash, P. (2007). Is the Child Perceptions Questionnaire for 11-14 year olds sensitive to clinical and self-perceived.

Lombardi, A., (1982). The adaptive value of dental crowding: A consideration of the biologic basis of malocclusion. *Am J Orthod*; 81: 38-42.

Lundstrom, A. (1977). Need for treatment in cases of malocclusion. *Transactions of the European Orthodontic Society*, pp. 111-123.

Macena, M., Katz, C., Rosenblatt, A., (2009). Prevalence of a posterior crossbite and sucking habits in Brazilian children aged 18 – 59 months. *European Journal of Orthodontics* 31;357–361.

Mandall, N., McCord, J., Blinkhorn, A., Worthington, H., O'Brien, K., (2000). Perceived aesthetic impact of malocclusion and oral self-perceptions in 14-15-year-old Asian and Caucasian children in greater Manchester. *Eur J Orthod*, Vol.22, No.2, pp. 175-183.

Mandall, N., Wright, J., Conboy, F., Kay, E., Harvey, L., O'Brien, K., (2005). Index of orthodontic treatment need as a predictor of orthodontic treatment uptake. *Am J Orthod Dentofacial Orthop*, Vol.128, No.6, pp. 703-707.

Manzanera, D., Montiel-Company, J., Almerich-Silla, J., Gandía, J., (2009). Orthodontic treatment need in Spanish schoolchildren: an epidemiological study using the Index of Orthodontic Treatment Need. *Eur J Orthod*, Vol.31, No.2, pp. 180-183.

Melink, S., Vagner, M., Boltezar, I., Ovsenik, M., (2010). Posterior crossbite in the deciduous dentition period, its relation with sucking habits, irregular orofacial functions, and otolaryngological findings. *American Journal of Orthodontics and Dentofacial*. Volume 138, Number 1.

Melsen, B., Terp, S., (1982). The influence of extractions caries cause on the development of malocclusion and need for orthodontic treatment. *Swed Dent J Suppl.*; 15:163-9.

Mohen Das, U., Venkatsubramanian, Reddy, D., (2008). Prevalence of malocclusion among school children in Bangalore, India. *Jaypee's international journal of clinical pediatric dentistry*. September-December 2008; 1(1):10-12.

Moorrees, C., (1959). The dentition of the growing child. Cambridge, Massachusetts: Harvard University Press.

Mossey, P., (1999). The heritability of malocclusion: Part 2. The influence of genetics in malocclusion. *Br J Orthod*; 26: 195-203.

Mtaya, M., Brudvik, P., Åstrøm, A., (2009). Prevalence of malocclusion and its relationship with sociodemographic factors, dental caries, and oral hygiene in 12- to 14-year-old Tanzanian schoolchildren. *European Journal of Orthodontics* 31; 467-476.

Mugonzibwa, E., Kuijpers-Jagtman, A., Van 't Hof, M., Kikwilu, E., (2004). Perceptions of dental attractiveness and orthodontic treatment need among Tanzanian children. *Am J Orthod Dentofacial Orthop*, Vol. 125, No.4, pp. 426-433.

Murshid, Z., Amin, H., Al-Nowaiser, A., (2010). Distribution of certain types of occlusal anomalies among Saudi Arabian adolescents in Jeddah city. *Community Dent Health*. Dec;27(4):238-41.

Ngom, P., Diagne, F., Dieye, F., Diop-Ba, K., Thiam, F., (2007). Orthodontic treatment need and demand in Senegalese school children aged 12-13 years. An appraisal using IOTN and ICON. *Angle Orthod*, Vol.77, No.2, pp. 323-330.

Øgaard, B., Larsson, E. & Lindsten, R. (1994). The effect of sucking habits, cohort,

sex, intercanine arch widths, and breast or bottle feeding on posterior crossbite in Norwegian and Swedish 3-year-old children. *Am J Orthod Dentofacial Orthop*, 106, 161-6.

Otuyemi, O., Ugboko, V., Adekoya-Sofowora, C., Ndukwe, K., (1997). Unmet orthodontic treatment need in rural Nigerian adolescents. *Community Dent Oral Epidemiol*, Vol.25, No.5, pp. 363-366.

Patrick, D., Lee, R., Nucci, M., Grembowski, M., Jolles, C., Milgrom, P., (2006). Reducing oral health disparities: a focus on social and cultural determinants. *BMC Oral Health*, 6:S4

Proffit, W. R. & Fields, H. W. (2000). Contemporary orthodontics, St. Louis, Mosby.

Proffit, W.R., Fields, H.W., Moray, L.J (1998). Prevalence of malocclusion and orthodontic treatment need in the United States: Estimates from the NHANES-III survey. *Int J Adult Orthod Orthogn Surg* 13:97-106.

Puertes-Fernández, N., Montiel-Company, J., Almerich-Silla, J., Manzanera, D., (2010). Orthodontic treatment need in a 12-year-old population in the Western Sahara. *Eur J Orthod*; 33(4):377-80.

Riedmann, T., Berg, R., (1999). Retrospective evaluation of the outcome of orthodontic treatment in adults. *J Orofac Orthop*, Vol.60, No.2, pp. 108-123.

Robke, F. J. (2008) Effects of Nursing Bottle Misuse on Oral Health: Prevalence of Caries, Tooth Malalignments and Malocclusions in North-German Preschool Children. *J Orofac Orthop*, 69, 5-19.

Rodrigues de Almeida, M., Pereira, A., Rodrigues de Almeida, R., Rodrigues de Almeida-Pedrin, R., Gabriel da Silva Filho, O., (2011). Prevalence of malocclusion in children aged 7 to 12 years. *Dental Press J Orthod* July-Aug; 16(4):123-31.

Rønning, O. & Thilander, B. (1995). *Introduction to orthodontics*, [Gøteborg], Gothia.

Rwakatema, D. S., Nganga, P. M. & Kemoli, A. M. (2006) Prevalence of malocclusion among 12-15-year-olds in Moshi, Tanzania, using Bjork's criteria. *East Afr Med J*, 83, 372-9.

Saleh, F., (1999). Prevalence of malocclusion in a sample of Lebanese schoolchildren: an epidemiological study. *Eastern Mediterranean Health Journal*, Volume 5, Issue 2, Page 337-343.

Salzmann, J.A. (1968). Handicapping malocclusion assessment to establish treatment priority. *American Journal of Orthodontics*, Vol.54, pp. 749-765.

Schopf, P. (1981) Der Anteil Exogener Faktoren an der Entstehung von Dysgnathien. *Fortschr. Kieferorthop*, 42, 19-28.

Shaw, WC; Richmond, S.; O'Brien, KD (1995). The use of occlusal indices: a European perspective. *American Journal of Orthodontics and Dentofacial Orthopedics*, Vol.107, pp.1-10.

Sheiham A. (1993). Guest editorial: The Berlin declaration on oral health and oral health services. *Quintessence Int*; 24: 829-832.

Sinclair, P., Little, R., (1983) Maturation of untreated normal occlusions. *American Journal of Orthodontics* 83: 114 – 123.

Smith, R., Bailit, H., (1977). Problems and methods in research on the genetics of dental occlusion, *Angle Orthod*; 47: 65-77.

So, L., Tang, E., (1993). A comparative study using the Occlusal Index and the Index of Orthodontic Treatment Need. *Angle Orthod*, Vol 63, No.1, pp. 57-64.

Soh, J., Sandham, A., (2004). Orthodontic treatment need in Asian adult males. *Angle Orthod*, Vol.74, No.6, pp. 769-773.

Soh, J., Sandham, A., Chan, Y., (2005). Malocclusion severity in Asian men in relation to malocclusion type and orthodontic treatment need. *Am J Orthod Dentofacial Orthop*; Vol.128, No.5, pp. 648-652.

Souames, M., Bassigny, F., Zenati, N., Riordan, P., Boy-Lefevre, M., (2006). Orthodontic treatment need in French schoolchildren: an epidemiological study using the Index of Orthodontic Treatment Need. *Eur J Orthod*, Vol.28, No.6, pp. 605-609.

Solow, B., Sonnesen, L., (1998). Head posture and mal-occlusion. *Eur J Orthod*.20:685-693.

Stahl, F. & Grabowski, R. (2003) Orthodontic findings in the deciduous and early mixed dentition--inferences for a preventive strategy. *J Orofac Orthop*, 64, 401-16.

Stoddard, E., (1947). Inheritance of Malocclusion. *J. Hered.* 38 (4): 117-120.

Summers, CJ. (1971). The occlusal index: a system for identifying and scoring occlusal disorders. *American Journal of Orthodontics*, Vol.59, pp. 552-567.

Swedish Medical Health Board. (1966). Socialstyrelsen Kungl Medicinalstyrelsens circular den 21 februari 1966 angående anvisningarna för journalföring inom folktandvårdens tandregleringsvård. Stockholm.

- Szyszkas-Sommerfeld, L., Buczkowska-Radlińska, J., (2010). Influence of tooth crowding on the prevalence of dental caries. A literature review. *Ann Acad Med Stetin*.56(2):85-8
- Tausche, E., Luck, O., Harzer, W. (2004). Prevalence of malocclusions in the early mixed dentition and orthodontic treatment need. *Eur J Orthod*, Vol.26, No.3, pp. 237-244.
- Tickle, M., Kay, E., Bearn, D., (1999). Socio-economic status and orthodontic treatment need. *Community Dent Oral Epidemiol*, Vol.27, No.6, pp. 413-418.
- Trottman, A. & Elsbach, H. G. (1996) Comparison of malocclusion in preschool black and white children. *Am J Orthod Dentofacial Orthop*, 110, 69-72.
- Tulloch, C., Proffit, W., Phillips, S., (2004). Outcomes in a 2-phase randomized clinical trial of early Class II treatment. *Am J Orthod Dentofacial Orthop*;125:657-67.
- Tuominen, M., Nystrom, M., Tuominen, R., (1995). Subjective and objective orthodontic treatment need among orthodontically treated and untreated Finnish adolescents. *Community Dent Oral Epidemiol*, Vol.23, pp. 286-290.
- Uçüncü, N., Ertugay, E., (2001). The use of the Index of Orthodontic Treatment need (IOTN) in a school population and referred population. *J Orthod*, Vol.28, No.1, pp. 45-52.
- Van Norman, R.,(1997). Digit-sucking: a review of the literature, clinical observations and treatment recommendations. *Int J Orofacial Myology*.;23:14-34.
- Viskovic, R., Vujanovic, M., Brcic, V. (1990). Prevalence of orthodontic anomalies, analysis and evaluation of dental health in three groups of pre-school children in Zadar. *Acta Stomatol Croat*, 24, 271-80.
- Warren, J., Bishara, S., (2002). Duration of nutritive and nonnutritive sucking behaviors and their effects on the dental arches in the primary dentition. *Am J Orthod Dentofacial Orthop*; 121:347-56.
- Wolpoff, M.(1971). Interstitial wear. *Am. J. Phys. Anthropol*. 34: 205-228.
- World Health Organization (1985). Oral health care systems. An international collaboration study. London. Quintessence publishing company Ltd.
- World Health Organization (2005). Preventing chronic disease: a vital investment. Geneva.

World Health Organization (2010). Equity, social determinants and public health programs, Geneva.

# APPENDICES

## **Appendix I**

القسم الأول: التعريف

اسم الولد \_\_\_\_\_  
اسم المدرسة \_\_\_\_\_  
الصف \_\_\_\_\_

11. علاقتك بالولد

١. الوالدة
٢. الاب
٣. الجدّ الجدة
٤. أخ أخت
٥. عمّ أعمّة
٦. علاقة أخرى ما هي

القسم الثاني: معلومات ديموغرافية اجتماعية

[ ] [ ] [ ]  
[ ] سنة

SD1. تاريخ الولادة: أشهر سنة

SD2. العمر في آخر عيد ميلاد

SD3. الجنس

١. ذكر
٢. انثى

SD4. الوضع العائليّ

١. متاهل متاهلة
٢. مُطلق مُطلّقة
٣. أرمل أرملة

SD5. أعلى مستوى علميّ

١. أمّي
٢. كتابة إقراءة
٣. ابتدائيّ
٤. متوسط
٥. ثانويّ
٦. كئيّة إجامعة

SD6. الدخل الإجماليّ الشهري للعائلة

١. ما دون ال ٥٠٠,٠٠٠ ل.ل
٢. بين ٥٠٠,٠٠٠ و ٩٩٩,٩٩٩ ل.ل
٣. بين ١,٠٠٠,٠٠٠ و ٣,٠٠٠,٠٠٠ ل.ل
٤. ما فوق ال ٣,٠٠٠,٠٠٠ ل.ل

SD7. ترتيب ولادة الولد؟

١. البكر
٢. الأخير الأصغر
٣. آخر (حدّد).....

H1. هل طفلك عانى أو لا يزال يعاني من أي مرض مزمن؟

١. نعم
٢. كلاً (انتقل الى السؤال H5)

H2. إذا كانت الإجابة بنعم، من أي الأمراض التالية؟

١. مرض السكري
٢. أمراض القلب
٣. مشاكل رئوية
٤. أمراض الجهاز الهضمي
٥. سرطان
٦. آخر (حدّد) \_\_\_\_\_

H3. هل لدى احد افراد العائلة حالياً، او عانى سابقا من نفس المرض؟

١. نعم
٢. كلاً (انتقل الى السؤال H5)

H4. إذا كانت الإجابة بنعم، من أي الأمراض التالية؟

١. مرض السكري
٢. أمراض القلب
٣. مشاكل رئوية
٤. أمراض الجهاز الهضمي
٥. سرطان
٦. آخر (حدّد) \_\_\_\_\_

H5. إذا نعم، رجاء حدّد علاقة الشخص بالطفل؟

١. الأب
٢. الأم
٣. الجدة/ الجد
٤. آخر (حدّد) \_\_\_\_\_

H6. طفلك يتنفس في الغالب من

١. أنف (انتقل الى السؤال H8)
٢. فم
٣. من الأنف والفم
٤. لا اعرف (انتقل الى السؤال H8)

H7. إذا كنت طفلك يتنفس من فمه، هل خضع للعلاج؟

١. نعم
٢. كلاً (انتقل الى السؤال H8)

H8. إذا كانت الإجابة بنعم في أي عمراتم علاج ذلك؟ [\_\_] سنة

H9. هل كانت الوالدة تُدخّن السجائر خلال فترة ملها بالولد المعني؟

١. نعم
٢. كلاً
٣. لا اعرف

H10. إذا نعم، خلال أيّ فصل من الحمل

١. الأوّل
٢. الثّاني
٣. الثّالث
٤. كلّ فترة الحمل
٥. لا اعرف

H11. تقريبا كم عدد السجائر يوميًا كانت تدخن الأم خلال فترة الحمل

١. ١-١٠
٢. ١١-٢٠
٣. أكثر من ٢٠ سيجارة
٤. لا اعرف

H12. هل كانت الوالدة تُدخّن الارغيلة خلال فترة ملها بالولد المعني؟

١. نعم
٢. كلا
٣. لا اعرف

#### القسم الرابع: عادات معيّنة لدى الولد

S1. هل كان الولد يمصّ اصبعه، شفتيه، او أيّ شيء آخر خلال فترة الرضاعة؟

١. نعم
٢. كلا (انتقل الى القسم الخامس)

S2. إذا نعم، ماذا كان يمصّ؟

١. ابهام الصبع
٢. الشفّة
٣. آخر (حدّد)

S3. في أيّ عمر بدأ/بدأت هذه العادة؟

S4. في أيّ عمر، اوقف/اوقفت هذه العادة؟

S5. ما هي مدّة فترة ممارسة هذه العادة؟

١. ساعة او أقل
٢. من ساعة الى ٣
٣. ساعات الى ٦
٤. ست ساعات وما فوق
٥. لا أذكر

#### القسم الخامس: طريقة التغذية

F1. كيف تمّ اطعام الولد خلال أوّل ستة اشهر من طفولته؟

١. رضاعة
٢. القنينة
٣. كلاهما
٤. لا اعرف

F2. ما هي مدّة ارضاعه ؟

١. ١-٥ اشهر
٢. اكثر من ٦ اشهر، اقلّ من سنتين
٣. اكثر من سنتين
٤. لا اتذكّر

F3. ما هي مدّة ارضاعه من القنينة؟

١. ١-٥ اشهر
٢. اكثر من ٦ اشهر، اقلّ من سنتين
٣. اكثر من سنتين
٤. لا اتذكّر

F4. كم مرة يتناول الولد الحلويات \ السكريات؟

١. اكثر من مرّة يوميًا، حدّد.....
٢. مرّة يوميًا
٣. مرّة في الاسبوع
٤. مرّة في الشهر
٥. بالمناسبات

F5. متى يتناول الحلويات\السكريات؟

- |                      |     |     |
|----------------------|-----|-----|
| ١. خلال وجبات الطعام | نعم | كلا |
| ٢. بعدها             | نعم | كلا |
| ٣. بين وجبتين        | نعم | كلا |
| ٤. قبل فترة النوم    | نعم | كلا |

#### القسم السادس: نمط الاهتمام بصحة الفم\الاسنان

B1. كم مرة عادة ينظف الولد أسنانه ؟

١. مرّة يوميًا\الكثير
٢. ٢-٣ مرّات يوميًا
٣. اقلّ من مرّة
٤. في المناسبات
٥. ابدا
٦. لا اعرف

B2. ما هي المواد المستعملة لتنظيف الاسنان؟

١. معجون اسنان
٢. لاشيء
٣. آخر، حدّد.....

B3. هل سبق أن عاين ولدكم اي طبيب اسنان ؟

١. نعم

٢. كلا

**B4.** إذا نعم، متى كانت آخر مرّة؟

١. شهر أو أقل

٢. ١ الى ٣ اشهر

٣. ٣ الى ٦ اشهر

٤. اكثر من ٦ اشهر

**B5.** إذا نعم، في آخر مرة عاين طبيب اسنان الولد لايّ سبب من الاسباب التالية؟

١. كشف روتيني نعم كلا

٢. تنظيف نعم كلا

٣. تسوّس نعم كلا

٤. الم حاد نعم كلا

٥. شكل الاسنان نعم كلا

٦. آخر، حدد نعم كلا

**B6.** هل تعرّضت اسنان الولد لمادة الفلوريد من غير معجون الأسنان؟

١. نعم

٢. كلا

**B7.** إذا نعم، كيف تمّ اخذ الفلوريد؟

١. بواسطة الماء؟

٢. غسل الفم

٣. إضافات غذائية احبوب

٤. خلال زيارات طبيب الاسنان

**B8.** كيف غالبا يستهلك الولد مادة الصودا؟ ببيسي، كوكاكولا وغيرها

١. اكثر من مرّة يوميا

٢. مرّة/يوم

٣. أقل من المعدل اليومي. عدّة مرات اسبوعيا

٤. في المناسبات

٥. ابدا

**B9.** هل تعتقد ان حالة فم الولد الصحيّة هي؟:

١. ممتازة

٢. جيّدة

٣. عادية

٤. سيّئة

٥. سيّئة جدا

**B10.** هل تعتقد ان الولد بحاجة الى تقويم اسنان؟

٤. نعم

٥. كلا

٦. لا اعرف

**B11.** إذا نعم لأية اسباب؟

١. اسنان متراكمة فوق بعضها البعض

٢. اسنان نائنة
٣. وضع غير طبيعي لأي من الفكّين
٤. آخر ، حدّد.....

**جزيل الشكر لمشاركتكم**

الرقم المتسلسل: ا ا ا ا ا

## تقييم صحة الفم في المدارس الابتدائية في لبنان: مقارنة بين المدارس العامة والخاصة الجامعة الامريكية في بيروت الاسئلة الخاصة بالاهل

كجزء من التقييم الصحي السنوي الذي تنظمه Ajjalouna، جرى تقييم صحة فم و أسنان طفلك من قبل أطباء أسنان مخصصين. لم يتلق طفلك أي علاج، وأرسلت ورقة معه لإعلامك ما إذا كان بحاجة إلى أي علاج. نود استخدام البيانات التي تم جمعها من فحص فم و أسنان طفلك في بحث يهدف إلى تقييم صحة طفلك عن طريق الفم، وربطها العوامل السلوكية والخلفية على حد سواء من الأطفال والاهل وستعرض البيانات على شكل بيانات.

ان مشاركتكم الطوعية، والمشكورة هي جد مطلوبة، لتجميع المعلومات المتعلقة باولادكم، وبحالة، وسلامة اسنانهم، بحيث يمكن ربطها بعوامل تتعلق بسلوكية وعادات الاولاد والاهل معا. ترمي الدراسة الى متابعة الأطفال لسنوات خمسة لمتابعة صحة أسنانهم.

نرجو ان تأخذوا وقتكم بقراءة هذه المعلومات بدقة وروية، قبل قرار المشاركة في الاستطلاع او عدمه:

1. سوف لن يأخذ الاستطلاع من وقتكم اكثر من ٥ دقائق، كما ان الاسم والاجوبة سوف تكون مجهولة المصدر، ولن تنشر مُطلقاً.

2. يمكن لكم عدم الاجابة عن كل الاسئلة، حتى بعد توقيع القبول بالمشاركة بعد قراءة وفهم كل ابعاد هذا البحث، وتم اخذ القرار بالمشاركة من قبلكم وتعبئة الاستطلاع، الرجاء توقيع القسم الأول. إذا وافقتم على امكانية الاتصال بكم بعد سنوات قادمة لتحديث مضمون هذا الاستطلاع، الرجاء توقيع القسم الثاني. سيتم الكشف وفحص الاطفال من قبل أطباء اسنان متخصصين، ليُصار بعدها الى تدوين المعلومات عن كل حالة. إذا كان الولد بحاجة الى علاج معين، سوف يتم ابلاغ الاهل عبر رسالة خطية تُرسل مع ولدهم. إذا كنت توافق على ان المعلومات التي تم جمعها من فحص طفلك عن طريق الفم ان تستخدم في دراستنا التي تتم في كلية العلوم الصحية وبالتعاون مع قسم تقويم الاسنان في الجامعة الامريكية في بيروت، الرجاء توقيع القسم الثالث.

شكرا سلفا لمساهمتمكم.

<p><b>القسم - ٣ -</b> الموافقة على استخدام المعلومات الواردة في الدراسة</p> <p>.....</p> <p>توقيع المشارك</p> <p>.....</p> <p>التاريخ</p>
---

<p><b>القسم - ٢ -</b> الموافقة على تحديث المعلومات</p> <p>.....</p> <p>توقيع المشارك</p> <p>.....</p> <p>التاريخ</p>
--

<p><b>القسم - ١ -</b> الموافقة على تعبئة الاستمارة</p> <p>.....</p> <p>توقيع المشارك</p> <p>.....</p> <p>التاريخ</p>
--

فريق البحث، يستطيع المساعدة في حال تعرّض عليكم تعبئة الاستمارة.  
رجاء الاتصال عند الحاجة ب:

- الدكتور انطوان حنا، قسم تقويم الاسنان، الجامعة الاميركية في بيروت، خلوي: ٠٣-٣٢٥١٦٣، بريد الكتروني: [ah111@aub.edu.lb](mailto:ah111@aub.edu.lb)
- الدكتور سيلين مكرزل، قسم تقويم الاسنان في الجامعة الاميركية في بيروت، خلوي: ٠٣-٩٦٨١٦٨، بريد الكتروني: [cm27@aub.edu.lb](mailto:cm27@aub.edu.lb)

## Appendix III

الرقم المتسلسل: ا ا ا ا ا

## تقييم صحة الفم في المدارس الابتدائية في لبنان: مقارنة بين المدارس العامة والخاصة الجامعة الامريكية في بيروت الاسئلة الخاصة بالاهل

تقوم كئيّة العلوم الصحيّة والعلوم بالتعاون مع قسم تقويم الاسنان في الجامعة الامريكية في بيروت باستطلاع يتعلّق بصحة الفم ( الاسنان ) لالف - ١٠٠٠ - طفل تتراوح أعمارهم بين ٦ و ١١ سنين منتسبين الى المدارس الخاصة والعامة. ان مشاركتكم الطوعيّة، والمشكورة هي جد مطلوبة، لتجميع المعلومات المتعلّقة باولادكم، وبحالة، وسلامة اسنانهم، بحيث يمكن ربطها بعوامل تتعلّق بسلوكيّة وعادات الاولاد والاهل معا. ترمي الدراسة الى متابعة الأطفال لسنوات خمسة لمتابعة صحة أسنانهم نرجو ان تأخذوا وقتكم بقراءة هذه المعلومات بدقّة ورويّة، قبل قرار المشاركة في الاستطلاع او عدمه:

١. سوف لن يأخذ الاستطلاع من وقتكم اكثر من ٥ دقائق، كما ان الاسم والاجوبه سوف تكون مجهولة المصدر، ولن تنشر مُطلقاً.

٢. يمكن لكم عدم الاجابة عن كلّ الاسئلة، حتى بعد توقيع القبول بالمشاركة. بعد قراءة وفهم كل ابعاد هذا البحث، وتم اخذ القرار بالمشاركة من قبلكم وتعيينه الاستطلاع، الرجاء توقيع القسم الأول. إذا وافقتم على امكانيّة الاتصال بكم بعد سنوات قادمة لتحديث مضمون هذا الاستطلاع، الرجاء توقيع القسم الثاني. سيتمّ الكشف وفحص الاطفال من قبل أطباء اسنان متخصصين، ليُصار بعدها الى تدوين المعلومات عن كلّ حالة. إذا كان الولد بحاجة الى علاج معيّن، سوف يتمّ ابلاغ الاهل عبر رسالة خطية تُرسل مع ولدهم. إذا وافقتم على ان يُشارك ولدكم في هذه الدراسة، الرجاء توقيع القسم الثالث.

شكرا سلفا لمساهمتمكم.

<p><b>القسم - ٣ -</b> الموافقة على مشاركة التلميذ</p> <p>..... توقيع المشارك</p> <p>..... التاريخ</p>
---

<p><b>القسم - ٢ -</b> الموافقة على تحديث المعلومات</p> <p>..... توقيع المشارك</p> <p>..... التاريخ</p>
--

<p><b>القسم - ١ -</b> الموافقة على تعبئة الاستمارة</p> <p>..... توقيع المشارك</p> <p>..... التاريخ</p>
--

البحث،

فريق

يستطيع المساعدة في حال تعذر عليكم تعبئة الاستمارة.  
رجاء الاتصال عند الحاجة ب:

- الدكتور انطوان حنا، قسم تقويم الاسنان، الجامعة الاميركية في بيروت، خلوي: ٣٢٥١٦٣-٠٣، بريد الكتروني: [ah111@aub.edu.lb](mailto:ah111@aub.edu.lb)
- الدكتور سيلين مكرزل، قسم تقويم الاسنان في الجامعة الاميركية في بيروت، خلوي: ٩٦٨١٦٨-٠٣، بريد الكتروني: [cm27@aub.edu.lb](mailto:cm27@aub.edu.lb)

## **Appendix IV**

## SBS Child Assent Form Template

# AUB Social & Behavioral Sciences Assent to Participate in Research

**Study Title:**

تقييم صحة الفم في المدارس الابتدائية في لبنان: مقارنة بين المدارس العامة والخاصة

**Researcher:**

سيلين مكرزل, انطوان حنا

**Sponsor:**

إننا نحاول درس كل ما يتعلق باسنانك وفمك. إذا توافق على أن يتم فحصك، فكل ما هو مطلوب منكم هو فتح فمك كي نستطيع فحص اسنانك. إن مدة الفحص لن تتجاوز الـ ١٠ دقائق. وقد سمح لنا والديك بفحصك. يمكنك التوقف عن المشاركة في هذه الدراسة ساعة تشاء. لن يكون هناك أي ألم أو خطر خلال المعاينة، وفي حال الحاجة للمعالجة، فسوف يتم اعلام والديك. سوف نتمكن من معرفة حالة وصحة اسنانكم والتأكد إذا ما كنتم بحاجة لعلاج. أنك لن تحصل على أي مكافآت مقابل السماح لنا بفحصك.

للسؤال عن الدراسة يمكنك الاتصال ب:

انطوان حنا : ٣٣٢٥١٦٣

سيلين مكرزل : ٣٩٦٨١٦٨

### Signing the assent form

لقد قرأت (أو شخص قد قرأ لي) هذه الورقة و فهمت مضمونها. أوافق يتم فحص فمي و أسناني.

AM/PM

التاريخ والوقت

التوقيع أو اسم الفرد.

### Investigator/Research Staff

لقد أوضحت للمشاركة قبل طلب التوقيع أعلاه. لا توجد فراغات في هذه الوثيقة. وقد سلمت نسخة من هذا النموذج إلى المشاركين أو ممثله / ممثلها.

توقيع الشخص الحاصل على موافقة

اسم الشخص الحاصل على موافقة

AM/PM

التاريخ والوقت

**This form must be accompanied by an IRB approved parental permission form signed by a**