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**A VALIDATION STUDY OF THE MALOCCLUSION
IMPACT QUESTIONNAIRE TO MEASURE ORAL
HEALTH-RELATED QUALITY OF LIFE IN YOUNG
ARABS WITH MALOCCLUSION**

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ABSTRACT

A Validation Study Of The Malocclusion Impact Questionnaire To Measure Oral Health-Related Quality Of Life In Young Arabs With Malocclusion

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Aim: To translate, culturally adapt and validate the Malocclusion Impact Questionnaire (MIQ) in a sample of Arab adolescents with malocclusion.

Materials and methods: After translation according to current guidelines, the comprehensiveness of the Arab version of MIQ (MIQ-AR) was verified in a pilot study of 20 Arab adolescents. The current main study was undertaken on a sample of 193 native Arab speakers, aged 10-16 years, presenting for an initial orthodontic consultation appointment. The Child Perceptions Questionnaire short version (CPQ11-14 ISF-16), which has been already validated for use in the Arabic language, was used to investigate criterion validity. Thirty-nine adolescents completed the same questionnaires (MIQ-AR and CPQ11-14 ISF-16) a second time after three weeks in order to test the repeatability of the measurements. Cronbach's alpha was used to test the internal consistency/reliability and Spearman's rho for the criterion validity and test-retest reliability. Statistical tests were undertaken using SPSS.

Result: The MIQ-AR presented high internal consistency (Cronbach's alpha= 0.927>0.70) and a very satisfactory Discrimination Index (DI=0.63>0.30). A positive, very strong, and statistically significant correlation was found between the total scores of the MIQ-AR scale and the CPQ11-14 ISF-16 scale ($\rho=0.710$, $p<0.001$). Test-retest reliability was at a high level ($\rho=0.904$, $p<0.001$).

Conclusion: The MIQ-AR exhibits good psychometric properties in terms of validity and

reliability and seems to be a reliable instrument to assess the impact of malocclusion on the Oral Health-Related Quality of Life in Arab adolescents. However, these findings should be interpreted with caution, as they may be limited to a population similar to the study sample. Further testing of the measure is required in a variety of environments.

DEDICATION

I would like to dedicate this dissertation to my beloved parents, Mr. Hasab-Elrasoul Ali and Mrs. Najat Mohamed as well as to my siblings for their unconditional love and support throughout my life, enabling me to be the person I am today.

In addition, I dedicate it to my exceptional professors, who have made a huge impact on my life; without their constant support, encouragement and inspiration, something necessary to complete this thesis, I would have never finished it. Thank you, Professors A.E. Athanasiou and E.G. Kaklamanos.

DECLARATION

I declare that all the content of this thesis is my own work. There is no conflict of interest with any other entity or organization.

Name: Mohamed Hasab-Elrasoul Ali Mohamed

Signature:

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1. INTRODUCTION

Since the paradigm shift in the definition of health by the World Health Organization in 1946 which stated that health “*is a state of complete physical, mental, and social wellbeing and not merely the absence of disease and infirmity*”, good oral health is no longer considered as just the absence of caries and periodontal diseases, but also as including mental and social wellbeing (Engel, 1977). The concept of “Quality of Life” (QoL) involves the “*subjective perception of the person's position in life, within the system of values and cultural characteristics of the society in which they live and in relation to personal goals, expectations, standards and concerns*” (World Health Organization, 1995).

“Health-Related Quality of Life” (HRQoL) is defined as “*how well a person functions in their life and his or her perceived wellbeing in physical, mental, and social domains of health*” (Hays and Reeve, 2010). Within this framework, the domains of QoL referring to the way people perceive their oral health, specifically corresponding to “Oral Health-Related Quality of Life” (OHRQoL), (Inglehart and Bagramian, 2002). OHRQoL was defined by Locker and Allen (2007) as “*the impact of oral disorders on aspects of everyday life that are important to patients and persons, with those impacts being of sufficient magnitude, whether in terms of severity, frequency or duration, to affect an individual's perception of their life overall*”. OHRQoL is considered to have four main components: (1) Function, concerning mastication and speech; (2) Psychological aspects, involving an individual’s appearance and self-esteem; (3) Social aspects, covering intimacy, communication and social interactions; and (4) Pain and discomfort (Inglehart and Bagramian, 2002).

Traditionally, the severity of malocclusion and the result of orthodontic intervention have been assessed using clinician-important outcomes, such as occlusal and radiographic cephalometric parameters. However, some impacts arising from malocclusion, like function, feelings and emotions, are known only to the patient; therefore, assessments made by clinicians may be conceptually different and, as a result, may differ from the patient’s

perspective (Valladares-Neto et al., 2014; Feu et al., 2010; Kiyak, 2008; Bennett and Phillips, 1999).

The notion that orthodontic problems are linked to HRQoL and OHRQoL is largely derived from studies linking physical, social and psychological distress to malocclusion (Gherunpong et al., 2006; Shaw et al., 1980). Several studies have shown that malocclusion may exert an effect on the everyday life and activities of young people (O'Brien et al., 2006, 2007; Kok et al., 2004) and have reported on the impacts of malocclusion in children (Bernabé et al., 2008; Johal et al., 2007; O'Brien et al., 2007; Page and Thomson, 2005). In general, it seems that the impacts of self-perceived malocclusion primarily affected the psychological and social aspects of everyday activities such as smiling, emotion, and social contact (Bernabé et al., 2008; Traebert and Peres, 2007).

The Malocclusion Impact Questionnaire (MIQ) is a condition specific OHRQoL assessment instrument, which was recently developed in the United Kingdom to assess OHRQoL in adolescents. The aim of the present study was to translate, culturally adapt and validate the MIQ questionnaire on a sample of Arab speaking adolescents with different types of malocclusion.

2. LITERATURE REVIEW

2.1. Quality of life (QOL)

Over the last two decades, the Quality of Life concept has received increased attention regarding research and application in various domains such as education, health care (physical and behavioral) and social services (elderly people and individuals with disabilities). Nowadays, the concept of QoL is particularly relevant, as it is not only used in everyday life but also in the terminology of different disciplines such as sociology, medicine, psychology, philosophy, economic sciences, etc. (Farquhar, 1995).

2.1.1. Historical development of the concept of QoL

Although the term Quality of Life began to appear in the 20th century, early approaches to notions comparable to QoL had appeared in the work of the ancient Greek philosophers, particularly Aristotle (384-322 BCE). In his work *Nicomachean Ethics* (Book 1.1095a.15), using the word "bliss" he was trying to outline a similar concept. Aristotle defines "bliss" as a multidimensional condition of complete happiness associated with personal perceptions and actions, and emphasizes not only its subjective character (that can mean different things to different people) but also the variability depending on the current conditions of life of each individual. Aristotle also utilized the word “εὐδαιμονία” (eudaimonia), which is commonly translated as well-being or welfare (Sandoe, 1999).

In 1948, the United Nations Universal Declaration of Human Rights, although not containing a precise report, touches on the concept of QoL stating that “*Everyone has the right to a standard of living adequate for their health and well-being*” (United Nations, 1948). Later, in the 1960s, the scope of the term broadened to incorporate concepts such as employment, housing, environment, education, health and the availability of leisure activities and rest. Then, in the 1970s, particular emphasis was placed on the idea of emotional and psycho-social balance, as well as well-being. Since 1980 there has been a particular interest in the

concept of QoL focusing on cases of people who are sick, in the process of treatment, or are in the recovery phase (Fallowfield, 1990).

2.1.2. Definitions of QoL

Until now there has been no widely acknowledged definition of QoL because the concept acquires distinctive meanings for different individuals under different circumstances (Farquhar, 1995). Therefore, in 2008, Voruganti stated that “*Quality of Life is easy to understand, but hard to define*”.

In general, the available definitions in the literature can be classified into two fundamental groups, the expert definitions and the lay definitions. The first group has four categories (Farquhar, 1995):

- (1) Global definitions, which measure the level of satisfaction and dissatisfaction and, because of their generality, fail to define the QoL components adequately.
- (2) Component definitions, that differentiate between the dimensions which are important for a comprehensive view of the individual's QoL.
- (3) Focused definitions which refer to a certain number of QoL components.
- (4) Combined definitions, which do not fall into any of the previous categories.

Lay definitions of QoL are divided into three major categories (Felceand Perry, 1995). The first category includes definitions concerning the quality of the living conditions, the second category includes definitions based on people’s expectations and, finally, the third category includes definitions embracing a combination of expectations and living conditions (Fisher 1992).

Examples of definitions of QoL include the following:

- “*The level of well-being of the society and the degree of satisfaction of a number of human needs.*” (UNESCO, 1982)
- “*The satisfaction of an individual’s values, goals and needs through the actualization of their abilities or lifestyle.*” (Emerson, 1985)

- *“The subjective perception of the person's position in life, within the system of values and cultural characteristics of the society in which they live and in relation to their personal goals, expectations, standards and concerns.”* (World Health Organization, 1995)

2.1.3. Content and features of QoL

The concept of QoL includes a combination of objective and subjective evaluations of many aspects of life that are considered basic human rights, which take place in a specific cultural and temporal context (Cunningham et al., 2002; Wallander et al., 2001). As QoL is linked to a variety of scientific disciplines, such as economics, philosophy, social sciences and health sciences, scientists of various disciplines focus on a different subject every time they attempt to define the QoL content (Farquhar, 1995).

The parameters related to QoL have developed to involve an overall assessment of the subjective experience of life (De Haes and van Knippenberg, 1985) and include areas such as the physical, social and psychological well-being of the individual (Young and Longman, 1983; Campbell et al., 1976). As stated by the majority of researchers, parameters such as health, economic prosperity, education, freedom, social participation, personal self-fulfillment and life satisfaction contribute appreciably to the perception of QoL of an individual (Rahman and Mittelhammer, 2011; Andrè et al., 2004). The levels of satisfaction, and consequently their QoL, are usually high in individuals with positive attitudes to the value of the physical, psychological, social and material aspects of their life (Hornquist, 1982).

2.2. Health-related quality of life (HRQOL)

All aspects of the life of each individual are influenced by both personal health and the activities that are aimed at maintaining or improving it. Even at a community level, health is one of the major welfare factors that contribute to QoL and the development of the community itself (Levasseur, 2008). As a consequence of modern medical discoveries and

the application of high technology biomedical methods there has been a significant increase in the life expectancy of most people, especially in the average life expectancy of western societies. However, scientists have been questioning whether these extra years of life are quality years with good health, free of symptoms and illnesses, or the increased life expectancy is accompanied by an increase in morbidity, especially in the elderly (Inglehart and Bagramian, 2002). For example, it has been found that, in cancer patients, despite significant advances in their treatment and survival rates, the disease and the available therapeutic approaches often cause adverse effects on their psychosomatic and social situation (Movsas, 2003), which, in some cases, may themselves act as significant predictors of survival (Montazeriet al., 2001). As a result of this shift, the measurements of health status no longer focus only on traditional mortality and morbidity rates, as previously, but consider also the domains of QoL referring to the way people perceive their health, i.e. Oral Health-Related Quality of Life (Inglehart and Bagramian, 2002).

Therefore, the assessment of HRQoL complements and completes clinical evaluation by adding the important element of the subjective assessment of physical and psychosocial health by the patient themselves at all times (Gimprich and Paterson, 2002). The wide range of information it provides can contribute to the knowledge of the physical and psychosocial impact of the disease, provide an understanding the reasons underlying patients reacting differently to the same disease, and enabling the development of clinical interventions and services to address the impact of diseases on an individual's health (Fontaine and Barofsky, 2001; Guyatt et al., 1993).

2.2.1. Historical development of HRQoL

Although the term HRQoL appeared in health sciences literature in the early 1980s (Streiner and Norman, 2008), it was based on the much earlier special emphasis given by the World Health Organization in the biopsychosocial approach to health, which is characterized by the “*complete physical, psychological and social wellbeing and not just the absence of disease*”

(World Health Organization, 1948). In recent years, HRQoL has attracted increasing interest on the part of researchers from the health sector. This interest has been related to the finding that the assessment of HRQoL offers a comprehensive and complete picture of the impact of various diseases on individuals and can portray their effect on physical and psychosocial health rather than the narrower focus of physiological and clinical examinations, which usually only detect health problems (Haywood et al., 2005; Fontaine and Barofsky, 2001; Guyatt et al., 1993). Furthermore, there is a need to evaluate the overall costs of the various therapeutic interventions with regard to their wider effectiveness, as compared to merely measuring the lengthening of patient survival (Gimprich and Paterson, 2002). The result of this shift has been that HRQoL has now been upgraded from a secondary study outcome, which complements biological and clinical indices, to a central element of health policy formulation (Slade, 2002; Bloom, 1991).

2.2.2. Definitions of HRQoL

Once more, as in the case of the term QoL, until now there has been no widely accepted definition for HRQoL (Gimprich and Paterson, 2002; Karimi and Brazier, 2016). In many cases, HRQoL is characterized as the area of QoL that is more focused on health evaluation (Miguel et al., 2008; Garratt et al., 2002). Since most definitions of HRQoL available today stem from the biopsychosocial approach to health (World Health Organization, 1948), it could be considered that HRQoL is focused on evaluating physical and psychological health, as well as social welfare (Mooney, 2006; Wood-Dauphinee, 1999; Hunt, 1997). Consequently, in the contemporary perspective, HRQoL is described as the multifactorial concept that refers to the perception of the positive and negative aspects of the physical, emotional, social and cognitive functions of the individual, physical discomfort and other symptoms resulting from disease or its treatment (Mooney, 2006; Fontaine and Barofsky, 2001; Wood-Dauphinee, 1999; Hunt, 1997; Osoba, 1994; Till and Osoba, 1994). The physical, psychological and social aspects of health are considered as separate areas, which

are affected by the experiences, beliefs, expectations and perceptions of each individual (Testa and Simonson, 1996).

2.2.3. Content and features of HRQoL

The features most frequently included in HRQoL definitions include physical, emotional, psychological, social, spiritual and functional parameters (Table 1) (Gimprich and Paterson, 2002). Therefore, when studying HRQoL it is important to understand health as a general over-arching concept, not just restricted to physical well-being but also involving the psychological and social integration and self-realization of the individual (Atchison, 2002; Slade, 2002; Patrick and Erickson, 1993). Moreover, it is especially important, when studying these phenomena, to use the correct tools to appraise the multifactorial, subjective and dynamic nature of HRQoL specifically for each population, disease or condition (Gift and Atchison, 1995; King et al., 1997; Gimprich and Paterson, 2002).

Table 1. Contents of HRQoL [adapted from Patrick and Erickson (1993) and Slade (2002)].

Domains		Characteristics
Health-related opportunities		Social or cultural handicap associated with a health condition Social or cultural barriers to health services Adaptability of the individual
Health perceptions		General perception of health Satisfaction with health
Functional status	Social	Restriction to roles, integration, contact, intimacy
	Psychological	Emotional situations, cognitive ability
	Physical	Restriction to activities, good physical condition
Malfunction		Symptoms & subjective complaints, Signs, Clinical measurements, Diagnosis
Survival		Mortality, Survival, Longevity

It is also important to appreciate that current research has shown that that HRQoL is dynamic and changes over time (Gimprich and Paterson, 2002; de Haesand van Knippenberg, 1985). Previous experiences related to health can affect the standards and expectations of individuals, which in turn require adjustment to the criteria to evaluate the HRQoL and the relative weight that they attach to the positive and negative aspects of their experiences (Gimprich and Paterson, 2002). Thus, it is useful to include these considerations in a chronological context and to compare the current situation with other periods in the life of individuals (Gimprich and Paterson, 2002).

2.3. Oral related quality of life (OHRQOL)

Until recently, the established perception that diseases of the oral cavity do not usually lead to major malfunctions (Davis, 1976) resulted in an underestimation of their psychological and social implications (Locker and Grushka, 1987; Reisine and Miller, 1985; Reisine, 1984; 1985; Reisine 1981; Sheiham and Croog, 1981). However, it is now recognized that oral health is one of the areas of general health that can affect daily functioning, as well as overall health and perceptions of QoL (Naito et al., 2006; Gift and Atchison, 1995).

2.3.1. Historical development of OHRQoL

The increased interest in OHRQoL is a relatively new phenomenon. Until recently most of the diseases of the oral cavity were considered more as personal irritating experiences and not situations that could have an impact on the general level of health (Slade, 2002); as, in most cases, the person who experienced these conditions did not have the typical characteristics of a patient (Gerson, 1972) and the problems related to oral health, with the exception of pain and certain neoplasms, were not considered to be significant (Dunnell and Cartwright, 1972). In addition, it was common assumption that these situations were more related to esthetics, self-esteem and only secondary to the social functioning of individuals (Davis, 1976), thus for example, not sufficient to justify absence from work (Gerson, 1972). Consequently, for a long time, dentistry had focused on the study of clinical indices reflecting the outcome of oral cavity diseases (Corson et al., 1999) and failed to provide insight into the impact on patients' functional and psychosocial well-being (Allen, 2003).

Cohen and Jago (1976) were among the first people to highlight the contribution of dentistry to improving the QoL and initiated the creation of socio-dental indexes. Later, based on the work of Locker (1988), who identified the methodological framework for measuring OHRQoL, considerable research effort was concentrated on developing relevant tools (McGrath and Broder, 2004; McGrath and Bedi, 2003; Broder et al., 2001; Slade and Spencer, 1994) and studying how oral health affects parameters such as social life, interaction, self-esteem and performance at work or school (Sischo and Broder, 2011).

Nowadays, the evaluation of OHRQoL is considered particularly important and has altered the dynamics of clinical practice as well as the evaluation of the efficacy of various treatments (Inglehart and Bagramian, 2002). From this perspective, it has been possible to provide personalized healthcare that focuses on the social and emotional experiences and physical functioning of each individual (Najman and Levine, 1981; Christie et al., 1993).

2.3.2. Definition of OHRQoL

As in the case of the term HRQoL, there is still no broadly accepted definition for the term OHRQoL (Inglehart and Bagramian, 2002). In a similar vein to that followed by the World Health Organization (1948), oral health can be defined as “*the state of oral health which allows individuals to eat, speak and to socialize without active disease, discomfort or shame and which contributes to the general sense of well-being*” (United Kingdom Department of Health, 1994). Following the same approach, OHRQoL was initially defined as “*the incidence of conditions associated with the oral cavity in daily functions*” (Slade, 1997) and later redefined and expanded as “*the symptoms of functional and psychosocial effects derived from diseases and oral disorders*” (Locker et al., 2002) which are considered important, and presented with such frequency, severity and duration as to influence the experience and perception of life in general (Locker and Allen, 2007).

2.3.3. Content and features of OHRQoL

In general, OHRQoL can be seen as the absence of negative effects of oral cavity diseases on social life and the existence of self-confidence resulting from the condition of the teeth and the face (Slade, 2002). Thus, OHRQoL constitutes a multifactorial concept that reflects the comfort of people when they eat, sleep and make social contacts, their self-esteem and satisfaction with oral health (United States Department of Health and Human Services, 2000). It comprises the result of the dynamic interaction between the various diseases and conditions of the oral cavity and face on one hand, and the factors related to the social environment (Locker et al., 2005) and the rest of the body, on the other (Atchison et al., 2006), during the life of the individual (Sischo and Broder, 2011).

The factors most commonly included in OHRQoL definitions relate to physical, psychological, social and functional parameters (Inglehart and Bagramian, 2002) (Figure 1).

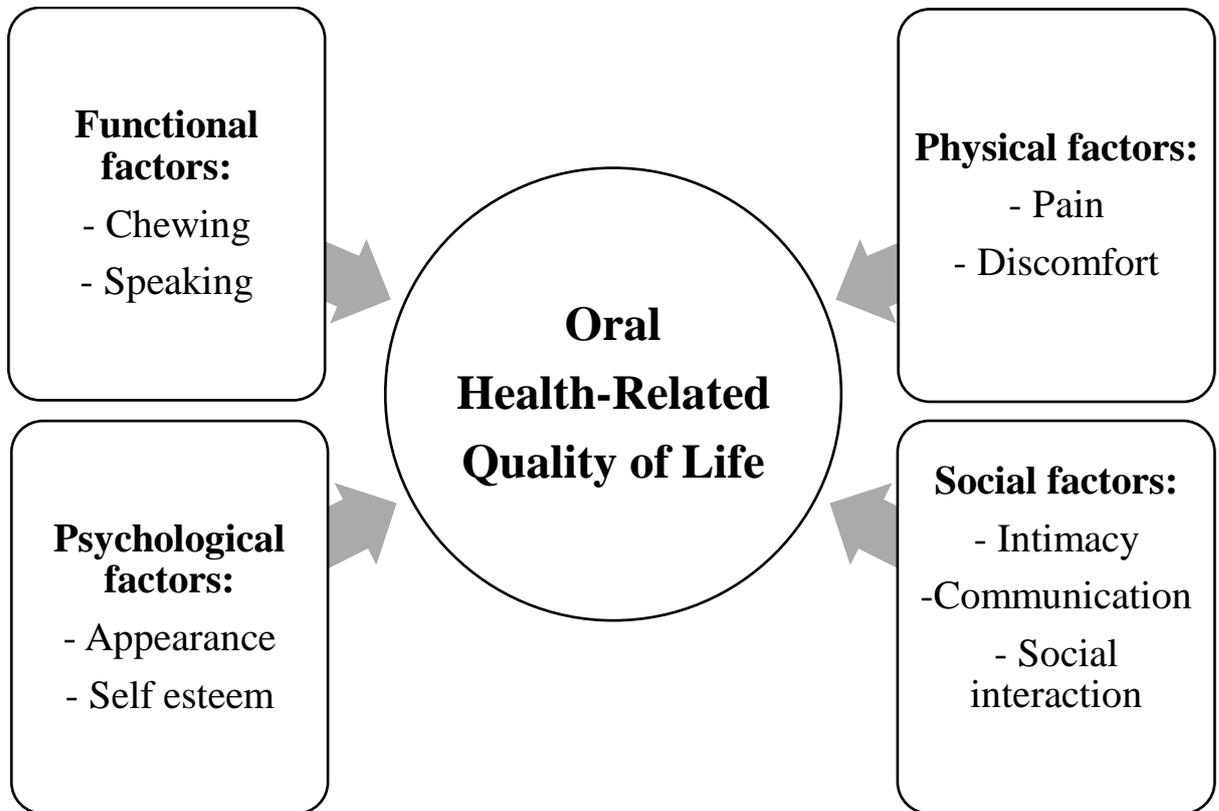


Figure 1. Main factors determining OHRQoL [adapted from Inglehart and Bagramian (2002)].

These factors also include areas such as school and work environment, as well as the expectations and satisfaction of patients regarding treatment (for people who are receiving a therapeutic intervention) (Sischo and Broder, 2011). These varied concepts, and the different domains that determine the individual's perception of their health include the multiple, correlated and often overlapping parameters of functionality and life, which although distinct, are not separated from, or exclusive of one another (Table 2) (Atchison, 2002; Slade, 2002; Gift and Atchison, 1995; Patrick and Erickson, 1993).

Table 2. Domains of OHRQoL and examples of measurement parameters related to the respective dimensions [adapted from Gift and Atchison (1995)].

Domains	Characteristics
Health-related opportunities	<p>Social or cultural handicap associated with a health condition Inability to find work because of the health of the mouth Effect of aesthetics and mouth function on the ability to create friendships and relationship with the family</p> <p>Social or cultural barriers to health services Stigma due to illness</p> <p>Adaptability of the individual Ability to function despite illness or disorder</p>
Health perceptions	<p>General perception of health Self-assessment of the health of the mouth, the concerns about it and the value attributed to it</p> <p>Satisfaction with health Satisfaction with function and aesthetics of the mouth</p>
Functional status	<p>Restriction to roles, integration, contact, intimacy Work / home / hobby management, smile and speaking based participation, interaction related to smile and speech, interaction with family members</p> <p>Emotional situations, cognitive ability Behavior and annoyance with regard to oral health or appearance</p> <p>Restriction to activities, good physical condition Discomfort or decrease in chewing capacity and swallowing function in relation to general nutrition and health</p>
Malfunction	<p>Symptoms & subjective complaints, Signs, Clinical measurements, Diagnosis Reporting of subjective symptoms / sensation / pain, Objective points / Saliva /Dental epidemiological indicators</p>
Survival	<p>Mortality, Survival, Longevity Neoplasms of the mouth, tooth loss, number of teeth</p>

Most of the abovementioned factors reported in relation to OHRQoL were incorporated by Sischo and Broder (2011) into a general theoretical model for OHRQoL (Figure 2).

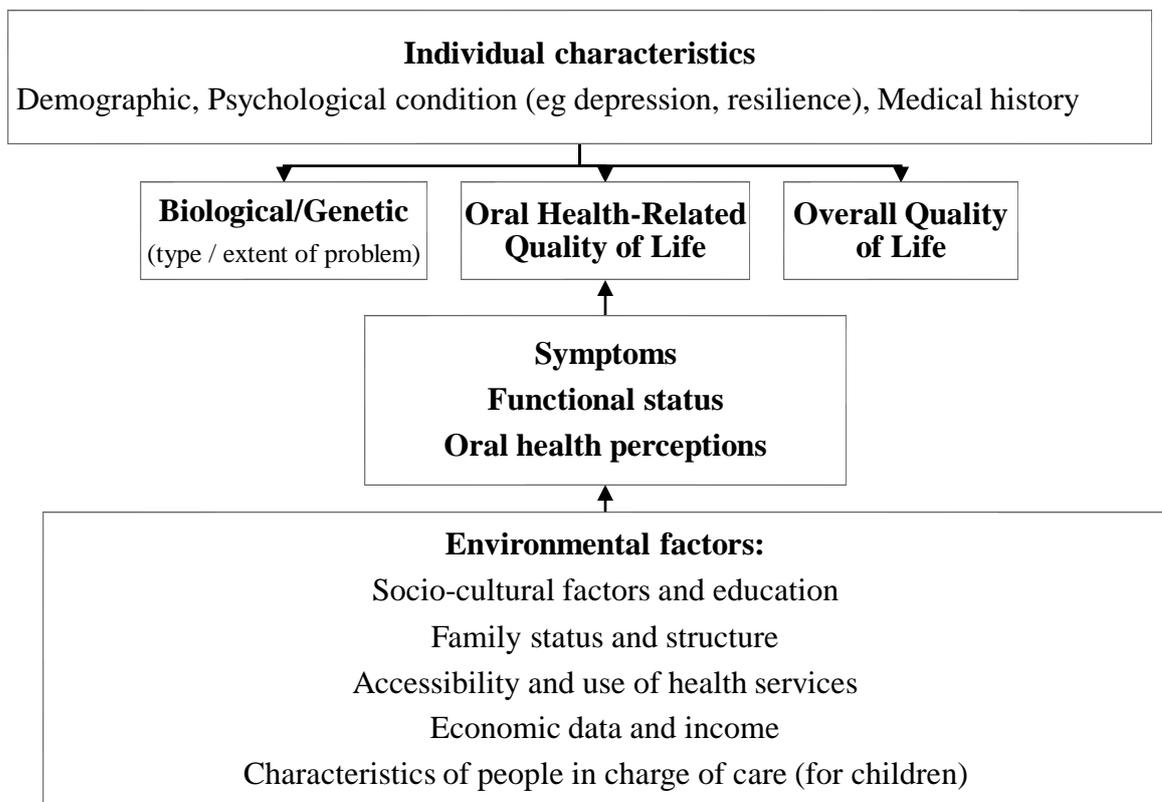


Figure 2. Theoretical model for OHRQoL [adapted from Sischo and Broder (2011)].

According to this model, which was based on the views of Wilson and Cleary (1995), parameters such as individual characteristics, the symptoms of a disease, functional and psychological experiences related to a disease and socio-cultural, as well as environmental influences, are able to modify the perception of OHRQoL, which serves as a link between biological and genetic variables on one hand, and the overall QoL on the other.

The model of Sischo and Broder (2011) includes the perception that, as a given oral health condition can affect the functionality of the individual, these effects may also undermine their overall QoL, which involves a wider assumption (Leplege and Hunt, 1997). However, the extent to which OHRQoL evaluation is related to the assessment of general QoL is not specific and its mechanism is not fully clarified. The effects of a disease are much broader and clearly distinct from the QoL concept, this is why they have to be measured separately (Wallander and Schmitt, 2001). The available OHRQoL measurement tools evaluate the functional and psychosocial impacts resulting from the diseases and disorders of the oral

cavity and the orofacial region, but do not necessarily provide a correlation between the meaning and significance of these effects on QoL (Locker and Allen, 2007).

The importance of investigating all these different areas in assessing the level of OHRQoL has been documented by a continually growing amount of research data (Sischo and Broder, 2011). Certain physical conditions, such as diseases and disorders of the oral cavity and the facial region, are involved in the perception of OHRQoL (Sischo and Broder, 2011). For example, individuals with periodontal disease (Ng and Leung, 2006) and craniofacial disturbances (Broder and Wilson-Genderson, 2007) are characterized by a lower level of OHRQoL than the general population. Moreover, current research practice includes evaluation of OHRQoL and emotional states. Some of these have been shown to exert a negative effect on their perception, such as dental phobia (Mehrstedt et al., 2007) and the assessment of dental and facial esthetics (Broder and Wilson-Genderson, 2007; Klages et al., 2004). Others, such as anxiety and depression, have been associated with the use of medical services and the response to treatment (Litt et al., 2009; Gale and Dixon, 1987), and finally, parameters such as self-esteem, psychological well-being and adaptability can positively modify the health status and the perception of HRQoL in general (Lopez et al., 2003; Broder, 2001) and oral health in particular (Sischo and Broder, 2011; Strauss, 2001).

At this point, it should be emphasized that, as in the case of oral health, the views of patients on OHRQoL are often not consistent with the views of doctors (Atchison et al., 1993). For this reason, it is now recognized that the views of the individuals themselves are necessary for a proper assessment (Sischo and Broder, 2011). Finally, it is important to note that HRQoL includes the assessment of both positive and negative aspects of the situations experienced by each person, Therefore, it includes both positive and negative thoughts, experiences and feelings (Broder and Wilson -Genderson, 2007; McGrath and Bedi, 2003; Patrick et al., 2002; Atchison and Dolan, 1990). In addition, it should be noted that, as in the case of HRQoL, especially in oral health research, it is important to use the correct research tool to investigate the multifactorial, subjective and dynamic nature of QoL, specific to each

population and every disease or condition (Sischo and Broder, 2011).

2.4. OHRQOL and orthodontics

Orthodontic treatment is usually an elective procedure aimed at correcting the various types of malocclusion (O'Brien et al., 2007; 1998; Proffit and Fields, 2012). The demand for correction from patients and the provision of treatment by orthodontists are based, among other reasons, on the assumption that it improves the esthetic, psychological and social well-being of individuals and hence their QoL (Feu et al., 2010; Kiyak, 2008; Burden Pine, 1995; Shaw et al., 1986; Sischo and Broder, 2011). Therefore, it could be expected that the measurement of parameters such as QoL, would be common in this scientific field (Sischo and Broder, 2011).

However, the specialty of orthodontics has not yet given the appropriate emphasis to the contemporary biopsychosocial model of oral health. Until today, orthodontic assessment is mainly based on the use of specific criteria, such as occlusal indices and cephalometric analyses to guide therapeutic decisions and evaluate the quality of orthodontic care (O'Brien et al., 1998). These evaluation tools are undoubtedly important, but they should be combined with QoL evaluations, since patients' views do not necessarily coincide with expert assessments, and the effects of occlusal disharmonies may be unrelated to their severity (Valladares-Neto et al., 2014; Feu et al., 2010; Kiyak, 2008; Bennett and Phillips, 1999). Consequently, the assessment of OHRQoL, and the respective physical, psychological and social effects, could help explain the increasing trends in orthodontic treatment demand that cannot be attributed solely to objective appraisals of malocclusion traits (Proffit and Fields, 2012).

Malocclusion can affect the patient physically in different ways, such as dental, mucosal or gingival trauma and speech. Several studies have linked dental trauma with untreated Class II, division I malocclusion, especially in cases where the upper incisors are severely proclined (Thiruvengkatahari et al., 2015; Koroluk et al., 2003; Shulman and Peterson, 2004).

Malocclusion can also give rise to pain as result of gingival or mucosal trauma, e.g. in cases of deep overbite, and by acting as a contributing factor to periodontal disease (Davies et al., 2001; Burgett, 1995). Another physical effect of malocclusion could be on speech. Recent studies have shown that certain types of malocclusion may affect the pronunciation of specific sounds, such as /s/, /t/, /z/, /j/ and /ch/ (Leavy et al., 2016; Shue-Te et al., 2000; Vallino and Tompson, 1993).

Malocclusion can also affect the psychological sphere of the patient. Dentition plays an important role in facial appearance, as people are concerned about the alignment and the appearance of their teeth (Bos et al., 2003; Espel and Stenvik, 1991). Several studies have also found that facial appearance is very important in social interactions (Kim et al., 2013; Borah and Rankin, 2010). Facial appearance is especially affected by malocclusion. Individuals with severe crowding of the anterior teeth or midline diastema have been found to be the most subjected to teasing and bullying (DiBiase and Sandler, 2001; Hawker and Boulton, 2000; Langlois et al., 2000).

Overall, many studies have demonstrated a negative correlation between malocclusion and OHRQoL in individuals across the age range (Javidi et al., 2017; Choi et al., 2016; Silva et al., 2016; Ramos-Jorge et al., 2015). The most important characteristics related to the adverse effects on OHRQoL include crowded teeth, anterior crossbites, increased concavity of the profile, and prominent lower anterior teeth (Palomares et al., 2016). The treatment of these traits could alter the perception of parameters associated with the physical and emotional domains and consequently modify the assessment of quality of life, which constitutes a dynamic phenomenon (Palomares et al., 2016; Esperao et al., 2010; Allison et al., 1997). Moreover, as orthodontic treatment enhances both functional and esthetic aspects, it could also exert a positive influence on how individuals perceive themselves and are seen by society, with a direct effect on their QoL (Palomares et al., 2016; Marques et al., 2006). A recent systematic review has shown that orthodontic treatment during childhood or adolescence moderately improves the emotional and social well-being domains of OHRQoL.

However, all studies included in the above-mentioned systematic review were observational, thus restricting the interpretation of their results (Javidi et al., 2017).

Furthermore, there appears to be a general lack of a theoretical basis for the outcomes collected, or the analyses conducted (Palomares et al., 2012; Liu, 2009). In many studies, it is assumed that there is a direct relationship between the clinical features of malocclusion and OHRQoL, without considering other factors that might influence this relationship, such as the individual's psychological well-being or their socio-economic status (Bernabé et al., 2007a; 2007b; 2008). Additional doubts have been expressed about the suitability of some of the generic measurement instruments currently used extensively for assessing OHRQoL in young people seeking orthodontic treatment (Marshman et al., 2010). Although these generic measures are useful for comparisons of OHRQoL between different conditions, their meaning and significance have been questioned (Locker et al., 2007). Additionally, it has been suggested that they cannot be readily applied to orthodontic patients, as they focus on pathological conditions, disease, pain and discomfort (Marshman et al., 2010; Locker et al., 2007). Consequently, more studies of a high methodological quality are needed in order to assess in depth the effect of malocclusion and its treatment on OHRQoL.

2.5. Assessment of HRQOL and OHRQOL

The various measuring tools for OHRQoL evaluation presented in the international literature show differences in objectives, measurement methodology and scoring ranges (Inglehart and Bagramian, 2002). Many of these tools are generic and address the general oral health level of a population (Inglehart and Bagramian, 2002). However, because of the weakness of generic tools to focus on specific aspects of OHRQoL, like malocclusion, and identify changes in some cases, it was necessary to create others tools, which are more specialized. Recently, condition specific questionnaires focusing on OHRQoL assessment in individuals with malocclusion problems have been developed, such as tools targeting people who need to be treated with orthognathic surgery or cleft lip and palate patients. These tools examine the

QoL of individuals in relation to the multiple effects of their situation and its response. A general comparison of generic tools and condition specific instruments is presented in Table 3 (Bennett and Phillips, 1999; Guyatt et al., 1993).

Table 3. Comparison between and generic and condition specific instruments [adapted from Bennett and Phillips, (1999) and Guyatt et al., (1993)].

	Strengths	Weaknesses
Generic	<p>Comparisons can be made between different interventions and situations.</p> <p>Effects in different areas of OHRQoL can be detected.</p>	<p>May not adequately focus on the area of interest.</p> <p>They may not have adequate responsiveness.</p> <p>Some questions may be unrelated to the situation or intervention studies.</p> <p>Some tools may be extremely extensive.</p>
Condition specific	<p>They make more sense in clinical practice.</p> <p>They have greater responsiveness.</p> <p>It is more acceptable to patients as they are more about their situation.</p> <p>They are usually not as extensive as the generic tools.</p>	<p>They do not permit comparisons between different situations.</p> <p>They may have a limited range of application in relation to the population or intervention to which they relate.</p> <p>Their development takes a long time.</p> <p>They usually incur greater financial costs to develop, implement and score.</p>

Until now, the most appropriate tool for measuring OHRQoL in individuals with malocclusion has not been determined. Generic tools present a number of important advantages; their psychometric properties are well-defined and can be used to make comparisons between populations with different problems. However, it may not be sensitive to the context of orthodontic problems, so the validity and responsiveness might be limited (Allen et al., 2001). On the contrary, condition specific questionnaires may be more appropriate for detecting minor changes in malocclusion populations.

2.5.1. Generic tools used for HRQoL and OHRQoL evaluation in individuals with various types of malocclusion problems

2.5.1.1. Sickness Impact Profile – (SIP)

The SIP measurement tool is one of the most well-known and commonly used for the evaluation of HRQoL (de Bruin et al., 1997; Bergner et al., 1976a; 1976b; 1981; Carter et al., 1976; Pollard et al., 1976). The SIP evaluates the effect of the disease on the person's behavior but not the subjective level of the disease or illness perception, which is in contrast to emotions, which are observable and can be objectively assessed. Behaviors that are involved in the profile are asserted to represent universal patterns of boundaries that are affected by a disease state, regardless of the specific conditions, treatment, individual characteristics or prognosis. It was designed to evaluate new therapies and to measure the level of health in the general population (Fayers and Machin, 2007; Williams, 1996; Bergner et al., 1981).

It consists of 136 questions and requires 20 to 30 minutes to complete. The questions describe everyday activities and respondents should check the activities they can perform and the statements that describe them the best. It may be completed by the patient himself or by a trained interviewer, but it is considered time consuming. The SIP measurement tool covers 12 main areas of health-related dysfunction according to the physical and psychosocial condition of the individual, but does not include a general question about health or QoL. In general, it emphasizes the effect of disease on activities and behavior, assessing social functioning as well, but not emotions or perceptions (Fayers and Machin, 2007; Bergner et al., 1981).

2.5.1.2 The Short Form - 36 Health Survey – (SF-36)

The SF-36 Health Survey measurement tool was developed by Ware and his colleagues in the 90s, and evaluates general health status (McHorney et al., 1993; 1994; Ware and Sherbourne,

1992). It is a reliable tool that approximates to the basic dimensions of HRQoL, while recording both the physical and mental state of the individual's health. The SF-36 Health Survey has been used to assess and estimate the disease burden and compare it with the general population (Fayers and Machin, 2007; Ware et al., 1993). The SF-36 Health Survey measurement tool consists of only 36 questions that are summarized in eight health scales which aggregate 2-10 items each, the 8-scales are derived from two major clusters: physical and mental health (McHorney et al., 1993; 1994; Ware and Sherbourne, 1992). Physical health is divided into sub-scales that measure physical functioning (10 questions), role-physical (4 questions), bodily pain (2 questions), and general health (5 questions). Mental health involves the sub-scales of vitality (4 questions), social functioning (2 questions), role-emotional (3 questions), and mental health (5 questions). There is also a question about the change in the perception of a person's general health over the last year and an even more general one about the overall perception of the patient's health status (Fayers and Machin, 2007; Ware et al., 1993).

Most of the questions in this tool have to be reported for the previous four weeks, but some are related to the present situation. Some questions, such as those that describe physical roles are answered with a yes or no, while others, such as questions about physical functioning, can be answered in three steps (very limited, a bit limited, not at all limited) and others have five or six categories of answers. The SF-36 is generally reliable, fast and suitable for self-administration, computerized administration or completion by trained interviewer face-to-face or by telephone interviews. It is suitable for individuals who are 14-year-old of age and above (Fayers and Machin, 2007; Ware et al., 1993).

2.5.1.3. Oral Health Impact Profile - 14 (OHIP-14)

The OHIP-14 instrument is based on the World Health Organization's International Classification of Impairments, Disabilities and Handicaps (1980) as adapted for dentistry by Locker (1988). This tool was initially developed by Slade (1997) in Australia, and measures a

variety of impacts that drastically affect everyday life (Allen, 2003; Robinson et al., 2003).

The OHIP-14 questionnaire consists of 14 questions, which are structured in seven dimensions and derived from the OHIP-49 scale (Slade and Spencer, 1994). The dimensions explored are functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. The effects of various diseases and conditions related to oral health are assessed over the previous 12 months (Allen, 2003).

The OHIP-14 questionnaire has been translated and evaluated for its validity and reliability with satisfactory results (Cronbach α factor of 0.86 - 0.95) into several languages and for populations with different social, demographic and clinical characteristics (Dahlström and Carlsson, 2010; Bae et al., 2007; Hagglin et al., 2007; Ikebe et al., 2004; 2007; Luo et al., 2007; Mehrstedt et al., 2007; Brennan and Spencer, 2004; 2006; John et al., 2006; Xin and Ling, 2006; Saub et al., 2005; Slade et al., 2005; Kushnir et al., 2004; Nuttall et al., 2001).

2.5.1.4. Child Perceptions Questionnaire (CPQ₁₁₋₁₄)

The CPQ₁₁₋₁₄ was developed and validated to measure the OHRQoL in young individuals aged between 11 and 14 years. Originally, the instrument comprised 37 questions divided into four domains: oral symptoms (6 items; e.g., pain), functional limitations (9 items; e.g., difficulty in eating), emotional (9 items; e.g., avoiding smiling or laughing around other children), and social well-being (13 items; e.g., being asked questions by other children about their mouth). The newer versions of the CPQ₁₁₋₁₄ have only 16 and 8 questions for easier and simpler use in clinical settings and surveys including the general population, respectively. The short forms of CPQ₁₁₋₁₄ were developed by conducting an interview with 83 children, asking them the original 37 questions with 4 possible answers ranging from 0 ("Does not bother me at all") to 4 ("Bothers me very much"). Then questions were arranged according to each domain and the 4 or 2 questions with the highest score were chosen for the CPQ₁₁₋₁₄-ISF16 and the CPQ₁₁₋₁₄-ISF8, respectively (Jokovic et al., 2006; 2002; Page et al., 2005).

Marshman et al. (2010) carried out a qualitative study involving young people with malocclusion to explore the face and content validity of one generic measure designed to assess OHRQoL in children, the 16-item short form of the Child Perceptions Questionnaire (CPQ11–14-ISF16) (Jokovic et al., 2006). They found concerns about several aspects of the measure, including the response format, the use of ‘double’ questions and the interpretation of certain words. Some questions were considered by the young people not to be relevant to the impact of malocclusion and several areas of daily life thought to be relevant were not included. The authors concluded that further consideration should be given to the need for a child-centered malocclusion-specific measure of OHRQoL. Such an instrument might be used as an outcome measure to assess the benefits of treatment and possibly, combined with normative needs assessment, to determine treatment need, leading to the provision of an enhanced quality of care (World Health Organization, 1946).

2.5.2. Condition specific tools used for OHRQoL evaluation in individuals with various types of malocclusion problems

2.5.2.1. Orthognathic Quality of Life Questionnaire (OQoLQ)

The only psychometrically validated tool specifically for individuals requiring orthognathic surgery is the Orthognathic Quality of Life Questionnaire (OQoLQ). This was created and validated psychometrically with good results by Cunningham et al. (2000; 2002). It consists of 22 questions divided into four dimensions: social aspects (8 questions), dentofacial esthetics (5 questions), oral function (5 questions) and awareness of dentofacial esthetics (4 questions) (Cunningham et al., 2000; 2002).

2.5.2.2. CLEFT-Q

The CLEFT-Q assesses the impact of surgery and treatment on cleft lip and palate patients’ appearance, speech and HRQoL. It is a new self-reporting outcome instrument developed for

patients aged from 8-29 years old (who are able to fill the questionnaire independently) (Wong Riff et al., 2017). The CLEFT-Q consist of 154 items divided into 3 scales and 13 concepts as follows: Appearance scales: face (16 items), teeth (12 items), jaws (12 items), lips (17 items), nose (13 items), nostrils (9 items), cleft scar (13 items); HRQoL scales: psychological (14 items), school (11 items), social (16 items) and speech-related distress (12 items); and facial function scales: speech (16 items) and eating/drinking (10 items) (Tsangaris et al., 2017). The patient is asked in the 7 appearance scales to think about the area mentioned and answer the question “how much do you like...” by choosing one of the following answers: “Not at all”, “A little bit”, “Quite a bit” and “Very much”. In the HRQoL and facial function scales the patient is asked to answer in relation to the previous week and the responses are: “Never”, “Sometimes”, “Often” and “Always” (Tsangaris et al., 2017).

2.5.2.3. Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ)

The Psychosocial Impact of Dental Aesthetics Questionnaire was developed by Klages et al. (2004; 2005) and is intended to be used to assess the psychosocial impact of dental esthetics on young adults aged 18 - 30 years. However, it has potential applicability to children and adolescents. It contains 23 questions divided into four scales. Social impact (8 items) and Aesthetics Scale (3 items) are both derived from the OQLQ. The rest of the scales are newly formulated: Dental self-confidence scale (6 items) and Psychological impact of dental esthetics (6 items). Each item has five answers with numerical values ranging from 0 = not at all, 1 = a little, 2 = somewhat, 3 = strongly and 4 = very strongly (Klages et al., 2006).

2.5.2.4. Malocclusion Impact Questionnaire (MIQ)

The Malocclusion Impact Questionnaire (MIQ) has been recently developed as an instrument to measure Oral Health-Related Quality of Life in young individuals with malocclusion (Benson et al., 2016).

The present form of the questionnaire consists of 2 global questions on how teeth affect the

young individual overall, 7 questions about how the patient's teeth make them feel, 4 questions about how teeth affect the patient in various situations, 4 questions about if the patient's teeth make them worried or concerned about specific issues and 2 questions about other ways the teeth might affect the individuals. The response format for the Malocclusion Impact Questionnaire consists of a 5-point severity scale based on the Child Health Utility 9D index (CHU9D), which is a generic child HRQoL (Stevens, 2009), i.e. 'don't' or 'am not', 'a little bit', 'a bit', 'quite a lot' and 'very much'. Each item was scored 0–4, the order depending on whether the item is positively worded ('Happy', 'Good looking', 'Confident') or negatively worded ('Nervous', 'Shy'). The scores for each item are added together to obtain a total score, higher scores indicating poorer OHRQoL (Benson et al., 2016). Cross-sectional evaluation has shown that Malocclusion Impact Questionnaire is both valid and reliable (Benson et al., 2016). To our knowledge there are no validation studies for an Arabic version of the MIQ instrument.

3. AIM

The aim of the present study is to linguistically and culturally adapt the MIQ instrument for an Arabic speaking population and to assess its reliability, validity and psychometric properties in a sample of young Arabic speakers with malocclusion.

4. MATERIALS AND METHODS

4.1. Arabic translation of the Malocclusion Impact Questionnaire

The translation process followed the International Quality of Life Assessment project guidelines (Streiner et al., 2014; Aaronson et al., 2002; Beaton et al., 2000; Bullinger et al., 1998). The English version of the Malocclusion Impact Questionnaire (Appendix I) was forwarded to be translated into the Arabic language independently by two translators with extensive knowledge of both the Arabic and English languages, which later met in person to agree on a common translation. The common forward translation was given to two other translators with extensive knowledge of both the Arabic and English languages, who then translated the questionnaire back into the English language. Finally, the forward and the backward translations were reviewed by all four translators, who then agreed on a final Arabic version of the Malocclusion Impact Questionnaire for the validation process (MIQ-AR) (Appendix II).

4.2. Initial validation of the Arabic version of the instrument

Before the validation study of the Arabic version of the Malocclusion Impact Questionnaire, ethical approval was obtained from the Research and Ethics Committee, Hamdan Bin Mohammed College of Dental Medicine, Mohammed Bin Rashid University of Medicine and Health Sciences.

The comprehensiveness of the MIQ-AR questionnaires was tested in a pilot study of 20 adolescents who came for the initial consultation appointment at the Orthodontic Clinic of the Dubai Dental Clinic. Provided informed consent was obtained, young people were given the Arabic version of the Malocclusion Impact Questionnaire (MIQ-AR). Although the adolescents were encouraged to discuss with a co-investigator (Dr. Tariq Al Awadhi) anything unclear or difficult for them to understand, they all indicated that they understood all the questions and the content. Therefore, no further changes in the wording of the

questionnaire were needed.

4.3. Main study

According to the literature, a sample size of 150-200 participants would be sufficient for an appropriate statistical analysis (Anthoine et al., 2014; Streiner et al., 2014; Schumacker et al., 2004; Muthén et al., 2002; Boomsma and Hoogland, 2001; Hoogland and Boomsma, 1998; Guyatt et al., 1986).

From April 2017 until December 2018, a convenience sample of 193 adolescents (10–16 years old; mean age, 13.1 ± 2.1 years, 35.2% male, 64.7% female), attending for a new patient consultation appointment were recruited from three University Orthodontic Clinics, namely Dubai Dental Clinic (Dubai, United Arab Emirates), Alexandria University (Alexandria, Egypt) and Khartoum University (Khartoum, Sudan).

The following selection criteria were applied: age between 10–16 years, either gender, native Arabic language speakers with both parent native Arabic speakers, who describe themselves as “needing braces”. Participants were excluded if they or their guardians did not consent, if they had previously undergone orthodontic treatment, exhibited congenital anomalies of the craniofacial region or severe deviations from the normal dental, dento-skeletal and skeletal relationships in the sagittal, vertical and transverse planes of space (Miethke, 1995) that require combined orthodontic and surgical treatment.

The participants were approached at their initial consultation appointment in the Orthodontic Clinics and were asked whether they thought they needed braces or not. Those who replied positively were invited to take part in the study and they, as well as their guardians, were given the consent form. The young people who themselves, as well as their guardians, consented, were given a questionnaire and were encouraged to complete it alone.

Each questionnaire consisted of a front sheet, containing the participant’s allocated study number, demographics and summary details of their occlusion, which was detached, completed and kept in a place accessible only by the principal investigator. The participant

was given the rest of the measure to be self-completed, which contained the Arabic short version of the Child Perceptions Questionnaire (CPQ11–14), a generic measure of OHRQoL (Bhayat and Ali, 2014) (Appendix III and IV), which its English short form is considered the “gold-standard” (CPQ11–14-ISF16) (Jokovic et al., 2006), and the Arabic version of the Malocclusion Impact Questionnaire. Finally, participants were asked if they were willing to complete the measure again after 2-3 weeks. Those who answered positively were asked to complete a modified questionnaire asking at the start if anything had changed since they completed the first questionnaire, i.e. they had some teeth extracted or braces fitted. Only data from those who indicated no change was analyzed.

For each of the participants, following their informed consent, the follow data were recorded: allocation study number, name, gender, age, telephone number, address and the Angle classification of malocclusion. The data were kept in a safe place accessible only by the principal investigator.

Data were entered onto an Excel spreadsheet (v 2010, Microsoft Corporation, Redmond, Washington, USA) and statistical tests were undertaken using SPSS (v24, IBM Corporation, Armonk, New York, USA).

4.3.1. Reliability and validity assessment

a. Criterion validity

Criterion validity was assessed by examining the correlation between the total scores of the MIQ-AR with the total scores of the already validated for the Arab speaking population CPQ₁₁₋₁₄-ISF16 (gold standard) using Spearman’s correlation coefficient.

b. Construct validity

Construct validity was assessed by examining the correlation between the total score with those of the global questions (self-report on how teeth affect overall the young individual) using Spearman’s rank correlation. The underlying hypothesis is that adolescents who rate

their oral health as “good” should have a lower questionnaire score, which means good OHRQoL.

c. Internal consistency/reliability

Internal consistency/reliability was tested using Cronbach’s alpha. By convention, values greater than 0.60 (Malhotra, 1996) or 0.70 (Nunnally, 1978) are considered satisfactory.

d. Test–retest reliability

Test–retest reliability was assessed in a sample of thirty-nine adolescents who completed the same questionnaire again after 2-3 weeks. The time interval was 2-3 weeks, chosen because this is a time period during which the oral health is usually not significantly changed and it is considered sufficient for the participant not to remember their previous answers. Test–retest reliability was tested using Spearman’s correlation coefficient for the summary scores of the repeated administration of the tests.

e. Principal Component Analysis (PCA)

Principal Component Analysis (PCA) for the MIQ-AR scale was carried out using Oblimin with Kaiser Normalization rotation of the axes. Bartlett's test of sphericity and the index of sample adequacy of Kaiser, Meyer, and Olkin (Kaiser-Meyer-Olkin, KMO) and the values of the Communalities of the items were also calculated (Hair et al., 1995).

5. RESULTS

5.1. Descriptive sample data

The recruitment period for the validation study was from April 2017 until December 2018. Out of the 193 children who participated in the study, 35.2% were boys and 64.7% were girls; 53.3% of adolescents presented with Angle Class I malocclusion, 37.2% Angle Class II malocclusion, 9.3% Angle Class III malocclusion. The mean age of the adolescents was 13.1 years (SD 2.1, Range 10-16). From the 193 subjects that participated in the study, 106 (54.9%) were from the Dubai Dental Clinic (Dubai, United Arab Emirates), 18 (9.3%) were from Alexandria University (Alexandria, Egypt), and 69 (35.8%) were from Khartoum University (Khartoum, Sudan). Five questionnaires were excluded because of multiple unanswered questions or because parents obviously participated in answering the questionnaire. No statistically significant differences were noted between questionnaires of different geographic origin (Wilcoxon p value >0.05).

5.2. Descriptive statistics and comparisons of the answers of the items of the MIQ-AR scale, at the beginning and the end of the study

According to Table 4 (see Wilcoxon p-value) there is only one statistically significant difference between the distribution of answers at the beginning and the end of the study for the item MIQ7 “How your teeth make you feel: Shy”, but the difference is not clinically significant.

Table 4. Descriptive statistics of the answers of the items of the MIQ-AR scale, at the beginning and the end of the study.

		Min.*	Median.	Max.**	Mean	S.D.***	W <i>p</i> ****
Overall, how much do your teeth bother you?	Beginning	0	1	4	1.6	1.2	0.762
	Ending	0	2	4	1.7	1.4	
Overall, how much do your teeth affect your life?	Beginning	0	1	4	1.4	1.3	0.616
	Ending	0	2	4	1.7	1.4	
Some questions about how your teeth make you feel							
Happy	Beginning	0	1	2	1.0	0.7	0.428
	Ending	0	1	2	1.0	0.8	
Good looking	Beginning	0	1	2	1.0	0.8	0.167
	Ending	0	1	2	0.8	0.8	
Confident	Beginning	0	1	2	0.6	0.6	0.579
	Ending	0	0	2	0.6	0.7	
Normal	Beginning	0	0	2	0.6	0.6	1.000
	Ending	0	0	2	0.5	0.7	
Sad	Beginning	0	1	2	0.6	0.7	0.392
	Ending	0	0	2	0.6	0.6	
Nervous	Beginning	0	0	2	0.5	0.6	0.789
	Ending	0	0	2	0.6	0.7	
Shy	Beginning	0	0	2	0.6	0.7	0.030
	Ending	0	1	2	0.7	0.8	
Some questions about how your teeth affect you when:							
Smiling	Beginning	0	1	2	0.8	0.8	0.579
	Ending	0	1	2	0.8	0.8	
Laughing	Beginning	0	0	2	0.6	0.7	0.225
	Ending	0	0	2	0.6	0.7	
Seeing photographs of myself	Beginning	0	1	2	0.7	0.7	1.000
	Ending	0	1	2	0.7	0.6	
Talking in public	Beginning	0	0	2	0.5	0.7	0.820
	Ending	0	0	2	0.6	0.7	
Some questions about if your teeth make you worried or concerned							
Other people having nicer teeth than me	Beginning	0	0	2	0.6	0.7	0.428
	Ending	0	1	2	0.7	0.8	
Being bullied	Beginning	0	0	2	0.5	0.7	0.222
	Ending	0	0	2	0.6	0.8	
Making friends	Beginning	0	0	2	0.2	0.5	1.000
	Ending	0	0	2	0.3	0.6	
Fitting in with friends	Beginning	0	0	2	0.2	0.5	0.560
	Ending	0	0	2	0.2	0.5	
Some questions about other ways your teeth might affect you							
Covering my teeth with my hand when I smile	Beginning	0	0	2	0.5	0.7	1.000
	Ending	0	0	2	0.6	0.8	
Biting some foods	Beginning	0	0	2	0.5	0.7	1.000
	Ending	0	0	2	0.6	0.8	

*Min.: Minimum

**Max.: Maximum

***S.D.: Standard deviation

****W *p*: Wilcoxon *p*-value

5.3. Criterion validity

Criterion validity was assessed by examining the correlation between the total scores of the

MIQ-AR with the total scores of the CPQ₁₁₋₁₄-ISF16. There was a positive, very strong, and statistically significant relationship (correlation) between the total scores of the MIQ-AR scale and the CPQ scale, at the beginning of the study ($\rho=0.710, p<0.001$).

5.4. Construct validity

Construct validity was assessed by examining the correlation between the total score with those of the global questions.

There was a positive, strong, and statistically significant relationship (correlation) between the scores of the MIQ-AR scale general question one and the MIQ-AR scale general question two, at the beginning of the study ($\rho=0.599, p<0.001$).

There was a positive, strong, and statistically significant relationship (correlation) between the scores of the MIQ-AR scale general question one and the total scores of the MIQ-AR scale, at the beginning of the study ($\rho=0.611, p<0.001$).

There was a positive, strong and statistically significant relationship (correlation) between the scores of the MIQ-AR scale general question two and the total scores of the MIQ-AR scale, at the beginning of the study ($\rho=0.557, p<0.001$).

There was a positive, strong and statistically significant relationship (correlation) between the scores of the MIQ-AR scale general question one and the MIQ-AR scale general question two scale, at the end of the study ($\rho=0.611, p<0.001$).

There was a positive, very strong and statistically significant relationship (correlation) between the scores of the MIQ-AR scale general question one and the total scores of the MIQ-AR scale, at the end of the study ($\rho=0.756, p<0.001$).

There was a positive, strong and statistically significant relationship (correlation) between the scores of the MIQ-AR scale general question two and the total scores of the MIQ-AR scale, at the end of the study ($\rho=0.582, p<0.001$).

5.5. Internal consistency/reliability

Internal consistency/reliability was tested using Cronbach's alpha. Based on the data in Table 5, it is noted that the two scales (MIQ-AR and CPQ) have very satisfactory reliability (Cronbach's $\alpha > 0.80$) (Malhotra, 1996; Nunnally, 1978).

In addition, they also have very satisfactory discrimination indices ($DI > 0.40$). The scale MIQ, at the beginning (pre) and at the end (post) of the study, has very satisfactory reliability indices (Cronbach's $\alpha = 0.927$, Cronbach's $\alpha = 0.957$, respectively). Also, the scale CPQ has very satisfactory reliability (Cronbach's $\alpha = 0.900$). Furthermore, the scale MIQ-AR, at the beginning and at the end of the study, has very satisfactory discrimination index ($DI = 0.63$ and $DI = 0.74$, respectively). Also, the scale CPQ has very satisfactory discrimination index ($DI = 0.57$).

Table 5. Cronbach's α and Discrimination Indices for the MIQ-AR scale, at the beginning and the end of the study, and the CPQ scale.

	Beginning		Ending	
	Cronbach's α	DI*	Cronbach's α	DI
MIQ-AR	0.927	0.63	0.957	0.74
CPQ	0.900	0.57	-	-

*DI: Discrimination index

5.6. Test-retest reliability

According to Table 6 (see Wilcoxon p -value) there is no statistically significant difference between measurement at the beginning and the ending of the study relative to the distribution of the total score of the MIQ-AR scale.

Table 6. Comparison between measurement, at the beginning and the end of the study, relative to the MIQ-AR scale total score.

		Min.*	Median	Max.**	Mean	S.D.***	W <i>p</i> ****
MIQ-AR Total	Beginning	0	9.0	34	10.1	7.8	0.833
	Ending	0	8.0	33	10.5	9.3	

*Min.: Minimum

**Max.: Maximum

***S.D.: Standard deviation

****W *p*: Wilcoxon *p*-value

Moreover, there was a positive, very strong, and statistically significant relationship (correlation) between the total scores of the MIQ-AR scale, at the beginning, and the MIQ-AR scale, at the ending of the study ($\rho=0.904$, $p<0.001$).

5.7. Principal Component Analysis (PCA) for the MIQ-AR scale

Principal Component Analysis (PCA) extracted, after Oblimin with Kaiser Normalization rotation of the axes, two significant components-factors that account for 54.4% of the total variance. In Table 7 are presented only the “loadings” which are at an absolute value ≥ 0.500 . “Loadings” greater than or equal to 0.300 have in general practical significance (Hair et al., 1995), but for the specific sample size ($N \approx 200$), “loadings” with an absolute value of ≥ 0.500 are also statistically significant at significance level $\alpha=0.05$ with power $\gamma=0.80$ (Hair et al., 1995). Regarding the suitability of the Principal Component Analysis model, Bartlett's test of sphericity showed that the correlation matrix differs statistically significantly from the identity matrix ($\chi^2=1568.119$, d.f.=136, $p<0.001$) and the index or otherwise the measure of sample adequacy of Kaiser, Meyer, and Olkin (Kaiser-Meyer-Olkin, KMO), relative to the appropriateness of the data for the application of the Principal Component Analysis (possibility to factorize the correlations matrix), was found to be equal to 0.933, much above the allowable limit of 0.50 according to Hair et al. (1995) or the 0.60 limit suggested by other authors, such as Coakes and Steed (1999) and Sharma (1996). Finally, from the values of the Communalities of the items, it was found that most of them have a value greater than 0.40, which indicates a satisfactory quality of data reconstitution from the model of the two

components (Hair et al., 1995).

Cronbach's internal consistency (reliability) coefficient for the total scale of the 17 questions was calculated at $\alpha=0.927$ and considered very satisfactory (Spector 1992, Norusis 1992). By convention, values greater than 0.60 (Malhotra, 1996) or 0.70 (Nunnally, 1978) are considered satisfactory. Thus, in the case of this specific measuring tool, the overall scale of 17 questions was considered reliable.

As mentioned above, Principal Components Analysis extracted two factors that account for 54.4% of the total variance. This proportion is considered almost satisfactory (Hair et al., 1995, Coakes and Steed, 1999).

The first component FMIQ1, that explains 46.9% of the total variance, is mainly related to items MIQ1, MIQ2, MIQ8, MIQ3, MIQ4, MIQ9, MIQ16, MIQ7, MIQ10, and MIQ5. The mean factor score is equal to 0.7. The reliability of the factor is $\alpha=0.906$ (very satisfactory).

The second component FMIQ2, which explains 7.5% of the total variance, is mainly related to items MIQ14, MIQ15, MIQ13, MIQ11, MIQ6, MIQ17, and MIQ12. The mean factor score is equal to 0.5. The reliability of the factor is $\alpha=0.823$ (very satisfactory).

Table 7. Results of the PCA and reliability analysis of the MIQ-AR scale, at the beginning.

+Com.: Communalities

	Components		
	FMIQ1	FMIQ2	Com.+
Happy (MIQ1)	0.937		0.670
Good looking (MIQ2)	0.823		0.603
Smiling (MIQ8)	0.687		0.599
Confident (MIQ3)	0.681		0.506
Normal (MIQ4)	0.634		0.529
Laughing (MIQ9)	0.592		0.608
Covering my teeth with my hand when I smile (MIQ16)	0.564		0.511
Shy (MIQ7)	0.557		0.556
Seeing photographs of myself (MIQ10)	0.478		0.540
Sad (MIQ5)	0.441		0.548
Making friends (MIQ14)		0.856	0.594
Fitting in with friends (MIQ15)		0.823	0.642
Being bullied (MIQ13)		0.652	0.557
Talking in public (MIQ11)		0.595	0.628
Nervous (MIQ6)		0.497	0.442
Biting some foods (MIQ17)		0.479	0.288
Other people having nicer teeth than me (MIQ12)		0.419	0.406
Variance (%)	46.9	7.5	
Total variance (%)	54.4		
Cronbach's α reliability coefficient	0.906	0.823	
Discrimination index	0.66	0.57	
Total scale Cronbach's α	0.927		
Total scale discrimination index	0.63		
Mean components scores	0.7	0.5	
Components' scores SD*	0.2	0.2	
KMO**	0.933		
Bartlett's test of sphericity	$\chi^2=1568.119$	d.f.**=136	$p<0.001$

*SD: Standard Deviation

**KMO: Kaiser-Meyer-Olkin measure of sampling adequacy

***d.f.: Degrees of freedom

The correlation between the two principal components of the MIQ scale at the beginning of the study, is equal to $r=0.756$ ($p<0.001$). They are strong correlated.

6. DISCUSSION

The aim of the present study was to test the psychometric properties of an Arabic translated version of the Malocclusion Impact Questionnaire (MIQ-AR), an instrument to measure the impacts on Oral Health-Related Quality of Life in Arab adolescents. Since the generic measurement tools which had been used to assess the ORHQoL in children with orthodontic problems were not able to address all aspects of the malocclusion impact on young individuals, the development of a condition specific tool was warranted (Marshman et al., 2010). Thus, the Arabic translation of the MIQ might play an important role in the measurement the OHRQoL in young Arabs with malocclusion, as the majority of the questionnaires available are in the English language.

The Arabic version of the MIQ-AR was found to be a valid, reliable and responsive instrument, with good psychometric properties that were comparable to those of the original English version. Every effort was taken during the translation process to use easy and simple words that are understandable by adolescents, as well as discussing the instrument repeatedly in a pilot study that lead to minor corrections. Testing the criterion validity of the new tool was done by comparing the responses from MIQ-AR to those from the already validated Arabic version of CPQ₁₁₋₁₄-ISF16. There was a positive, very strong, and statistically significant relationship (correlation) between the total scores of the MIQ-AR scale and the CPQ₁₁₋₁₄ scale. Construct validity of the MIQ-AR was measured by exploring correlations with two global questions, showing positive strong correlations. The Spearman's correlation coefficient MIQ-AR total scores was 0.904, showing a positive, very strong, and statistically significant relationship (correlation). The MIQ-AR had internal consistency comparable to that of the English version (Cronbach alpha 0.916), showing that both measurements are homogeneous and their questions are related to each other, as reliability scores greater than 0.70 are considered high.

Limitations of the study

There is a possibility of responder bias due to the fact that responders may not be completely honest when answering the questionnaire, either for privacy protection or answering in a way they feel that the researcher wants them to answer, even though the patient was informed that his answers will not affect his treatment. Another problem could arise from the presence of parents or family members during completion of the questionnaire which might have affected the answers.

Recommendations for future studies

Further testing of the MIQ-AR in each Arabic country separately is warranted, in order to assess longitudinally patient's OHRQoL before and after orthodontic treatment. Future studies could use online questionnaires to avoid skipping questions and get better completion rates, as submission is only possible if all questions are answered. This approach also facilitates data collection and analysis, is free of possible manual inputting errors and it is environmentally friendly. Finally, accessibility issues for patients with visual impairment can be overcome by asking the patient directly by means of an interview.

7. CONCLUSION

The MIQ-AR exhibits good psychometric properties in terms of validity and reliability and seems to be a reliable instrument to assess the impact of malocclusion on the Oral Health-Related Quality of Life in Arab adolescents. However, these findings should be interpreted with caution as it may be limited to a population similar to the study sample. Further testing of the measure is required in a variety of environments.

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9. APPENDICES

Appendix I

Study Centre:			
Participant Number:		Today's Date:	

How do your teeth affect you and your life?



Thanks for taking part in our questionnaire. We would like you to:

- ☺ Answer all questions
- ☺ Remember that there are no right or wrong answers, we just want to know what you think and what matters to you
- ☺ Please hand this back to the receptionist or return in the envelope provided when you have finished.

Some questions about you:				
Are you? (Please tick)	A Boy <input type="checkbox"/>	A Girl <input type="checkbox"/>		
How old are you?	years			
Some questions about how <u>your teeth</u> affect you overall				
Please read the questions and for each one circle the word which suits you best.				
1. Overall, how much do your teeth bother you?				
Not at all	A little	Somewhat	Quite a bit	Very much
2. Overall, how much do your teeth affect your life?				
Not at all	A little	Somewhat	Quite a bit	Very much

- Please read each question carefully and think about how your teeth affect you today
- Before you answer, ask yourself: “Does this happen to me because of my teeth?”
- Put a tick in the box for the answer that is best for you
- Only tick **one** box for each question please

Some questions about how your teeth make you feel

3. Happy

Because of the way my teeth look

I feel happy

I feel a bit happy

I don't feel very happy

4. Good looking

Because of the way my teeth look

I feel good looking

I feel a bit good looking

I don't feel very good looking

5. Confident

Because of the way my teeth look

I feel confident

I feel a bit confident

I don't feel very confident

6. Normal

Because of the way my teeth look

I feel normal

I feel a bit normal

I don't feel very normal

7. Sad

Because of the way my teeth look

I don't feel sad

I feel a bit sad

I feel very sad

8. Nervous
Because of the way my teeth look
<input type="checkbox"/> I don't feel nervous
<input type="checkbox"/> I feel a bit nervous
<input type="checkbox"/> I feel very nervous
9. Shy
Because of the way my teeth look
<input type="checkbox"/> I don't feel shy
<input type="checkbox"/> I feel a bit shy
<input type="checkbox"/> I feel very shy
Some questions about how <u>your teeth</u> affect you when:
10. Smiling
Because of the way my teeth look
<input type="checkbox"/> Smiling doesn't bother me
<input type="checkbox"/> Smiling bothers me a bit
<input type="checkbox"/> Smiling bothers me a lot
11. Laughing
Because of the way my teeth look
<input type="checkbox"/> Laughing doesn't bother me
<input type="checkbox"/> Laughing bothers me a bit
<input type="checkbox"/> Laughing bothers me a lot
12. Seeing photographs of myself
Because of the way my teeth look
<input type="checkbox"/> Seeing photographs of myself doesn't bother me
<input type="checkbox"/> Seeing photographs of myself bothers me a bit
<input type="checkbox"/> Seeing photographs of myself bothers me a lot
13. Talking in public
Because of the way my teeth look
<input type="checkbox"/> Talking in public doesn't bother me
<input type="checkbox"/> Talking in public bothers me a bit
<input type="checkbox"/> Talking in public bothers me a lot

Some questions about if your teeth make you worried or concerned

14. Other people having nicer teeth than me

Because of the way my teeth look

- I don't worry about other people having nicer teeth than me
- I worry about other people having nicer teeth than me a bit
- I worry about other people having nicer teeth than me a lot

15. Being bullied

Because of the way my teeth look

- I don't worry about being bullied
- I worry about being bullied a bit
- I worry about being bullied a lot

16. Making friends

Because of the way my teeth look

- I don't worry about making friends
- I worry about making friends a bit
- I worry about making friends a lot

17. Fitting in with friends

Because of the way my teeth look

- I don't worry about fitting in with friends
- I worry about fitting in with friends a bit
- I worry about fitting in with friends a lot

Some questions about other ways your teeth might affect you

18. Covering my teeth with my hand when I smile

Because of the way my teeth look

- I don't cover my teeth with my hands when I smile
- I cover my teeth with my hands when I smile a bit
- I cover my teeth with my hands when I smile a lot

19. Biting some foods

Because of the way my teeth meet

- I don't have a problem biting some foods
- I have a bit of a problem biting some foods
- I have lots of problems biting some foods

Thanks for your time

**Please will you return this to the reception desk or post it to us
using the pre-paid envelope**

Appendix II

		مركز الدراسة
تاريخ اليوم		اسم المشترك

كيف تؤثر أسنانك عليك وعلى حياتك؟



نشكرك على مشاركتك في هذا الاستبيان. نرجو منكم التالي:
 - الإجابة على جميع الأسئلة
 - الهدف من الاستبيان معرفة آرائك واحتياجاتك. ليس هنالك إجابة صحيحة أو خاطئة

بعض الأسئلة عنك				
هل انت		<input type="checkbox"/> ولد	<input type="checkbox"/> بنت	
كم عمرك؟		سنة _____		
بعض الأسئلة عن تأثير الأسنان عليك بشكل شامل				
الرجاء قراءة السؤال ولكل سؤال وضع دائرة حول الجواب الأنسب لك				
١ - بشكل عام، هل تزعجك أسنانك				
أبداً	قليلاً	بشكل متوسط	معظم الأحيان	كثيراً
٢ - بشكل عام، هل تؤثر أسنانك على حياتك اليومية				
أبداً	قليلاً	بشكل متوسط	معظم الأحيان	كثيراً

الرجاء قراءة كل سؤال بتمعن والتفكير بتأثير أسنانك على حياتك اليومية قبل الإجابة أسأل نفسك: " هذا يحدث لي بسبب أسناني؟"
ضع إشارة بجانب الجواب الذي تظنه مناسباً
ضع إشارة واحدة لكل سؤال

بعض الأسئلة عن كيفية تأثير الأسنان على شعورك

١ - سعيد

بسبب مظهر أسناني

أشعر بالسعادة

أشعر بقليل من السعادة

لا أشعر بكثير من السعادة

٢ - حسن المظهر

بسبب مظهر أسناني

أشعر أن مظهري جميل

أشعر أن مظهري جميل بعض الشيء

لا أشعر بالرضى عن مظهري

٣ - الثقة بالنفس

بسبب مظهر أسناني

أشعر بالثقة

أشعر بقليل من الثقة

لا أشعر بالثقة

٤ - طبيعي

بسبب مظهر أسناني

أشعر بأنني طبيعي

أشعر طبيعي بعض الشيء

لا أشعر بأنني طبيعي

٥ - حزين	
بسبب مظهر أسناني	
<input type="checkbox"/>	لا أشعر بالحزن
<input type="checkbox"/>	أشعر بقليل من الحزن
<input type="checkbox"/>	أشعر بكثير من الحزن
٦ - متوتر	
بسبب مظهر أسناني	
<input type="checkbox"/>	لا أشعر بالتوتر
<input type="checkbox"/>	أشعر بقليل من التوتر
<input type="checkbox"/>	أشعر بكثير من التوتر
٧ - خجول	
بسبب مظهر أسناني	
<input type="checkbox"/>	لا أشعر بالخجل
<input type="checkbox"/>	أشعر بقليل من الخجل
<input type="checkbox"/>	أشعر بكثير من الخجل
بعض الأسئلة في تأثير أسنانك عليك عندما:	
٨ - تبتسم	
بسبب مظهر أسناني	
<input type="checkbox"/>	الابتسام لا يزعجني
<input type="checkbox"/>	الابتسام يزعجني قليلاً
<input type="checkbox"/>	الابتسام يزعجني كثيراً
٩ - تضحك	
بسبب مظهر أسناني	
<input type="checkbox"/>	الضحك لا يزعجني
<input type="checkbox"/>	الضحك يزعجني قليلاً
<input type="checkbox"/>	الضحك يزعجني كثيراً

١٠ - رؤية صورتك الشخصية	
بسبب مظهر أسناني	
<input type="checkbox"/>	رؤية صوري الشخصية لا يزعجني
<input type="checkbox"/>	رؤية صوري الشخصية يزعجني قليلاً
<input type="checkbox"/>	رؤية صوري الشخصية يزعجني كثيراً
١١ - التحدث أمام العامة	
بسبب مظهر أسناني	
<input type="checkbox"/>	التحدث أمام العامة لا يزعجني
<input type="checkbox"/>	التحدث أمام العامة يزعجني قليلاً
<input type="checkbox"/>	التحدث أمام العامة يزعجني كثيراً
بعض الأسئلة حول إذا ما كانت أسنانك تجعلك تشعر بالقلق أو الإهتمام الزائد	
١٢ - يمتلك الآخريين أسنان أفضل من أسناني	
بسبب مظهر أسناني	
<input type="checkbox"/>	لا يقلقني امتلاك الآخريين أسنان أفضل من أسناني
<input type="checkbox"/>	يقلقني امتلاك الآخريين أسنان أفضل من أسناني قليلاً
<input type="checkbox"/>	يقلقني امتلاك الآخريين أسنان أفضل من أسناني كثيراً
١٣ - مضايقة الآخريين	
بسبب مظهر أسناني	
<input type="checkbox"/>	لا تقلقني مضايقة الآخريين لي
<input type="checkbox"/>	تقلقني مضايقة الآخريين لي قليلاً
<input type="checkbox"/>	تقلقني مضايقة الآخريين لي كثيراً
١٤ - مصادقة الآخريين	
بسبب مظهر أسناني	
<input type="checkbox"/>	لا يقلقني تكوين الأصدقاء
<input type="checkbox"/>	يقلقني تكوين الأصدقاء قليلاً
<input type="checkbox"/>	يقلقني تكوين الأصدقاء كثيراً

١٥ - الانسجام مع الأصدقاء	
بسبب مظهر أسناني	
<input type="checkbox"/>	لا يقلقني الانسجام مع الأصدقاء
<input type="checkbox"/>	يقلقني الانسجام مع الأصدقاء قليلاً
<input type="checkbox"/>	يقلقني الانسجام مع الأصدقاء كثيراً
أسئلة عن نواح أخرى لتأثير أسنانك عليك	
١٦ - تغطية أسناني بيدي عندما أبتسم	
بسبب مظهر أسناني	
<input type="checkbox"/>	لا أعطي أسناني بيدي عندما أبتسم
<input type="checkbox"/>	أعطي أسناني بيدي قليلاً عندما أبتسم
<input type="checkbox"/>	أعطي أسناني بيدي كثيراً عندما أبتسم
١٧ - العض على بعض الأطعمة	
بسبب طريقة التواء أسناني	
<input type="checkbox"/>	ليس لدي أي مشكلة في العض على بعض الأطعمة
<input type="checkbox"/>	أعاني من مشكلة في العض على بعض الأطعمة أحياناً
<input type="checkbox"/>	أعاني من مشكلة في العض على بعض الأطعمة معظم الأحيان

شكراً على تعاونكم

Appendix III

١ - الى أي مدى تؤثر حالة أسنانك، شفتيك ، فكك أو فمك على حياتك بشكل عام؟				
أبداً	قليلاً	بشكل متوسط	معظم الأحيان	كثيراً
٢ - هل تقول أن صحة أسنانك ، شفتيك ، فكك و فمك:				
ممتازة	جيدة جداً	جيدة	مقبوله	سيئة

خلال الأشهر الثلاث الماضية... هل عانيت من:	
بسبب أسنانك، شفتيك، فمك أو فكك	
١ - ألم في أسنانك أو شفتيك، أو فكك أو فمك؟	
<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية
٢ - رائحة نفس غير مستحبة (كريهة)؟	
<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية
٣ - تقرحات في فمك؟	
<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية

٤- طعام عالق بين أسنانك؟	
<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية
٥ - صعوبة شرب أو تناول الأطعمة الساخنة أو الباردة؟	
<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية
٦ - صعوبة في عض أو مضغ أطعمة مثل التفاح، الذرة، أو قطع اللحم؟	
<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية
٧ - صعوبة في نطق أي كلمة؟	
<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية

٨ - استغرقت وقتاً أطول من الآخرين لتناول وجبتك؟

<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية

٩ - الإنزعاج؟

<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية

١٠ - سرعة الانفعال أو الإحباط؟

<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية

١١ - الخجل أو الإحراج؟

<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية

١٢ - القلق من رأي الآخرين حيال أسنانك؟

<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية

١٣ - وجه إليك أطفال آخرون أسئلة عن أسنانك، أو شفقتك، أو فكرك أو فمك؟

<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية

١٤ - أعاظك أو سخر منك أطفال آخرون، أو نادوك بألقاب غير محببة؟

<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية

١٥ - تجنبت الابتسام أو الضحك؟

<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية

١٦ - تجادلت مع أطفال أو العائلة	
<input type="checkbox"/>	أبداً
<input type="checkbox"/>	مرة أو مرتين
<input type="checkbox"/>	أحياناً
<input type="checkbox"/>	غالباً
<input type="checkbox"/>	يومية أو شبه يومية

شكراً على تعاونكم

Appendix IV

1. Descriptive statistics of the answers of the CPQ scale

Appendix Table 1. Descriptive statistics of the answers of the CPQ scale.

	Min.*	Median	Max.**	Mean	S.D.***
Overall, would you say that your oral and dental health is	0	1.0	4	1.2	1.2
Overall, how much do your teeth affect your life?	0	2.0	4	1.7	1.2
In the past 3 months, how often have you.... (had/been).....because of your teeth/mouth					
Pain in teeth/mouth	0	1	4	1.2	1.1
Bad breath	0	0	4	0.9	1.1
Mouth sores	0	0	4	0.8	1.0
Food caught between teeth	0	2	4	1.7	1.2
Difficulty eating/drinking hot/cold foods	0	1	4	1.1	1.2
Difficulty chewing firm foods	0	0	4	0.9	1.2
Difficulty saying words	0	0	4	0.5	1.0
Taking longer to eat a meal	0	0	4	0.9	1.3
Upset	0	1	4	1.2	1.3
Felt irritated/frustrated	0	0	4	1.0	1.2
Felt shy	0	0	4	1.0	1.3
Concerned what people think about teeth/mouth	0	0	4	1.1	1.3
Asked questions	0	1	4	1.0	1.2
Teased/called names	0	0	4	0.5	1.1
Avoided smiling/laughing	0	0	4	0.8	1.1
Argued with children/family	0	0	4	0.6	1.0

*Min.: Minimum

**Max.: Maximum

***S.D.: Standard deviation

2. Correlation between the CPQ scale scores

There was a positive, strong, and statistically significant relationship (correlation) between the scores of the CPQ scale general question one and the CPQ scale general question two ($\rho=0.608, p<0.001$). There was a positive, strong, and statistically relationship (correlation) between the scores of the CPQ scale general question one and the total scores of the CPQ scale ($\rho=0.655, p<0.001$). There was a positive, strong, and statistically significant relationship (correlation) between the scores of the CPQ scale general question two and the total scores of the CPQ scale ($\rho=0.608, p<0.001$).

3. Principal Component Analysis (PCA) for the CPQ scale

Principal Component Analysis (PCA) extracted, after Oblimin with Kaiser Normalization

rotation of the axes, three significant components-factors that account for 57.1% of total variance. In Appendix Table 2 presents only the “loadings” which are at an absolute value ≥ 0.500 . Regarding the suitability of the Principal Component Analysis model, Bartlett's test of sphericity showed that the correlation matrix differs statistically significantly from the identity matrix ($\chi^2=1018.967$, d.f.=120, $p<0.001$) and the index or otherwise the measure of sample adequacy of Kaiser, Meyer, and Olkin (Kaiser-Meyer-Olkin, KMO), relative to the appropriateness of the data for the application of the Principal Component Analysis, was found to be equal to 0.902, much above the allowable limit of 0.50 according to Hair et al. (1995) or the 0.60 limit suggested by other authors, such as Coakes and Steed (1999) and Sharma (1996). Finally, from the values of the Communalities of the items, it was found that most of them have a value greater than 0.40, which indicates a satisfactory quality of data reconstitution from the model of the three components (Hair et al., 1995).

Cronbach's internal consistency (reliability) coefficient for the total scale of the 16 questions was calculated at $\alpha=0.900$ and considered very satisfactory (Spector 1992, Norusis 1992). By convention, values greater than 0.60 (Malhotra, 1996) or 0.70 (Nunnally, 1978) are considered satisfactory. Thus, in the case of this specific measuring tool, the overall scale of 16 questions was considered reliable.

As mentioned above, Principal Component Analysis extracted three factors that account for 57.1% of the total variance. This proportion is considered almost satisfactory (Hair et al., 1995, Coakes and Steed, 1999).

The first factor FCPQ1 that explains 41.0% of the total variance is mainly related to items CPQ2, CPQ10, CPQ16, CPQ9, CPQ11, CPQ8 and CPQ7. The mean factor score is equal to 0.9. The reliability of the factor is $\alpha=0.834$ (very satisfactory).

The second factor FCPQ2, which explains 8.9% of the total variance, is mainly related to items CPQ1, CPQ3, CPQ6, and CPQ4. The mean factor score is equal to 1.2. The reliability of the factor is $\alpha=0.677$ (satisfactory).

The third factor FCPQ3, which explains 7.2% of the total variance, is mainly composed of

CPQ13, CPQ12, CPQ15, and CPQ14 items. The mean factor score is equal to 0.9. The reliability of the factor is $\alpha=0.828$ (very satisfactory).

Appendix Table 2. Results of the PCA and reliability analysis of the CPQ scale.

	Components			Com.+
	FCPQ1	FCPQ2	FCPQ3	
Bad breath (CPQ2)	0.801			0.572
Felt irritated/frustrated (CPQ10)	0.692			0.659
Argued with children/family (CPQ16)	0.644			0.418
Upset (CPQ9)	0.587			0.601
Felt shy (CPQ11)	0.559			0.757
Taking longer to eat a meal (CPQ8)	0.525			0.389
Difficulty saying words (CPQ7)	0.443			0.312
Pain in teeth/mouth (CPQ1)		0.848		0.715
Mouth sores (CPQ3)		0.618		0.481
Difficulty chewing firm foods (CPQ6)		0.610		0.525
Food caught between teeth (CPQ4)		0.490		0.545
Difficulty eating/drinking hot/cold foods (CPQ5)				0.515
Asked questions (CPQ13)			0.837	0.724
Concerned what people think about teeth/mouth (CPQ12)			0.741	0.598
Avoided smiling/laughing (CPQ15)			0.656	0.741
Teased/called names (CPQ14)			0.645	0.580
Variance (%)	41.0	8.9	7.2	
Total variance (%)	57.1			
Cronbach's α reliability coefficient	0.834	0.677	0.828	
Discrimination index	0.58	0.46	0.66	
Total scale Cronbach's α	0.900			
Total scale discrimination index	0.57			
Mean components scores	0.9	1.2	0.9	
Components' scores SD*	0.2	0.4	0.7	
KMO**	0.902			
Bartlett's test of sphericity	$\chi^2=1018.967$	d.f.**=120	$p<0.001$	

+Com.: Communalities

*SD: Standard Deviation

**KMO: Kaiser-Meyer-Olkin measure of sampling adequacy

***d.f.: Degrees of freedom

The correlations between the three principal components of the CPQ scale are shown in Appendix Table 3.

Appendix Table 3. Correlations between the three principal components of the CPQ scale.

		FCPQ1	FCPQ2
FCPQ2	<i>r</i> *	0.515	
	<i>P</i>	<0.001	
FCPQ3	<i>rho</i>	0.614	0.414
	<i>P</i>	<0.001	<0.001

**r*: Pearson's *r*

According to Appendix Table 3, the correlation between the first and the second principal component of the CPQ scale is equal to $r=0.515$ ($p<0.001$), the correlation between the first and the third principal component of the CPQ scale is equal to $r=0.614$ ($p<0.001$), and the correlation between the second and the third principal component of the CPQ scale is equal to $r=0.414$ ($p<0.001$). The three components are highly correlated.