Impact of malocclusion on daily events among Brazilian adolescents

Thesis prepared for the degree of Master of Philosophy in Dentistry by

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Dedication

to my parents, my husband, my sister and Brother-in-law

Satyanarayana and Padmavathi, Vinay Satya Kumar, Tejaswi & Praveen

I will be forever grateful for all the times you made my dreams yours, and for your unconditional love and support

Preface

This thesis reports on the research related to the investigation of the association between malocclusions and health-related quality of life (HRQoL) in adolescents that was carried out during my MPhil candidature at the Australian Research Centre for Population Oral Health (ARCPOH), Adelaide Dental School, Adelaide, South Australia from January 2018 until May 2020.

This thesis is structured in a publication format and consists of four chapters. Chapter 1 presents the background and literature review, includes rationale of the study with references. Chapter 2 represents the general aim and specific objectives of the present thesis. Chapter 3 refers to the methodology of the study. Chapter 4 provides the manuscript arising for the work contained within the thesis. Chapter 5 includes final considerations and highlights the future directions in this field of research.

Abstract

The general aim of the current thesis was to investigate the association between oral health and its impact on oral health-related quality of life (OHRQoL) among Brazilian adolescents. Specific objectives of our study were: 1) to demonstrate the characteristics of malocclusion among Brazilian adolescents; 2) to evaluate the role of malocclusion on OHRQoL; and 4) to assess whether the impact of malocclusion on OHRQoL among adolescents varied based on the severity levels of malocclusion. Secondary analysis was performed on the data of the Pelotas 2004 Birth Cohort Study conducted with adolescents in the urban city of Pelotas, Brazil in 2004.

Oral health and general health are very closely related and are considered to be important health problems among individuals due to their expense associated with treatment, prevalence rate and impact level among individuals and adolescents. This investigation can even have key suggestions for general and oral health prevention strategies relevant to the present knowledge on risk factors for these conditions. Assessment of the current impacts of Oral health conditions on quality of life might even develop understanding of the importance of dental conditions.

Findings presented in this thesis indicate that a negative association between oral conditions and OHRQoL exists. Adolescents with severe malocclusion identified with a DAI score greater than 36, showed a negative impact on OHRQoL. Individuals with the presence of dental plaque were seen suffering with severe malocclusion, which is in turn was negatively associated with OHRQoL. The evidence provided by the current thesis may not only contribute primarily to the scientific literature but may also furnish researchers and epidemiologists with information vital for orthodontic treatment and be useful to identify community needs and help in the implementation of treatment plans.

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Thesis Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will or in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Date: 1/04/2020

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Finally, I would like to thank all the researchers and the participants involved in the *Pelotas Birth Cohort Study*, for the grant of the data and supporting in completion of my MPhil.

Chapter – 1

Introduction

The Concept of oral health

According to the World Health Organisation (WHO)(1), health is a state of complete physical, mental and social well-being and not merely the absence of disease of infirmity. The oral cavity is often considered to be the mirror for any signs and symptoms for all the conditions in the body. Examination of the mouth is often considered to be the best source to identify the signs of disease affecting the human body. Many conditions affecting the body such as diabetes increase the risk of periodontal disease in general(2-4). Oral health and general health are closely related and thus important for holistic care(5, 6). It is always believed that oral health reflects the state of the oral cavity which therefore reflects and supports the health of the entire body of an individual(7, 8). There were various concepts put forward by different authors in terms of defining oral health. In the year 2016, the most recent definition of oral health is put forward by World Dental Federation – FDI defined as follows

" oral health is multi-faceted, including the ability to speak, smile, smell, chew and perform other daily activities in day – to – day life thereby conveying a range of emotions through expressions with confidence"(5, 9). Dolan et al., defined "oral health as a functional and comfortable dentition which allows individuals to continue in their roles" in the late 90's(10). In 1998 and 2000 Boyd et al. (11) and Hawkins et al. (12) stated oral health as a state of the mouth where future disease is inhibited, and the teeth are of socially acceptable appearance. Indices such as number of missing, decayed and filled teeth index (DMFT), community periodontal index of treatment needs (CPITN) have been considered as key tools to assess Oral Health status(13-16).

Health-related quality of life

Quality of life (QoL), refers to well-being with every aspect of life. As the term oral health has been defined by WHO(1), quality of life has been explained by WHO as an individual perception of their position in life in the context of value systems and culture in which they live their expectations, in relation to their goals and standards. This term health-related quality of life is understood as the perception of how individuals or a group of people perceived social, psychological and physical health impacts caused by health outcomes on their day to day life(5, 17, 18). According to the World Health Organization (WHO)(1), the term Health Related Quality of Life is described as an individual assessment of how some specific factors affect his/her well-being. Instruments employed to measure such impact are always helpful in improving the level of interactions between patients and health care providers thereby assisting in organisation of health care services.

For public health purposes, the quality of life measure is mainly helpful to identify and prioritize the level of severity, to screen for any unknown illness and to monitor any treatment plans or changes to the treatment.

Any subjective examination of individuals past experiences of health, functioning, symptoms, perception about the care rendered, of satisfaction with the care received, is often named as Patient Reported Outcomes (PRO)(19). It can be a personal evaluation of one's disease or the treatment which provides impact on their daily lifestyle. The outcomes have to be personally answered by the individual itself without any prompts by other individuals or health care professionals. Children's knowledge of health has been improving in day to day life. The experience of children in regard to their health is explained in terms of appearance of symptoms, or if they are feeling weak. Children are capable of giving enough information about their own health and illness.

Oral health related quality of life

The concept of oral health related quality of life which evolved over time to its current understanding is proposed by Locker and Allen in the year 2007, is as follows, the impact of oral disorders on aspects of everyday life that are important to patients and persons, with those impacts being sufficient in terms of severity, duration or even frequency to affect an individual's perception of their life as a whole(20).

The evaluations are always helpful in the fields of research and clinical management. These instruments can be used to evaluate Oral Health Related Quality of Life in clinical and epidemiological investigations. These instruments which are used for evaluations are helpful for identifying and prioritizing patient's problems and preferences. Various authors have given different measures to identify oral health-related quality of life.

Slade has given three measures to identify oral health related quality of life and named them as social indicators, used to identify the level of oral disease at community level. The second one being the global self-rating by individuals is otherwise known as asking an individual about their self, in terms of oral health status(21). The last one being the multiple items questionnaire which is used to measure overall dental health versus specific instruments and the later one being the measure of specific oral health conditions such as dental anxiety, dento-facial deformity, to assess denture impact of specific aged population or to identify the effect on children. Different measures of OHRQOL with their author name and year are shown in table 1.

Table 1: Name of measures with their author names and year

Authors	**Year**	**Name of the measure**
Pahel, Rozier, Slade (22)	2007	ECOHIS
Jokovic , Locker, Guyatt (12)	2006	CPQ
McGrath and Bedi.,(23)	2000	Oral Health-quality of life UK
Adulyanon and Sheiham(24)	1997	Oral impacts on daily performances
Leao and Sheiham(25)	1996	Dental impact on daily living
Locker and Miller(26)	1994	Subjective oral health status indicators
Slade and Spencer(21)	1994	OH-impact profile
Hunt et al.t(27)	1993	Dental impact profile
Atchison and Dolan(28)	1990	Geriatric oral health assessment index

Most of instruments applied to investigate oral health-related quality of life of individuals (OHRQoL) include functional, psychological, and aesthetic components as well as information on pain and discomfort aspects(29).

Malocclusion

Concepts

Several studies have investigated malocclusion in various aspects, and although it appears to be simple, yet it is always a complex task to define. In recent times, the term malocclusion is defined as the malformation of the maxilla or the mandible and malposition of teeth that may result in physical, psychological and social consequences and shows even an impact on the aesthetic appearance of an individual and can result in functional limitation in most of the cases with severe malocclusion(30). Consequently, several indices used to estimate the occurrence of malocclusion play a vital role in assessing the severity, complexity, and treatment outcome of malocclusion. Malocclusion is not a pathological disease, but rather a deviation or variation from a particular pattern or formation which could lead to impairment in orofacial functions. Classification of the condition is proposed by Angle's, which is further classified as Angle's class I, II and III, respectively. Among them Angle's class II malocclusion is further termed as division I and division II individually(31). Apart from all this, malocclusion might negatively affect the patient's psychosocial well-being, self-esteem levels as well as influence their quality of life. There are, at least, four different types of American and European Orthodontic treatment-need indices used to diagnose malocclusion. These being the Index of Orthodontic Treatment Need (IOTN), Handicapping Labio-Lingual Deviation Index, Index of Complexity, Outcome and Need (ICON) and Dental Aesthetic Index (DAI). The DAI is one of the indices which combines both objective and subjective aspects of the occlusion. This index has been identified as one of the most reliable with a score ranging from ≤25 (No treatment need/slight need for treatment), 26-30 (elective treatment), 31-35 (Treatment highly desirable), ≥35 (treatment mandatory)(32, 33). The goal of treatment need indices is to mainly identify the severity of the malocclusion and its effects on daily lifestyle and identify any need for orthodontic treatment. Some examples of compromised oral condition are pain in any region of mouth either involving teeth or pain can be due to surrounding tissue of teeth which is the gums further leads to difficulty in speaking, chewing and sometimes the individual will restrict themselves from being more comfortable with their peers which in turn is seen affecting their psychological and self-esteem levels. Compromised oral health shows negative impact on quality of life but

malocclusion doesn't just affect aesthetic aspects of the adolescents it also shows its impact on psychological aspects(24, 34). Oral health could be an element of quality of life that not solely includes oral diseases, but conjointly includes practical aspects equivalent to change of state, yawning, and psychological aspects equivalent to anxiety concerning aesthetics. Oral health being a component of QoL, can be assessed using parental self-perception questionnaires which will eventually help us better understand the parent, as well as the child suffering with malocclusion(35).

Aetiological factors

There are many known factors associated with the establishment of malocclusion. The most common causative factors include hereditary, even any habit acquired by the individual after birth or if there is any defect in the bone development. The etiology of this condition is often complex and may vary. This condition can even arise due to environmental causes, genetic factors or a combination of the above-mentioned causes. Malocclusions that are genetically determined are often also influenced by environmental factors. Factors such as mouth breathing, adverse sucking habits in the early childhood has been the main causative factors for developing conditions like anterior open bites and posterior cross bites. Sometimes children with breathing issues might even be the reason for impaired development of teeth. Thus, as a whole etiology of malocclusion can be basically due to systemic conditions, inherited during birth, acquired factors, or any adverse effect to teeth that has occurred due to trauma or tooth loss due to any dental caries or periodontal conditions(36).

Malocclusion: epidemiological measures and prevalence

Malocclusion is the third leading oral condition, secondarily to periodontal disease and dental caries(37). Malocclusion is highly prevalent among adolescents(38) worldwide and due to its impact on their quality of life it should be considered as a Dental Public Health problem. In the epidemiological field, several indices used to estimate the occurrence of malocclusion play a vital role in assessing the severity, complexity, and treatment outcome of malocclusion. Malocclusion is commonly seen in a large proportion among children and

adolescents. It is also known that prevalence of different types of malocclusion might seem different depending upon the stage of teeth present (primary, mixed or permanent dentition)(39). The factors causing variations in frequencies might possibly be the variation in the study population (age, gender, ethnicity), and different approach to assessment of the condition.

Prevalence of any type of malocclusion varied from 19.0% in Kadiogo, Burkina Faso(40) to 93.0% at Foggia, Italy(41). The variation in the range of absolute values seems to be reduced for certain malocclusion traits and more specific occlusal deviations. Based on grades four and five of IOTN index, the prevalence varied from 28.7% at Kirikale(42), Turkey to 43.8% at Tirana, Albania(43). Anterior open bite varied from 1.0% in Kuwait to 15.0% at Tanzania(45). The prevalence rates of severe/very severe malocclusion measured by the Dental Aesthetic Index varied from 4.0% at Shimla city, India(44) to 41.3% at Lagos, Nigeria(46). Prevalence of various types of malocclusion might seem different in most parts of the world. There was a gradual decrease of around 70% to 58% in the prevalence of malocclusion seen in the Swedish population among children between 3 and 7 years of age(16). Class III malocclusion seems to be predominant among the population in Eastern Asia, whereas in some parts of Africa open bite seems to be more prevalent(47).

Strategies for recording and measuring malocclusion can be distinguished under qualitative and quantitative techniques(32). Qualitative methods of estimating malocclusion incorporate indices such as malalignment index and index of tooth position. Quantitative methods of measuring malocclusion as with most of the indices utilized include handicapping labiolingual index, malocclusion severity estimate, occlusal index, dental aesthetic index, treatment priority index(32).

The dental aesthetic index (DAI) is largely been used in epidemiological studies as it can produce a score which combines aesthetic and physical aspects of teeth while other indices need separate assessment(48). DAI is also easy to use, takes less time to record the score.

A proper method of measuring and recording this condition is not only for documentation but also for the epidemiologists who carry out further research for the provision of orthodontic treatment. Malocclusion can be usually measured using the Dental Aesthetic Index (DAI), which combines clinical and aesthetic aspects of the individuals which indirectly measures the social acceptability of dental appearance.

Dimberg et al. identified that most common types of malocclusion being anterior open bite, excessive overjet, class II malocclusion and posterior crossbite(49).

Adolescents and parents perceived untreated malocclusion as a condition which has a psychological and social impact on individual quality of life with most of the interventions for this dental disorder made during this stage of people's life. In normal circumstances adolescents seek dental intervention for the purpose of enhancing their own physical and aesthetic appearance. This condition is seen in most of the adolescents worldwide. The treatments are usually carried out during the adolescence stage, after the complete eruption of permanent teeth due to the awareness about their own physical appearance and aesthetics. The prevalence rate and severity of malocclusion can vary due to different study sampling such as age and different methodologies used in the studies(50). The prevalence rate of class II malocclusion is higher in northern European populations when compared to Eastern Asia as that region has highly prevalent class III malocclusion traits(48). Malocclusion is the malformation of the maxilla or the mandible and malposition of teeth that may result in physical, psychological and social consequences. Studies have shown that malocclusion has impact on aesthetic appearance and has even seen presenting functional limitations in most of the cases with severe malocclusion(18, 51, 52). Although this condition is not life-threatening, but in the unfavorable condition, it can show its impact on the quality of life of individuals. There are many known factors which in turn cause this condition among which the most common causative factors being hereditary, or it can be observed after any habit acquired by the individual after birth or if there is any defect in the bone development(53).

Malocclusion and oral health related quality of life

During the last 30 years, studies on the association between the presence of malocclusion or orthodontic treatment need and OHRQoL have been subject of interest in different countries. Especially among those countries that have some level of public sponsored support for some level of orthodontic treatment. More and more there is the need to justify the utilization of those funds where the maximum benefits are likely to occur. The potentially harmful impact of malocclusion on physical, psychological, and social characteristics of the individuals drives the need of such studies as well as the adoption of several OHRQoL tools to assess the portrayed association at a population level. Dimberg et al., carried out quantitative studies and identified that severe malocclusions show significant impact on Oral Health-Related Quality of Life (OHRQoL), mainly in the social and emotional aspects(49). In 2016, Kragt et al emphasized that the effect of malocclusions on OHRQoL is seemed to be modified by their

age and cultural environment of the children(54). A recent meta-analysis and systematic review in the year 2015 on malocclusion, orthodontic treatment and Oral Health Impact Profile (OHIP-14) carried out by Andiappan et al., among persons 15 years of age and above revealed that OHIP-14 scores were significantly lower after receiving orthodontic treatment, therefore, showing improvement in the quality of life(55).

Several research studies have been conducted to identify the relationship between oral health conditions and quality of life. Concerning the issue several studies have been performed in various countries like Brazil, Mongolia and India consistently demonstrated the relationship between oral health conditions and health-related quality of life (56-59). The above studies support the fact that oral diseases may be a risk factor for general health conditions. They also highlight that variance in the findings can be because of a varied population group, different methodology and limitations for the study. A study conducted among 14-year old Italian adolescents have developed a CPQ_{11-14} questionnaire for the use in Italy and identified that this tool appears to be reliable and valid for assessing Oral Health Related Quality of Life and identified about 98% of response rate for all questions(60). Research among children and adolescents is been carried out in Lithuania using CPQ_{11-14} as an assessing tool to evaluate OHRQoL and identified consistency of the tool among adolescents(61).

Oral health conditions have an impact on an individual's day to day life, appearance, social interactions and in turn can affect their psychological and self-esteem levels(62). Since caries is one of the determinants of malocclusion(63), for this reason evaluating the association of malocclusion and oral health-related quality of life, might require further investigations for a better understanding the impact of malocclusion on oral health-related quality of life.

Rationale

The concept of oral health demonstrates the impact of the disease on the individual's quality of life. Conditions affecting oral health are highly prevalent with malocclusion not being the main cause. Several clinical and epidemiological studies have been carried out to identify the relationship between oral diseases to individual quality of life, however longitudinal epidemiological studies investigating the impact of malocclusion on oral health-related quality of life was not found in the current literature among adolescents. Such research will be of great help for future researchers and oral health care providers. Since dental caries is

one of the essential determinants of malocclusion, and the need for orthodontic treatment is quite prevalent among adolescents the examination of the relationship between malocclusion and oral health-related quality of life is given most importance. In addition to this the oral health-related quality of life dimension is the best measurement for orthodontic treatment needs or any further measurement, which might even be of great use for the health policymakers. A study has been conducted among Malaysian adolescents, to demonstrate the effect of malocclusion among adolescents on their family household income and identified that families with a minimal monthly income were more likely to have an adverse effect on their OHRQoL and also whose families showed malocclusion were more likely to have poorer quality of life than other family adolescents without malocclusion(64). This investigation can even have the key suggestions for general and oral health prevention strategies to the present knowledge on the risk factors. Assessment of the current impacts of oral health conditions on health-related quality of life might even develop our knowledge of the importance of dental conditions. In general, there are various instruments which currently represent various aspects of knowledge for better understanding of the impact of oral health conditions on quality of life.

Research question

1. Is the presence of malocclusion negatively associated with oral health-related quality of life regardless of other dental condition in adolescents?
2. Is the simultaneous consideration of other dental conditions a key in considering in the uniqueness of this current thesis?

General aim

In this study, the main aim of this research was to investigate the association between oral health and its impact on health-related quality of life among 12- 13 years-old Brazilian adolescents.

Specific objectives

1. To demonstrate the characteristics of malocclusion among 12-13 years-old Brazilian adolescents;
2. To evaluate the role of malocclusion on Oral Health-Related Quality of Life (HRQoL);
3. To assess whether the impact of malocclusion on OHRQoL among adolescents varied based on the severity levels of malocclusion.

Chapter – 2

Methods

Study setting

The Pelotas 2004 Birth Cohort Study

Pelotas is located in south of Brazil, in the Rio Grande do Sul state, very close to Uruguay. It has a population of, approximately, 400 000 inhabitants mainly people from Spain, Portugal, and Africans with a slave background. Most of the population live in urban areas and the city has as its main activities the agriculture, commerce, livestock farming, and it is also an important university center with 3 key universities. Pelotas is marked by a period of impoverishment after a prosperous period which is reflected in health indicators such as infant mortality rate. The infant mortality rate in Pelotas is higher than in Brazil as a whole, as well as other cities in the south of Brazil. In terms of the number of dentists Pelotas presents 1 dentist for 660 inhabitants. Pelotas has had fluoridated water since 1961.
A population-based birth cohort study was carried out in the urban city of Pelotas, Brazil, in the year 2004 (2004PBCS), including all live births in the city. The 2004PBCS was performed due to changes in nutritional and epidemiological aspects of the Brazilian population that occurred in the last 30 years(65). The 2004PBCS mainly investigated the extent of progression in maternal and child health status and their determinants. The main objectives of the 2004PBCS were to assess prenatal and perinatal conditions, health service utilization (use of medicines, any treatments), socio-economic and gender inequalities and to identify information on stillbirths, neonatal and post-neonatal deaths and to describe early life morbidity and nutritional outcomes. In 2004, all mothers living in the urban area of Pelotas and their children born in maternity hospitals of the city of Pelotas (n = 4231) were eligible to participate in this study. The 2004PBCS carried out full follow-up visits rather than sub-samples at the ages of 3, 12, 24 and 48 months. During the follow-ups, mothers were interviewed in the perinatal study with respect to their demographic, socio-economic and reproductive features, lifestyle, morbidity, health care utilization and breastfeeding practices(66).

The Pelotas Oral Health Study

Two oral health studies (OHS) were nested in the 2004PBCS. In 2009, the first oral health study (OHS09) was carried out. Children who were born between September and December in the year 2004 and were followed up at 4 years of age were invited to participate in the OHS09 (1,303 children). A questionnaire was applied to the parents which included mothers and child's oral health behaviour, self-perception of the mothers and child's oral health and self-rated maternal oral health. All the variables on Oral Hygiene status were indicated by the child's mother and included daily brushing habit with a question "In general, how many times a day does the child brush their teeth?" and the responses were every day, once, twice, thrice or more than four times. The bedtime brushing habit is investigated with a question "Before bed, does the child brush his/her teeth?" and the responses were never, sometimes, always or irregular (i.e., never/sometimes) and regular (always). Children were dentally examined in their homes, seated in a normal chair with the aid of artificial illumination (head lamp). Dental conditions such as dental caries (dmfs index), plaque, dental trauma, and malocclusion were investigated. Prior to the dental examination, examiners were trained and calibrated to perform dental examinations. During this process, eight dentists examined 100 pre-schoolchildren excluded from the sample(67). To verify the consistency of the team selected, the kappa index was used to assess dichotomous categorical variables. The kappa weighted index was used for ordinal polytomic categorical variables and intraclass correlation coefficient was used for numerical variables. The results obtained were compared with that of the gold standard. The second oral health study (OHS17) nested in the 2004PBCS was carried out in 2017 and included all children (n = 1,129) who participated in the 2009OHS. Participants were between 12 and 13 years of age and were investigated at the children's home regarding different oral health outcomes such as dental caries, malocclusion, dental trauma, plaque, oral mucosal lesions, fluorosis, dental erosion, and periodontal conditions. A questionnaire was applied to the children composed of 139 questions which was further made simpler by dividing them into blocks such as Identification – Block A, Use of Dental Services – Block B, Bruxism – Block C, Issues related to mother regarding hygiene and use of dental services – Block D, Family functionality – Block E, Parental stress – Block F, Educational Styles Scales – Block G, Sense of Coherence – Block H, Habits of Oral hygiene – Block I, Eating habits – Block J, Perception related to Oral Health – Block L with questions concerning oral health behaviours, oral health-related quality of life, use of dental services, use of different sources of fluoride, dietary habits, and toothache. The oral health

follow-up team consisted of nine trained oral health examiners (dentists), seven interviewers, and a team supervisor. Also, parental stress and sense of coherence were investigated among parents(68).

Key variables for the current study

Main exposure

The key exposure variable for the current study was malocclusion in the permanent dentition collected in the second wave of the Pelotas oral health study (OHS17). The oral examination to estimate malocclusion was carried out using Dental Aesthetic Index which is recommended by the WHO(1), and the need for orthodontic treatment was obtained from this index. The Dental Aesthetic Index (DAI) comprises of overall score of 10 occlusal conditions related to crowded incisal division, number of anterior missing teeth, spaced divisions, midline diastema, anterior maxillary irregularity, anterior open bite, maxillary and mandibular overjet, anteroposterior molar relationship and anterior mandibular irregularity. This index indicates four different levels of orthodontic treatment need, as follows: DAI≤25 - there is no treatment necessary for minor malocclusion or normal occlusion, DAI score between 26 and 30 - definite malocclusion elective treatment was advised, DAI score between 31 and 35 demands high need for treatment and for severe malocclusion (DAI≥36) there is compulsory need for treatment(69). Malocclusion was evaluated according the four different levels of orthodontic treatment need from the DAI index as the main exposure.

Other oral health conditions

Other oral health conditions like dental caries (DMFS), dental trauma, dental fluorosis, gingival inflammation, any area of teeth affected with plaque and erosion were assessed among children aged 12 years from the selected population for the study. A written consent was obtained from the participants for their participation in the study. Intra oral examination was carried out under artificial light and the examiners used proper protective equipment. Mouth mirrors and millimetre probes were used in clinical examinations.

Outcome of the present study

The outcome for the current study was Oral Health-Related Quality of Life (OHRQoL) in the adolescence period. Data from OHS17 regarding quality of life was considered the outcome. The Child Perception Questionnaire (CPQ_{11-14}) is designed to measure OHRQoL among children aged between 11 and 14 years. It consists of 37 questions distributed into four health domains: oral symptoms (n = 6), functional limitations (n = 9), emotional well-being (n = 9) and social well-being (n = 13). The question: " *In the past 3 months, how often have you ... (had/been) ... because of your teeth/mouth?"* is answered according to the following categories: never, once or twice, sometimes, often, and every-day or almost every day with scores ranging from 0 to 4, respectively. An overall score is also able to be calculated relating to what had occurred in the last three months. Each child was asked to complete the ECOHIS (see under Potential confounders below) and CPQ questionnaire just prior to the dental examination.

Potential confounders

There are some independent variables considered as potential confounders for the following study. Information on the subjects parental schooling and family income at birth, access to orthodontic treatment, oral-health related quality of life at childhood, and other dental conditions were considered potential confounders. In this present study we used the National Economic Indicator (IEN), a wealth indicator that is less subject to temporal variability as it is based on aspects that does not change over short duration of time. The IEN is considered as a major indicator of permanent income which is developed exclusively for urban areas producing a rank for socio-economic position. The indicator was developed from 13 household aspects and the education of the head of household, through principal component analysis. The various aspects included are the education of head of the household, number of bathrooms, number of bedrooms, number of television sets, number of cars, radio, fridge or freezers, videocassette, washing machine, microwave oven, telephone lines, computers and air conditioning(70). At birth family income was collected on years of full-time education and analysed in four different categories 'up to 4 years', '5-8 years', '9-11 years', and 'above 12 years. To identify how was the impact of dental conditions on the quality of life during the childhood the 'Early Childhood Oral Health Impact Scale (ECOHIS) was developed. This questionnaire includes 13 questions: 9 questions about parents' perception of the impact of

oral health on children (Child Impact Section) and other 4 questions about impact on family. Responses were coded from (0 – 5): [0 = ‘never’, 1 = ‘hardly ever’, 2 = ‘occasionally’, 3 = ‘often’, 4 = ‘very often’, and 5 = ‘don’t know’(71).

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS for windows, version 22.0, SPSS Inc., Chicago, IL, USA). Data were analysed using descriptive statistics (mean and standard deviation). After the descriptive statistics, linear regressions between the outcome and independent variables were performed to estimate the crude associations (beta coefficients and 95% confidence intervals). The choice of linear regression was based on the normal distribution of the outcome. Multivariable linear regression was performed to verify the impact of malocclusion on Oral Health Related Quality of Life (OHRQoL) of adolescents according to the following models: model 1 presents a crude analysis, model 2 adjusted model 1 for socioeconomic status, maternal schooling and sex, model 3 adjusted model 2 for ECOHIS and finally, the fully adjusted model 4, accounting for model 3 adjusted for DMFS other dental conditions and orthodontic treatment.

References

1. The World Health Organization Quality of Life assessment (WHOQOL): position paper from the World Health Organization. Social science & medicine (1982). 1995;41(10):1403-9.
2. Liccardo D, Cannavo A, Spagnuolo G, Ferrara N, Cittadini A, Rengo C, et al. Periodontal Disease: A Risk Factor for Diabetes and Cardiovascular Disease. Int J Mol Sci. 2019;20(6).
3. Poskerova H, Linhartova PB, Holla LI. Oral diseases in diabetic patients. Vnitr Lek. 2019;65(4):314-20.
4. Benrachadi L, Mohamed Saleh Z, Bouziane A. [The impact of periodontal therapy on the diabetes control: A systematic review]. Presse Med. 2019;48(1 Pt 1):4-18.
5. Hescot P. The New Definition of Oral Health and Relationship between Oral Health and Quality of Life. Chin J Dent Res. 2017;20(4):189-92.
6. Chaffee BW, Rodrigues PH, Kramer PF, Vitolo MR, Feldens CA. Oral health-related quality-of-life scores differ by socioeconomic status and caries experience. Community Dent Oral Epidemiol. 2017;45(3):216-24.
7. Vares E, Popov VI. [State of the oral cavity in persons assigned to the Yessentuki health resort]. Stomatologiia (Mosk). 1977;56(6):84-5.
8. Bialoszewska K, Lazarewicz M, Swieczkowski D, Cwalina N, Merks P, Bialoszewski A, et al. The state of the health of the oral cavity and health behaviors. Wiad Lek. 2018;71(7):1354-9.
9. A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. Br Dent J. 2017;223(3):203.
10. Dolan TA, Mulligan R, Berkey D, Saunders MJ. Enhancing the oral health of older adults: recommendations for action. Spec Care Dentist. 1996;16(6):229-36.
11. Boyd LD, Palmer C, Dwyer JT. Managing oral health related nutrition issues of high risk infants and children. The Journal of clinical pediatric dentistry. 1998;23(1):31-6.
12. Hawkins RJ, Zanetti DL, Main PA, Jokovic A, Dwyer JJ, Otchere DF, et al. Oral hygiene knowledge of high-risk Grade One children: an evaluation of two methods of dental health education. Community Dent Oral Epidemiol. 2000;28(5):336-43.
13. Gilchrist F, Rodd H, Deery C, Marshman Z. Assessment of the quality of measures of child oral health-related quality of life. BMC Oral Health. 2014;14:40-.
14. Kumar S, Kroon J, Lalloo R. A systematic review of the impact of parental socio-economic status and home environment characteristics on children's oral health related quality of life. Health Qual Life Outcomes. 2014;12:41-.
15. Alsumait A, ElSalhy M, Raine K, Cor K, Gokiert R, Al-Mutawa S, et al. Impact of dental health on children's oral health-related quality of life: a cross-sectional study. Health and quality of life outcomes. 2015;13:98.
16. Johansson G, Ostberg A-L. Oral health-related quality of life in Swedish young adults. Int J Qual Stud Health Well-being. 2015;10:27125-.
17. Ukra A, Foster Page LA, Thomson WM, Farella M, Tawse Smith A, Beck V. Impact of malocclusion on quality of life among New Zealand adolescents. N Z Dent J. 2013;109(1):18-23.
18. Masood Y, Masood M, Zainul NN, Araby NB, Hussain SF, Newton T. Impact of malocclusion on oral health related quality of life in young people. Health Qual Life Outcomes. 2013;11:25.

19. Rothman ML, Beltran P, Cappelleri JC, Lipscomb J, Teschendorf B; Mayo/FDA Patient-Reported Outcomes Consensus Meeting Group. Patient-reported outcomes: conceptual issues. Value Health. 2007;10 Suppl 2:S66-S75.
20. Locker D, Allen F. What do measures of 'oral health-related quality of life' measure?. Community Dent Oral Epidemiol. 2007;35(6):401-411.
21. Sanders AE, Spencer AJ, Slade GD. Evaluating the role of dental behaviour in oral health inequalities. Community Dent Oral Epidemiol. 2006;34(1):71-79.
22. Pahel BT, Rozier RG, Slade GD. Parental perceptions of children's oral health: the Early Childhood Oral Health Impact Scale (ECOHIS). Health Qual Life Outcomes. 2007;5:6.
23. Dini EL, McGrath C, Bedi R. An evaluation of the oral health quality of life (OHQoL) instrument in a Brazilian population. Community Dent Health. 2003;20(1):40-44.
24. Adulyanon S, Vourapukjaru J, Sheiham A. Oral impacts affecting daily performance in a low dental disease Thai population. Community Dent Oral Epidemiol. 1996;24(6):385-389.
25. Leao A, Sheiham A. The development of a socio-dental measure of dental impacts on daily living. Community Dent Health. 1996;13(1):22-26.
26. Locker D, Miller Y. Subjectively reported oral health status in an adult population. Community Dent Oral Epidemiol. 1994;22(6):425-430.
27. Hunt RJ, Slade GD, Strauss RP. Differences between racial groups in the impact of oral disorders among older adults in North Carolina. J Public Health Dent. 1995;55(4):205-209.
28. Atchison KA, Dolan TA. Development of the Geriatric Oral Health Assessment Index. J Dent Educ. 1990;54(11):680-687.
29. Abreu LG, Melgaço CA, Abreu MH, Lages EM, Paiva SM. Effect of malocclusion among adolescents on family quality of life. Eur Arch Paediatr Dent. 2015;16(4):357-363.
30. Basha S, Mohamed RN, Swamy HS, Parameshwarappa P. Untreated Gross Dental Malocclusion in Adolescents: Psychological Impact and Effect on Academic Performance in School. Oral Health Prev Dent. 2016;14(1):63-69.
31. Tang EL, Wei SH. Recording and measuring malocclusion: a review of the literature. Am J Orthod Dentofacial Orthop. 1993;103(4):344-351.
32. Kok YV, Mageson P, Harradine NW, Sprod AJ. Comparing a quality of life measure and the Aesthetic Component of the Index of Orthodontic Treatment Need (IOTN) in assessing orthodontic treatment need and concern. J Orthod. 2004;31(4):312-301.
33. Manzanera D, Montiel-Company JM, Almerich-Silla JM, Gandía JL. Diagnostic agreement in the assessment of orthodontic treatment need using the Dental Aesthetic Index and the Index of Orthodontic Treatment Need. Eur J Orthod. 2010;32(2):193-198.
34. Bittencourt JM, Martins LP, Bendo CB, Vale MP, Paiva SM. Negative effect of malocclusion on the emotional and social *well*-being of Brazilian adolescents: a population-based study. Eur J Orthod. 2017;39(6):628-633.
35. Abreu LG, Melgaco CA, Abreu MH, Lages EM, Paiva SM. Perception of parents and caregivers regarding the impact of malocclusion on adolescents' quality of life: a cross-sectional study. Dental Press J Orthod. 2016;21(6):74-81.
36. Sheldon GH. Psychological factors in the etiology of malocclusion. N Y State Dent J. 1969;35(5):277-284.
37. Grippaudo C, Paolantonio EG, Antonini G, Saulle R, La Torre G, Deli R. Association between oral habits, mouth breathing and malocclusion. Acta Otorhinolaryngol Ital. 2016;36(5):386-394.
38. Behbehani F, Artun J, Al-Jame B, Kerosuo H. Prevalence and severity of malocclusion in adolescent Kuwaitis. Med Princ Pract. 2005;14(6):390-395.

39. Alhammadi MS, Halboub E, Fayed MS, Labib A, El-Saaidi C. Global distribution of malocclusion traits: A systematic review [published correction appears in Dental Press J Orthod. 2019 Aug 01;24(3):113]. Dental Press J Orthod. 2018;23(6):40.e1-40.e10.
40. Dabone C, Delisle HF, Receveur O. Poor nutritional status of schoolchildren in urban and peri-urban areas of Ouagadougou (Burkina Faso). Nutr J. 2011;10:34.
41. 74th Congress of the Italian Society of Pediatrics : Rome, Italy. 12-16 June 2018. Ital J Pediatr. 2018;44(Suppl 3):149.
42. Bilgic F, Gelgor IE, Celebi AA. Malocclusion prevalence and orthodontic treatment need in central Anatolian adolescents compared to European and other nations' adolescents. Dental Press J Orthod. 2015;20(6):75-81.
43. Gaçe E PH, Dulli R. Malocclusions and dental anomalies in Albanian children with disabilities. Alban Med J 2015;3:34-42.
44. Bhardwaj VK, Veeresha KL, Sharma KR. Prevalence of malocclusion and orthodontic treatment needs among 16 and 17 year-old school-going children in Shimla city, Himachal Pradesh. Indian J Dent Res. 2011;22(4):556-560.
45. Behbehani F, Artun J, Al-Jame B, Kerosuo H. Prevalence and severity of malocclusion in adolescent Kuwaitis. Med Princ Pract. 2005;14(6):390-395.
46. Onyeaso CO. Prevalence of malocclusion among adolescents in Ibadan, Nigeria. Am J Orthod Dentofacial Orthop. 2004;126(5):604-607.
47. Gaikwad SS, Gheware A, Kamatagi L, Pasumarthy S, Pawar V, Fatangare M. Dental caries and its relationship to malocclusion in permanent dentition among 12-15 year old school going children. J Int Oral Health. 2014;6(5):27-30.
48. Ashari A, Mohamed AM. Relationship of the Dental Aesthetic Index to the oral health-related quality of life. Angle Orthod. 2016;86(2):337-342.
49. Dimberg L, Arnrup K, Bondemark L. The impact of malocclusion on the quality of life among children and adolescents: a systematic review of quantitative studies. Eur J Orthod. 2015;37(3):238-247.
50. Alajlan SS, Alsaleh MK, Alshammari AF, Alharbi SM, Alshammari AK, Alshammari RR. The prevalence of malocclusion and orthodontic treatment need of school children in Northern Saudi Arabia. J Orthod Sci. 2019;8:10.
51. Sun L, Wong HM, McGrath CPJ. The factors that influence oral health-related quality of life in 15-year-old children. Health Qual Life Outcomes. 2018;16(1):19.
52. Claudino D, Traebert J. Malocclusion, dental aesthetic self-perception and quality of life in a 18 to 21 year-old population: a cross section study. BMC Oral Health. 2013;13:3.
53. Oliveira DC, Ferreira FM, Morosini Ide A, Torres-Pereira CC, Martins Paiva S, Fraiz FC. Impact of Oral Health Status on the Oral Health-Related Quality of Life of Brazilian Male Incarcerated Adolescents. Oral Health Prev Dent. 2015;13(5):417-425.
54. Kragt L, Dhamo B, Wolvius EB, Ongkosuwito EM. The impact of malocclusions on oral health-related quality of life in children-a systematic review and meta-analysis. Clin Oral Investig. 2016;20(8):1881-1894.
55. Andiappan M, Gao W, Bernabé E, Kandala NB, Donaldson AN. Malocclusion, orthodontic treatment, and the Oral Health Impact Profile (OHIP-14): Systematic review and meta-analysis. Angle Orthod. 2015;85(3):493-500.
56. Araki M, Yasuda Y, Ogawa T, et al. Associations between Malocclusion and Oral Health-Related Quality of Life among Mongolian Adolescents. Int J Environ Res Public Health. 2017;14(8):902.
57. Siluvai S, Kshetrimayum N, Reddy CV, Siddanna S, Manjunath M, Rudraswamy S. Malocclusion and related quality of life among 13- to 19-year-old students in Mysore City - a cross-sectional study. Oral Health Prev Dent. 2015;13(2):135-141.

58. Masood Y, Masood M, Zainul NNB, Araby N, Hussain SF, Newton T. Impact of malocclusion on oral health related quality of life in young people. Health Qual Life Outcomes. 2013;11:25.
59. Kaur P, Singh S, Mathur A, et al. Impact of Dental Disorders and its Influence on Self Esteem Levels among Adolescents. J Clin Diagn Res. 2017;11(4):ZC05-ZC08.
60. Olivieri A, Ferro R, Benacchio L, Besostri A, Stellini E. Validity of Italian version of the Child Perceptions Questionnaire (CPQ11-14). BMC Oral Health. 2013;13:55.
61. Kavaliauskiene A, Sidlauskas A, Zaborskis A. Relationship Between Orthodontic Treatment Need and Oral Health-Related Quality of Life among 11–18-Year-Old Adolescents in Lithuania. Int J Environ Res Public Health. 2018;15(5):1012.
62. Peres MA, Barros AJ, Peres KG, et al. Oral health follow-up studies in the 1993 Pelotas (Brazil) birth cohort study: methodology and principal results. Every Public Health. 2010;26(10):1990-1999.
63. Peres KG, Peres MA, Demarco FF, Tarquínio SB, Horta BL, Gigante DP. Oral health studies in the 1982 Pelotas (Brazil) birth cohort: methodology and principal results at 15 and 24 years of age. Every Public Health. 2011;27(8):1569-1580.
64. Tan, Jo-Pei & Rumaya, Juhari & Yaacob, Siti. (2012). Malaysian Adolescents' Life Satisfaction. Archives of Science -Geneve.65. 1661-464.
65. Santos IS, Barros AJ, Matijasevich A, Domingues MR, Barros FC, Victora CG. Cohort profile: the 2004 Pelotas (Brazil) birth cohort study. Int J Epidemiol. 2011;40(6):1461-1468.
66. Victora CG, Barros FC. Cohort profile: the 1982 Pelotas (Brazil) birth cohort study. Int J Epidemiol. 2006;35(2):237-242.
67. Jaber MA. Dental caries experience, oral health status and treatment needs of dental patients with autism. J Appl Oral Sci. 2011;19(3):212-217.
68. de Silva AM, Hegde S, Akudo Nwagbara B, et al. Community-based population-level interventions for promoting child oral health. Cochrane Database Syst Rev. 2016;9(9):CD009837.
69. Ashari A, Mohamed AM. Relationship of the Dental Aesthetic Index to the oral health-related quality of life. Angle Orthod. 2016;86(2):337-342.
70. Barros AJ, Victora CG. [A nationwide wealth score based on the 2000 Brazilian demographic census]. Rev Public Health. 2005;39(4):523-529.
71. Aggarwal VP, Mathur A, Dileep CL, Batra M, Makkar DK. Impact of sociodemographic attributes and dental caries on quality of life of intellectual disabled children using ECOHIS. Int J Health Sci (Qassim). 2016;10(4):480-90.

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Chapter – 3

Impact of malocclusion on oral health related quality of life among Brazilian adolescents

Introduction

Malocclusion is the malformation of maxilla or the mandible and malposition of teeth that may result in physical, psychological, and social consequences.

In the epidemiological field, several indices used to estimate the occurrence of malocclusion play a vital role in assessing the severity, complexity, and treatment outcome of malocclusion. Strategies for recording and measuring malocclusion can be distinguished under qualitative and quantitative techniques. Qualitative methods of estimating malocclusion incorporate indices such as malalignment index and index of tooth position. Quantitative methods of measuring malocclusion as with most of the indices utilized include handicapping labiolingual index, malocclusion severity estimate, occlusal index, dental aesthetic index, treatment priority index(1).

Malocclusion is the third leading oral condition, secondarily to periodontal disease and dental caries(2, 3-5). Malocclusion is highly prevalent among adolescents worldwide and due to its impact on their quality of life should be considered as a Dental public health problem(6-10). Adolescents and parents perceived untreated malocclusion as a condition which has a psychological and social impact on individual quality of life(9,11-14) with most of the interventions for this dental disorder made during this stage of people's life. In normal circumstances adolescents seek for dental intervention for the purpose of enhancing their own physical and aesthetic appearance(13,15,16).

Studies have demonstrated the impact of severe malocclusion on esthetic appearance and on functional limitations. Persistent biting of cheek, changes in facial appearance, vocalizing issues and mouth breathing are a portion of the significant indications that characterize this debilitating condition(17,18).

A study suggested that handicapping malocclusion had a negative effect on physical/aesthetic effects and quality of life among Brazilian adolescents. Moreover, malocclusion is associated

with emotional and social aspects of individual's quality of life(19). Several studies have reported that there is significant effect of malocclusion on the Oral Health Related Quality of Life (OHRQoL) associated with psychological and self-esteem levels of adolescents(7,20). A study conducted in India showed that anterior traumatic teeth, tooth decay and tooth loss could have a negative impact on psycho-social behavior which consequently affects their self-esteem(18). Conversely, a study carried out in Mongolian adolescents showed no significant relation associated with malocclusion and OHRQoL.

According to World Health Organization (WHO), the term Health Related Quality of Life is best described as an individual assessment of how the following factors affect his/her well-being(21,22). Functional component, psychological component, aesthetic component and pain and discomfort component are the four major components of OHRQoL(23,24,25). Although malocclusion is not fatal, it possesses adverse effects on OHRQoL(26).

The absence of viable data on malocclusion and its effect on adolescent's quality of life contribute immensely to the literature and furnish researchers and epidemiologists with information vital for orthodontic treatment (27). This approach may benefit the researchers to better understand the relationship between malocclusion and quality of life and will be also useful for health care providers in organizing health care (orthodontic treatment).

This study aims to investigate the impact of malocclusion on OHRQoL in adolescents by conducting secondary analysis of the data available from *Pelotas 2004 Birth Cohort Study.*

Methods

Pelotas is located in south of Brazil, in the Rio Grande do Sul state, very close to Uruguay. A population-based birth cohort study was carried out in the urban city of Pelotas, Brazil, in the year 2004 (2004PBCS), including all live births in the city. all mothers living in the urban area of Pelotas and their children born in maternity hospitals of the city of Pelotas (n = 4231) were eligible to participate in this study. The 2004PBCS carried out full follow-up visits rather than sub-samples at the ages of 3, 12, 24 and 48 months. During the follow-ups, mothers were interviewed in the perinatal study with respect to their demographic, socio-economic and reproductive features, lifestyle, morbidity, health care utilization and breastfeeding practices. In 2009, the first oral health study (OHS09) was carried out. Children who were born between September and December in the year 2004 and were followed up at 4

years of age were invited to participate in the OHS09 (1,303 children). A questionnaire was applied to the parents which included mothers and child's oral health behaviour, self-perception of the mothers and child's oral health and self-rated maternal oral health. Children were dentally examined in their homes, seated in a normal chair with the aid of artificial illumination (head lamp). Dental conditions such as dental caries (dmfs index), plaque, dental trauma, and malocclusion were investigated. Prior to the dental examination, examiners were trained and calibrated to perform dental examinations. During this process, eight dentists examined 100 pre-schoolchildren excluded from the sample. The second oral health study (OHS17) nested in the 2004PBCS was carried out in 2017 and included all children (n = 1,129) who participated in the 2009OHS. Participants were between 12 and 13 years of age and were investigated at the children's home regarding different oral health outcomes such as dental caries, malocclusion, dental trauma, plaque, oral mucosal lesions, fluorosis, dental erosion, and periodontal conditions. The key exposure variable for the current study was malocclusion in the permanent dentition collected in the second wave of the Pelotas Oral Health Study (OHS17). The oral examination to estimate malocclusion was carried out using Dental Aesthetic Index (DAI) which is recommended by the WHO(28), and the need for orthodontic treatment was obtained from this index. The Dental Aesthetic Index (DAI). Malocclusion was evaluated according the four different levels of orthodontic treatment need from the DAI index as the main exposure. In terms of need for definitive orthodontic treatment DAI were made to classify into 4 categories 1. Normal malocclusion with a DAI score of ≤25; 2. Definite malocclusion with a score ranging between 26-30; 3. Severe malocclusion where the score ranges between 31-35 and 4. Handicapping malocclusion with a DAI score ≥36(29). The outcome for the current study was Oral Health-Related Quality of Life (OHRQoL) in the adolescence period analysed as a continuous variable. Data from OHS17 regarding quality of life was considered the outcome. The Child Perception Questionnaire (CPQ_{11-14}) is designed to measure OHRQoL among children aged between 11 and 14 years. The question: " *In the past 3 months, how often have you ... (had/been) ... because of your teeth/mouth?"* is answered according to the following categories: never, once or twice, sometimes, often, and every-day or almost every day with scores ranging from 0 to 4, respectively. An overall score is also able to be calculated relating to what had occurred in the last three months. Each child was asked to complete the ECOHIS and CPQ questionnaire just prior to the dental examination. Information on the subjects parental schooling and family income at birth, access to orthodontic treatment, oral-health related quality of life at

childhood, and other dental conditions were considered potential confounders. In this present study we used the National Economic Indicator (IEN), a wealth indicator that is less subject to temporal variability as it is based on aspects that doesn't change over short durations of time.

In the current study needs for orthodontic treatment was the main exposure. It was applied the Dental Aesthetic Index (DAI), which was measured using mouth mirror and dental probe under a clinical set up at 12 years of age. DAI was categorized into 4 categories depending on the level of severity of malocclusion. The index score between 0-25 is no malocclusion / no treatment required, 26-30 (mild / moderate) level of treatment need, score between 31-35 (severe malocclusion) there is need for treatment and ≥36 (handicapping malocclusion) where there is definite need for treatment. Wealth indicator, maternal schooling at birth, sex, completed orthodontic treatment, DMFS, trauma, fluoride, gingivitis, plaque, fluoride, erosion at 12 years of age and ECOHIS are considered to be the potential confounders. The wealth indicator is nothing but the family income at birth in quintiles which is categorized into 5 categories with number 1 being the (lowest income) and 5 being the (highest income) category. Maternal schooling was collected as the number of completed years of mothers's schooling at child birth and it was categorized into 4 categories as follows: 0-4, 5-8, 9-11 and ≥12 years. Subjects response to their orthodontic treatment completion was recorded as have had completed orthodontic treatment, orthodontic treatment not completed, and never have had at 12 years of age. The number of surfaces with decay, missing and filled surface of teeth among 12-year-old adolescents was identified under a clinical setup using dental chair, mouth mirror, dental probe and dental light. These scores are further categorized into 0 (no surfaces affected with decay/mission/filled), 1-4 and ≥5. Adolescents at 12 years of age affected with any dental conditions such as plaque (30), gingivitis by the application of Gingival Bleeding Index was proposed by Silness and Loe(31), The scores were classified into score 0,1,2,3 and 4 where score 0 indicated normal gingiva, score 1 indicated gingiva with mild inflammation/slight change in colour/slight oedema/no bleeding on probing, score 2 indicated gingiva with moderate inflammation/redness/oedema/glazing and bleeding on probing, score 3 indicated gingiva with severe inflammation/marked redness and oedema/ulceration and tendency to spontaneous bleeding . Any signal of inflammation (scores 1-4) was considered the presence of gingivitis. Fluorosis was classified based on Dean index characteristics(32). Dean's Index includes the categories Questionable, Mild,

Moderate/Severe and corroded appearance of the tooth. Those areas of teeth with occasional white flecking and spotting of enamel are considered to be questionable, whereas areas with white opacity involving more of the tooth surface were considered to be mild cases and pitting/brownish staining of the tooth surfaces were under moderate/severe. Any level of trauma and erosion responses are noted down with the help of questionnaire and the response given were either yes/no.

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS for windows, version 22.0,SPSS Inc., Chicago, IL, USA). Data were analysed using descriptive statistics (mean and standard deviation). After the descriptive statistics, linear regressions between the outcome and independent variables were performed to estimate the crude associations (beta coefficients and 95% confidence intervals). Multivariable linear regression was performed to verify the impact of malocclusion on Oral Health Related Quality of Life (OHRQoL) of adolescents according to the following models: model 2 adjusted model 1 for socioeconomic status, maternal schooling and sex, model 3 adjusted model 2 for ECOHIS and finally, the fully adjusted model 4, accounting for model 3 adjusted for DMFS other dental conditions and orthodontic treatment.

Results

Study selection and characteristics

A total of 1129 children were investigated in 2009, and during the second follow up nearly one thousand (n = 996 children) were dental assessed and interviewed at 12 years of age in 2017. Table 1 shows a high proportion of mothers who attended between 5 and 8 years of schooling (39.1%) and approximately 10% (10.4%) of the mothers having 12 years or over of schooling. Slightly more than a half of the sample was female (50.1%). Nearly one fifth of the sample were caries free (63.3%) while the majority (13.3%) had 5 or more DMF surfaces. Apart from dental caries, the dental condition with highest prevalence was dental plaque (80.0%), followed by gingival inflammation (51.7%). Dental trauma (24.4%) and fluorosis (22.9%) showed similar prevalence. During adolescence, DAI had a borderline association with OHRQoL. Around (49.7%) of children had a DAI score between 0-25 and with a score of ≥36 about 10.0% of children were identified. An inverse association between the level of family wealth indicator and the OHRQoL indexes at 5 and 12 years of age was observed. The higher the wealth indicator the lowest the negative impact on the child´s OHRQoL. Children whose mother attended school for 12 years or over had lower scores of the CPQ11-14 index than the others. The higher the number of affected DMF surfaces the greater the impact on individual OHRQoL index in both ages. The presence of dental plaque was positively associated with the overall QoL index. Adolescents with an overall DAI score of 36 or over had greater CPQ11-14 scores than the others. (Table 1).

Association between DAI and independent variables

Associations between DAI index and the independent variables are displayed in table 2. Only the presence of dental plaque was associated with the DAI index, with significant greater prevalence of severe malocclusion among those presenting plaque (11.2%) than those without plaque (6.1%).

Multivariable linear regression analysis between CPQ$_{11-14}$ and DAI

Table 3 represents the multivariable linear regression analysis between CPQ11-14 index and the DAI index. Children with mandatory orthodontic treatment had greater scores of the CPQ11-14 index (Model 1). CPQ11-14 score was higher, on average, 1.928 (SE 0.749) units among those with mandatory orthodontic treatment when compared to those with normal occlusion. This result was found even after adjustment for all covariates. Other covariates that remained associated with lower scores of the CPQ11-14 index was maternal schooling at 9-11and ≥12 years when compared to those who attended school less than 5 years. Other variables like ECOHIS and DMFS with a score ranging between 1-4 and ≥5 was related with lower CPQ11-14 scores when compared to those whose DMFS score is equal to 0.

Discussion

In the present study, adolescents with severe malocclusion, identified through the DAI score ≥36, had a greater chance of experiencing a negative impact on their oral health-related quality of life than their counterparts. This finding was observed regardless of the presence of other dental conditions and well-known confounders such as a wealth indicator and maternal schooling.

The overall prevalence of severe malocclusion was 10.2%, while slightly more than a half of participants had normal or minor malocclusions. Similar findings for severe malocclusion were reported among adolescents aged from 15 to19 years from a different region in Brazil(33); however, it was lower than that indicated in other cities in the southern region of Brazil, where prevalences of 27.2% (34) and 17.7% for severe malocclusion(11) were found. The difference in the results of the study could be due to variation in age of the participants that comprised the samples. In our current study we observed a high percentage of adolescents with normal/minor malocclusion followed by those with definite, high need for treatment and who require essential treatment categorised as severe malocclusion.
Similar results with a high percentage of minor malocclusion (82.7%) followed by those with definite need for treatment, and with severe malocclusion (17.3%) were observed among 12-15 years-old school children in India, which used the same malocclusion index (35).

Several studies have investigated the impact of malocclusion on the OHRQoL, among them, only two systematic reviews focused on children and adolescents(36,37-39). A systematic review presented in 2014 concluded that the level of evidence was high, highlighting that severe malocclusions have negative effects on OHRQoL among children and adolescents especially in the aesthetic zone such as the presence of anterior crowding, midline diastema, overjet and deep-bite. Moreover, such malocclusions affect, predominantly, emotional and social well-being domains(40). Interestingly, a study carried out in Brazil investigated the association between children and parents' views about their child OHRQoL perception. The authors found that children and parents do not necessarily share the same views about child OHRQoL, particularly how it impacts on their social and emotional well-being(37). Despite the evidence on the association between malocclusions and negative impact on OHRQoL,

some studies such as in the Zambia (41) observed an inverse association in this association. Cultural differences and age of the children could explain such difference in findings(42).

Among all investigated independent variables, only the presence of dental plaque was significantly associated with severe malocclusion. This finding corroborates with other studies where children with the presence of need of orthodontic treatment were three times more likely to have gingival bleeding and plaque than those without orthodontic treatment needs in India (43). Visible plaque was also significantly associated with children without spacing in maxillary anterior teeth in Southern Brazil (44), and with the presence of malocclusion in Brazil (44) and Malaysia (45, 46). Plaque is the main etiological factor for any periodontal disease, which is influenced by host's immunological response(47). A varied number of studies from various populations have reported that poor oral hygiene and presence of visible plaque contribute to severe malocclusion and are very strong predictors for gingival inflammation(48) which further shows an adverse effect on OHRQoL(49). The presence of certain types of malocclusion can make it difficult to clean the teeth which might contribute to the accumulation of plaque.

No association was found between sex and the negative impact on OHRQoL, which is also in agreement with the data reported in previous studies (44, 50,51). The results of our current study might be explained by the fact that children in the age group selected for the current study perceived the psychosocial effect of malocclusion(51). The presence of dental plaque was significantly associated with a negative impact on OHRQoL, which is in agreement with the data reported in previous studies from Brazil (44) and Malaysia (45,46). Another outcome associated with negative impact of OHRQoL was the presence of dental caries. The greater the number of DMFS the stronger was the association. If the tooth decay is untreated it may cause difficulties in eating and sleeping that may impact child growth and is a leading cause of absence from both school and work. There are very few studies in which experience of caries were taken into consideration in the analysis of the association between malocclusion and OHRQoL, which gives an innovative approach to our study. Moreover, caries and tooth loss are the major predisposing factors for malocclusion both in primary and permanent dentition(52).

An association was found between level of education of maternal mothers and OHRQoL. It is an important marker; thus, increasing child caries was seen associated with negative impact

on child's quality of life. Moreover, the mean ECOHIS scores were significantly lower of mothers with least educational attainment (ratio: 0.7; 95% CI: 0.5,1.0)(6). In the field of oral health, it is always believed that maternal schooling, income levels and other dental conditions are associated with over-all quality of life among children and adolescent's(53). To the best of our knowledge, this is the first study that controls the analysis of the association between malocclusion in permanent dentition and OHRQoL for the level of quality of life in earlier stages of the life. ECOHIS is a tool, which is widely used to investigate OHRQoL in childhood, it includes different domains and also describes the impact in early stages. In the current study, by adjusting the analyses for ECOHIS, it helped us to reinforce the idea that the negative impact on OHRQoL in adolescents is related to recent oral health conditions after childhood rather than a cumulative issue. Severe DAI category was associated with negative OHRQoL, independently of other oral health diseases and conditions and previous negative impact on the quality of life during childhood. Both ECOHIS and CPQ scales are strongly associated with each other.

This study makes a great contribution to academic literature as it is the first investigation that carried a secondary analysis using the Pelotas oral health study and provided such evidence in a sample of other Pelotas oral health follow up studies. It has been suggested that adolescents oral and dental conditions have an effect on the adolescents OHRQoL (54) . The results of our study revealed that severe malocclusion had a greater chance of impact on OHRQoL. To further achieve a more comprehensive analysis, it is recommended to conduct a multidisciplinary approach to reduce negative impact on QoL. Moreover, with the development of special oral health policies with a focus on those with severe malocclusion considering the adverse effect of a reduced QoL for future management of health and would be helpful to identify the disease progression.

The limitations of the present study are typical of the study design, specific population with specific cultural aspects and characteristics so that we cannot generalize the findings. There are many unmeasured confounders like other conditions that affect OHRQoL may exist and they were not taken into consideration. The percentage of losses of participants for follow-up could be an issue however the individuals located in 2015 were similar to the original cohort according to most of the baseline characteristics. The strengths of our current study are inclusion of ECOHIS as a confounder, quality of data collection, the quality control of the

interview-based assessments, the robust instrument used to investigate QoL and evaluation of a population-based sample of adults in a middle income setting. The results showed a significant association between impact of malocclusion on overall OHRQoL and this finding may be characteristic of the specific population of the particular geographic region from where the selection of children and adolescents took place. While concerning the negative impact of malocclusion on OHRQoL, it should be identified/analysed with utmost caution and it cannot be the same for the entire population in the same age group.

Conclusion

In conclusion, the impact of malocclusion on daily events among adolescents in Brazilian adolescent's was a common finding in our study. Some other important variables like gingival status, schooling of the father's that possibly act during the childhood which might be affecting the QoL were not included in our present study. These findings may not only contribute to the literature but may also furnish researchers and epidemiologists with information vital for orthodontic treatment and useful to identify the community needs and help in the implementation of treatment plan. Further studies need to be developed to clarify the most complex relationship between impact of malocclusion on QoL.

References

1. de Paula Júnior DF, Santos NC, da Silva ET, Nunes MF, Leles CR. Psychosocial impact of dental esthetics on quality of life in adolescents. Angle Orthod. 2009;79(6):1188-1193.
2. Behbehani F, Artun J, Al-Jame B, Kerosuo H. Prevalence and severity of malocclusion in adolescent Kuwaitis. Med Princ Pract. 2005;14(6):390-395.
3. Nobile CG, Pavia M, Fortunato L, Angelillo IF. Prevalence and factors related to malocclusion and orthodontic treatment need in children and adolescents in Italy. Eur J Public Health. 2007;17(6):637-641.
4. da Rosa GN, Del Fabro JP, Tomazoni F, Tuchtenhagen S, Alves LS, Ardenghi TM. Association of malocclusion, happiness, and oral health-related quality of life (OHRQoL) in schoolchildren. J Public Health Dent. 2016;76(2):85-90.
5. Claudino D, Traebert J. Malocclusion, dental aesthetic self-perception and quality of life in a 18 to 21 year-old population: a cross section study. BMC Oral Health. 2013;13:3.
6. Gavric A, Mirceta D, Jakobovic M, Pavlic A, Zrinski MT, Spalj S. Craniodentofacial characteristics, dental esthetics-related quality of life, and self-esteem. Am J Orthod Dentofacial Orthop. 2015;147(6):711-718.
7. Spalj S, Slaj M, Varga S, Strujic M, Slaj M. Perception of orthodontic treatment need in children and adolescents. Eur J Orthod. 2010;32(4):387-394.
8. da Costa AC, Rodrigues FS, da Fonte PP, Rosenblatt A, Innes NPT, Heimer MV. Influence of sense of coherence on adolescents' self-perceived dental aesthetics; a cross-sectional study. BMC Oral Health. 2017;17(1):117.
9. Patil SP, Harsha R H, Mane AB, Sharma JH, Patil PR. Factors influencing the perceived orthodontic treatment need and its relationship with awareness of malocclusion among college adolescents. J Indian Assoc Public Health Dent 2014;12:179-84
10. Grippaudo C, Paolantonio EG, Antonini G, Saulle R, La Torre G, Deli R. Association between oral habits, mouth breathing and malocclusion. 2016;36(5):386-394
11. Bhatia SK, Goyal A, Kapur A. Habitual biting of oral mucosa: A conservative treatment approach. Contemp Clin Dent. 2013;4(3):386-389.
12. Dalle, Heloisa & Vedovello, Silvia & Degan, V & Godoi, A & Custodio, William & Menezes, C. (2019). Malocclusion, facial and psychological predictors of quality of life in adolescents. Community dental health. 36. 298-302.
13. Iranzo-Cortes JE, Montiel-Company JM, Bellot-Arcis C, et al. Factors related to the psychological impact of malocclusion in adolescents. Sci Rep. 2020;10(1):13471.
14. Dimberg L, Arnrup K, Bondemark L. The impact of malocclusion on the quality of life among children and adolescents: a systematic review of quantitative studies. Eur J Orthod. 2015;37(3):238-247.
15. Bhatia SK, Goyal A, Kapur A. Habitual biting of oral mucosa: A conservative treatment approach. Contemp Clin Dent. 2013;4(3):386-389.
16. Scapini A, Feldens CA, Ardenghi TM, Kramer PF. Malocclusion impacts adolescents' oral health-related quality of life. Angle Orthod. 2013;83(3):512-518.
17. Masood M, Masood Y, Newton T. Cross-bite and oral health related quality of life in young people. J Dent. 2014;42(3):249-255.
18. Kavaliauskiene A, Sidlauskas A, Zaborskis A. Relationship Between Orthodontic Treatment Need and Oral Health-Related Quality of Life among 11⁻18-Year-Old Adolescents in Lithuania. Int J Environ Res Public Health. 2018;15(5):1012.

19. Silva LF, Thomaz EB, Freitas HV, Pereira AL, Ribeiro CC, Alves CM. Impact of Malocclusion on the Quality of Life of Brazilian Adolescents: A Population-Based Study. PLoS One. 2016;11(9):e0162715.
20. Bennadi D, Reddy CVK. Oral health related quality of life. Journal of International Society of Preventive & Community Dentistry. 2013;3(1):1-6.
21. Post MW. Definitions of quality of life: what has happened and how to move on. Top Spinal Cord Inj Rehabil. 2014;20(3):167-180.
22. Thomson WM, Broder HL. Oral-Health-Related Quality of Life in Children and Adolescents. Pediatr Clin North Am. 2018;65(5):1073-1084.
23. Araki M, Yasuda Y, Ogawa T, et al. Associations between Malocclusion and Oral Health-Related Quality of Life among Mongolian Adolescents. Int J Environ Res Public Health. 2017;14(8):902.
24. Traebert ES, Peres MA. Do malocclusions affect the individual's oral health-related quality of life?. Oral Health Prev Dent. 2007;5(1):3-12.
25. Silveira MF, Freire RS, Nepomuceno MO, Martins AM, Marcopito LF. Severity of malocclusion in adolescents: populational-based study in the north of Minas Gerais, Brazil. Rev Public Health 2016;50:11.
26. Traebert E, Martins LGT, Pereira KCR, et al. Malocclusion in Brazilian Schoolchildren: High Prevalence and Low Impact. Oral Health Prev Dent. 2018;16(2):163-167.
27. Tang EL, Wei SH. Recording and measuring malocclusion: a review of the literature. Am J Orthod Dentofacial Orthop. 1993;103(4):344-351.
28. The World Health Organization Quality of Life assessment (WHOQOL): position paper from the World Health Organization. Soc Sci Med. 1995;41(10):1403-1409.
29. Nagalakshmi S, James S, Rahila C, Balachandar K, Satish R. Assessment of malocclusion severity and orthodontic treatment needs in 12-15-year-old school children of Namakkal District, Tamil Nadu, using Dental Aesthetic Index. J Indian Soc Pedod Prev Dent. 2017;35(3):188-192.
30. Barbosa TS, Gaviao MB. Oral health-related quality of life in children: part II. Effects of clinical oral health status. A systematic review. Int J Dent Hyg. 2008;6(2):100-107.
31. Chen M, Feng ZC, Liu X, Li ZM, Cai B, Wang DW. Impact of malocclusion on oral health-related quality of life in young adults. Angle Orthod. 2015;85(6):986-991.
32. Zhang M, McGrath C, Hagg U. The impact of malocclusion and its treatment on quality of life: a literature review. Int J Paediatr Dent. 2006;16(6):381-387.
33. da Cunha IP, Pereira AC, Frias AC, et al. Social vulnerability and factors associated with oral impact on daily performance among adolescents. Health Qual Life Outcomes. 2017;15(1):173.
34. Cortellazzi KL, Tagliaferro EP, Pereira SM, et al. A cohort study of caries incidence and baseline socioeconomic, clinical and demographic variables: a Kaplan-Meier survival analysis. Oral Health Prev Dent. 2013;11(4):349-358.
35. B Hasmun NN, Drummond BK, Milne T, Cullinan MP, Meldrum AM, Coates D. Effects of environmental tobacco smoke on the oral health of preschool children. Eur Arch Paediatr Dent. 2017;18(6):393-398.
36. Andiappan M, Gao W, Bernabé E, Kandala NB, Donaldson AN. Malocclusion, orthodontic treatment, and the Oral Health Impact Profile (OHIP-14): Systematic review and meta-analysis. Angle Orthod. 2015;85(3):493-500.
37. Chiapinotto FA, Vargas-Ferreira F, Demarco FF, Correa FO, Masotti AS. Risk factors for gingivitis in a group of Brazilian schoolchildren. J Public Health Dent. 2013;73(1):9-17.

38. Baiju RMP, Peter E, Nayar BR, Varughese JM, Varghese NO. Prevalence and predictors of early periodontal disease among adolescents. J Indian Soc Periodontol. 2019;23(4):356-361.
39. Kruger MSDM, Casarin RP, Gonçalves LB, Pappen FG, Bello-Correa FO, Romano AR. Periodontal Health Status and Associated Factors: Findings of a Prenatal Oral Health Program in South Brazil. Int J Dent. 2017;2017:3534048.
40. Dimberg L, Arnrup K, Bondemark L. The impact of malocclusion on the quality of life among children and adolescents: a systematic review of quantitative studies. Eur J Orthod. 2015;37(3):238-247.
41. Anthony SN, Zimba K, Subramanian B. Impact of Malocclusions on the Oral Health-Related Quality of Life of Early Adolescents in Ndola, Zambia. Int J Dent. 2018;2018:7920973.
42. Kragt L, Dhamo B, Wolvius EB, Ongkosuwito EM. The impact of malocclusions on oral health-related quality of life in children-a systematic review and meta-analysis. Clin Oral Investig. 2016;20(8):1881-1894.
43. State of the oral cavity in persons assigned to the Yessentuki health resort. Stomatologiia (Mosk). 1977;56(6):84-85.
44. Chaffee BW, Rodrigues PH, Kramer PF, Vítolo MR, Feldens CA. Oral health-related quality-of-life scores differ by socioeconomic status and caries experience. Community Dent Oral Epidemiol. 2017;45(3):216-224.
45. Marques LS, Pordeus IA, Ramos-Jorge ML, et al. Factors associated with the desire for orthodontic treatment among Brazilian adolescents and their parents. BMC Oral Health. 2009;9:34.
46. Mtaya M, Brudvik P, Astrom AN. Prevalence of malocclusion and its relationship with socio-demographic factors, dental caries, and oral hygiene in 12- to 14-year-old Tanzanian schoolchildren. Eur J Orthod. 2009;31(5):467-476.
47. Vedovello SA, Ambrosano GM, Pereira AC, Valdrighi HC, Filho MV, Meneghim Mde C. Association between malocclusion and the contextual factors of quality of life and socioeconomic status. Am J Orthod Dentofacial Orthop. 2016;150(1):58-63.
48. Kolawole KA, Folayan MO. Association between malocclusion, caries and oral hygiene in children 6 to 12 years old resident in suburban Nigeria. BMC Oral Health. 2019;19(1):262.
49. Shaghaghian S, Bahmani M, Amin M. Impact of oral hygiene on oral health-related quality of life of preschool children. Int J Dent Hyg. 2015;13(3):192-198.
50. Freire-Maia FB, Auad SM, Abreu MH, et al. Oral Health-Related Quality of Life and Traumatic Dental Injuries in Young Permanent Incisors in Brazilian Schoolchildren: A Multilevel Approach. PLoS One. 2015;10(8):e0135369.
51. Dutra SR, Pretti H, Martins MT, Bendo CB, Vale MP. Impact of malocclusion on the quality of life of children aged 8 to 10 years. Dental Press J Orthod. 2018;23(2):46-53.
52. Gaikwad SS, Gheware A, Kamatagi L, Pasumarthy S, Pawar V, Fatangare M. Dental caries and its relationship to malocclusion in permanent dentition among 12-15 year old school going children. J Int Oral Health. 2014;6(5):27-30.
53. Vedovello SA, Ambrosano GM, Pereira AC, Valdrighi HC, Filho MV, Meneghim Mde C. Association between malocclusion and the contextual factors of quality of life and socioeconomic status. Am J Orthod Dentofacial Orthop. 2016;150(1):58-63.
54. Abreu LG, Melgaco CA, Bastos Lages EM, Paiva SM. Impact of malocclusion on adolescents' oral health-related quality of life. Gen Dent. 2016;64(6):e1-e5.

Table 1 : Descriptive and clinical variables of subjects with mean EOHIS and CPQ11-14

Variables	**Sample**		**ECOHIS**		**CPQ 11-14**	
	n	**%**	**mean**	**se**	**mean**	**se**
Wealth indicator (quintiles) – birth						
1 (lowest)	163	16.4	16.71	.803	25.90	.442
2	143	14.4	16.58	.514	24.20	.933
3	159	16.0	16.04	.473	24.68	.554
4	159	16.0	16.01	.999	25.15	.987
5 (highest)	152	15.3	15.24	.771	23.45	.931
p- value			*.000*		*.021*	
Maternal schooling (completed years) – birth						
0-4	111	11.2	16.37	.697	25.73	.200
5-8	387	39.1	16.76	.907	25.42	.200
9-11	368	37.1	15.68	.069	23.73	.512
≥ 12	103	10.4	15.83	.763	23.04	.885
p- value			*.812*		*.153*	
Sex						
Male	495	49.9	16.14	.223	24.44	.893
Female	496	50.1	16.22	.817	24.65	.851
p- value			*.767*		*.633*	
Completed orthodontic treatment (12 yrs.)						
Yes	55	5.5	15.04	.391	22.95	.417
No	282	28.5	16.30	.289	24.86	.652
Never had	466	47.0	16.26	.003	24.20	.718
p- value			*.194*		*.937*	
DAI index (12 years)						
0-25	493	49.7	16.08	.078	24.25	.732
26-30	252	25.4	16.35	.436	24.30	.484
31-35	138	13.9	16.17	.355	24.73	.247
≥ 36	99	10.0	16.02	.192	26.26	.629
p- value			*.918*		*.018*	
DMFS (number of surfaces) (12 yrs.)						
0	627	63.3	15.87	.867	23.75	.819
1-4	232	23.4	16.68	.103	24.88	.776
≥ 5	132	13.3	16.78	.501	27.75	.014
p- value			*.004*		*.000*	
Trauma (12 yrs.)						
No	749	75.6	16.27	.156	24.56	.071
Yes	242	24.4	15.89	.557	24.51	.221
p- value			*.231*		*.920*	
Fluoride (12 yrs)						
No	763	77.1	16.10	.973	24.64	.904
Yes	227	22.9	16.47	.201	24.18	.743
p- value			*.242*		*.373*	
Gingivitis (12 yrs)						
No	478	48.2	16.28	.924	24.47	.331
Yes	512	51.7	16.08	.119	24.61	.349
p- value			*.442*		*.748*	
Plaque (12 yrs)						
No	198	20.0	16.08	.481	23.27	.144
Yes	793	80.0	16.21	.156	24.87	.007
p- value			*.698*		*.003*	
Erosion (12 yrs)						
No	887	89.5	16.11	.954	24.51	.839
Yes	104	10.5	16.73	.566	24.90	.147
p- value			*.149*		*.576*	

Table 2 shows the association between the Dental Aesthetic Index (DAI) and the independent variables.

Variables	DAI								p
	Normal/Minor malocclusion		Definite malocclusion		High need of treatment		Severe Malocclusion		
	n	(%)	n	(%)	n	(%)	n	(%)	
Wealth indicator (quintiles) – birth									.411
1 (lowest)	76	46.6%	34	20.9%	31	19.0%	22	13.5%	
2	62	44.9%	39	28.3%	21	15.2%	16	11.6%	
3	76	47.8%	44	27.7%	22	13.8%	17	10.7%	
4	84	53.2%	42	26.6%	19	12.0%	13	8.2%	
5 (highest)	81	53.3%	43	28.3%	15	9.9%	13	8.6%	
Maternal schooling (completed years) – birth									.671
0-4	4	50.0%	3	37.5%	1	12.5%	-		
5-8	49	47.6%	25	24.3%	20	19.4%	9	8.7%	
9-11	441	50.5%	224	25.6%	118	13.5%	91	10.4%	
≥ 12									
Sex									.092
Male	228	46.3%	132	26.8%	79	16.1%	53	10.8%	
Female	266	54.0%	120	24.3%	60	12.2%	47	9.5%	
Completed orthodontic treatment (12 yrs)									.609
Yes	147	51.9%	71	25.1%	38	13.4%	27	9.5%	
No	35	64.8%	8	14.8%	6	11.1%	5	9.3%	
Never had	14	48.3%	8	27.6%	5	17.2%	2	6.9%	
DMFS (number of surfaces) (12 yrs)									.801
0	315	50.4%	154	24.6%	87	13.9%	69	11.0%	
1-4	118	51.8%	60	26.3%	31	13.6%	19	8.3%	
≥ 5	61	46.2%	38	28.8%	21	15.9%	12	9.1%	
Trauma (12 yrs)									.462
No	380	51.1%	189	25.4%	98	13.2%	77	10.3%	
Yes	114	47.3%	63	26.1%	41	17.0%	23	9.5%	
Fluoride (12 yrs)									.210
No	381	50.2%	190	25.0%	103	13.6%	85	11.2%	
Yes	113	50.2%	61	27.1%	36	16.0%	15	6.7%	
Gingivitis (12 yrs)									.333
No	254	53.1%	114	23.8%	63	13.2%	47	9.8%	
Yes	240	47.3%	138	27.2%	76	15.0%	53	10.5%	
Plaque (12 yrs)									.023
No	116	58.9%	47	23.9%	22	11.2%	12	6.1%	
Yes	378	48.0%	205	26.0%	117	14.8%	88	11.2%	
Erosion (12 yrs)									.377
No	444	50.3%	230	26.0%	124	14.0%	85	9.6%	
Yes	50	49.0%	22	21.6%.	15	14.7%	15	14.7%	

Table 3: Multiple linear regression analysis of the relationship between DAI, income,

		Model 1			Model 2			Model 3			Model 4		
		'B'	**SE**	**PVALUE**	**'B'**	**SE**	**P**	**'B'**	**SE**	**PVALUE**	**'B'**	**SE**	**P**
DAI	No treatment	-	-	-	-	-	-	-	-	-	-	-	-
	Minor malocclusion or normal occlusion	.021	.529	.969	.083	.527	.875	-.151	.532	.776	-.151	.532	.776
	Definite malocclusion/ elective treatment	.451	.659	.494	.395	.657	.549	.314	.669	.639	.314	.669	.639
	Compulsory need for treatment	1.982	.754	.009	1.955	.750	.009	1.928	.749	.010	1.928	.749	.010
Wealth indicator (quintiles) – birth	1 (lowest)-ref	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-.614	.670	.359	-.522	.680	.443	-.520	.671	.439
	3	-	-	-	.310	.654	.636	.377	.664	.570	.388	.657	.555
	4	-	-	-	1.240	.673	.066	1.289	.684	.060	1.384	.676	.041
	5 (highest)	-	-	-	-.043	.737	.953	.299	.753	.692	.457	.753	.544
Maternal schooling (years at childbirth)	0-4 -ref	-	-	-	-	-	-	-	-	-	-	-	-
	5-8	-	-	-	-.057	.687	.934	-.268	.704	.703	.069	.698	.922
Sex	Male	-	-	-	.279	.435	.522	.233	.443	.599	.226	.440	.608
	Female-ref	-	-	-	-	-	-	-	-	-	-		-
		-	-	-	-	-	-	.145	.055	.009	.123	.055	.025
ECOHIS	1-4	-	-	-	-	-	-	-	-	-	1.078	.528	.041
	≥ 5	-	-	-	-	-	-	-	-	-	3.184	.685	.000
Plaque	No -ref	-	-	-	-	-	-	-	-	-	-	-	-
	Yes	-	-	-	-	-	-	-	-	-	.924	.550	.093
Orthodontic treatment	Yes - ref	-	-	-	-	-	-	-	-	-	-	-	-
	No	-	-	-	-	-	-	-	-	-	-1.310	.993	.188
	Never had	-	-	-	-	-	-	-	-	-	-.749	.455	.100

maternal schooling, sex, DMFS, ECOHIS, plaque and orthodontic treatment according to CPQ (as a dependent variable) in adolescent's age 12 years.

*OT = Orthodontic Treatment; Model 1: Dental Aesthetic Index (DAI); Model 2: DAI, income, maternal schooling and sex; Model 3 : DAI, income, maternal schooling, sex and ECOHIS; Model 4: DAI, income, maternal schooling, sex, ECOHIS, Decay Missing and Filled surfaces of teeth (DMFS), Dental condition (Plaque) and Orthodontic treatment

Chapter – 4

Final Considerations

This chapter summarize the findings of this study, its limitations, and implications for future research studies.

In the literature, there were a lot of evidence available which reported association between impact of malocclusion and OHRQoL.

There was an association between dental conditions affecting the teeth and overall oral health related quality of life (OHRQoL). The socio-economic status and the schooling level of maternal mothers of participants did show a positive relationship between malocclusion and OHRQoL which in turn was affecting overall quality of life of an individual.

The paper presented on chapter 4 showed that only the presence of dental plaque was associated with the DAI index, with the prevalence of severe malocclusion higher among those with plaque (11.2%) than without plaque (6.1%). It was identified higher the wealth indicator (16.7%) the less negative was the impact on QoL and this association was observed in both ages, at 5 years (p=.003) and 12 years (p=.022) of age. Maternal schooling was inversely associated with the QoL at 12 years of age and most mothers had between 5 and 8 years of schooling (40.8%) and approximately 10% (9.9%) of the mothers did attend school after 12 years. Finally, after adjusting for all the covariates, the CPQ is 1.9 units higher among those with severe DAI, and there was similar CPQ among the others. Mixed findings were observed regarding the type and severity level of association between malocclusion and OHRQoL.

General discussion

In the secondary analysis of the current study there was significant association between malocclusion and OHRQoL among school children adolescents in Brazil after adjustment for income, maternal schooling, sex, DMFS, ECOHIS, dental condition (plaque) and orthodontic treatment. However, dental plaque was associated with the DAI index, with the prevalence of severe malocclusion higher among those with plaque (11.2%) than without plaque (6.1%). Furthermore, socioeconomic status and maternal schooling level is significantly associated with overall quality of life.

This study investigated the impact of malocclusion on daily events among schoolchildren adolescents in a population-based birth cohort from Pelotas in Southern Brazil, using a secondary analysis of the data available. In my current study Oral Health Related Quality of Life (OHRQoL) is affected by oral health conditions like plaque. Dental caries was also the most frequently associated in impacting OHRQoL which was observed in North Carolina(72). The mentioned study investigated using a different set of data and different measures were used to identify the OHRQoL, than those investigated in my study which may explain the differences in results obtained.

Among all the variables investigated in this study only those related to the cohort participants ECOHIS, dental plaque, DMFS and completed orthodontic treatment were associated with DAI in adolescence. Level of education of maternal mothers is an important marker; higher education level is one of the best predictors of better education level and lesser impact on OHRQoL(6). In the field of oral health, it is always believed that maternal schooling, income levels and other dental conditions are associated with over-all quality of life among children and adolescent's(73).

There is lack of studies that address the relationship between maternal schooling, income level, dental conditions among children and adolescent's oral health.

Dental caries in both children and adolescents was associated with DAI. As per the results, dental plaque was associated with QoL. Teeth affected with dental plaque was significant factor affecting OHRQoL among adolescent's.
Income, maternal schooling, gender, dental condition and orthodontic treatment needs on DAI has been investigated(74, 75-77). In the above-mentioned studies, poor oral health related quality of life was observed among school going children and adolescents. Our study results confirm that wealth indicator and maternal schooling play an important role over individual QoL. Unlike the other studies, we statistically adjusted for all the covariates like the CPQ being 1.9 units higher among those with severe DAI and there was similar CPQ among the others.

In conclusion, the impact of malocclusion on daily events among adolescents in Brazilian adolescent's was a common finding in our study. Some other important variables like periodontal status, schooling of the family head that possibly act during the childhood which might be affecting the QoL were not included in our present study. These findings may not only contribute immensely to the literature but may also furnish researchers and epidemiologists with information vital for orthodontic treatment and useful to identify the community needs and help in the implementation of treatment plan. Further studies need to be developed to clarify the most complex relationship between impact of malocclusion on QoL.

Chapter – 5

References

1. The World Health Organization Quality of Life assessment (WHOQOL): position paper from the World Health Organization. Social science & medicine (1982). 1995;41(10):1403-9.
2. Liccardo D, Cannavo A, Spagnuolo G, Ferrara N, Cittadini A, Rengo C, et al. Periodontal Disease: A Risk Factor for Diabetes and Cardiovascular Disease. Int J Mol Sci. 2019;20(6).
3. Poskerova H, Linhartova PB, Holla LI. Oral diseases in diabetic patients. Vnitr Lek. 2019;65(4):314-20.
4. Benrachadi L, Mohamed Saleh Z, Bouziane A. [The impact of periodontal therapy on the diabetes control: A systematic review]. Presse Med. 2019;48(1 Pt 1):4-18.
5. Hescot P. The New Definition of Oral Health and Relationship between Oral Health and Quality of Life. Chin J Dent Res. 2017;20(4):189-92.
6. Chaffee BW, Rodrigues PH, Kramer PF, Vitolo MR, Feldens CA. Oral health-related quality-of-life scores differ by socioeconomic status and caries experience. Community dentistry and oral epidemiology. 2017;45(3):216-24.
7. Vares E, Popov VI. [State of the oral cavity in persons assigned to the Yessentuki health resort]. Stomatologiia (Mosk). 1977;56(6):84-5.
8. Bialoszewska K, Lazarewicz M, Swieczkowski D, Cwalina N, Merks P, Bialoszewski A, et al. The state of the health of the oral cavity and health behaviors. Wiad Lek. 2018;71(7):1354-9.
9. A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. Br Dent J. 2017;223(3):203.
10. Dolan TA, Mulligan R, Berkey D, Saunders MJ. Enhancing the oral health of older adults: recommendations for action. Spec Care Dentist. 1996;16(6):229-36.
11. Boyd LD, Palmer C, Dwyer JT. Managing oral health related nutrition issues of high risk infants and children. The Journal of clinical pediatric dentistry. 1998;23(1):31-6.
12. Hawkins RJ, Zanetti DL, Main PA, Jokovic A, Dwyer JJ, Otchere DF, et al. Oral hygiene knowledge of high-risk Grade One children: an evaluation of two methods of dental health education. Community dentistry and oral epidemiology. 2000;28(5):336-43.
13. Gilchrist F, Rodd H, Deery C, Marshman Z. Assessment of the quality of measures of child oral health-related quality of life. BMC Oral Health. 2014;14:40-.
14. Kumar S, Kroon J, Lalloo R. A systematic review of the impact of parental socio-economic status and home environment characteristics on children's oral health related quality of life. Health and quality of life outcomes. 2014;12:41-.
15. Alsumait A, ElSalhy M, Raine K, Cor K, Gokiert R, Al-Mutawa S, et al. Impact of dental health on children's oral health-related quality of life: a cross-sectional study. Health and quality of life outcomes. 2015;13:98.
16. Johansson G, Ostberg A-L. Oral health-related quality of life in Swedish young adults. Int J Qual Stud Health Well-being. 2015;10:27125-.
17. Ukra A, Foster Page LA, Thomson WM, Farella M, Tawse Smith A, Beck V. Impact of malocclusion on quality of life among New Zealand adolescents. N Z Dent J. 2013;109(1):18-23.

18. Masood Y, Masood M, Zainul NN, Araby NB, Hussain SF, Newton T. Impact of malocclusion on oral health related quality of life in young people. Health Qual Life Outcomes. 2013;11:25.
19. Rothman ML, Beltran P, Cappelleri JC, Lipscomb J, Teschendorf B; Mayo/FDA Patient-Reported Outcomes Consensus Meeting Group. Patient-reported outcomes: conceptual issues. Value Health. 2007;10 Suppl 2:S66-S75.
20. Locker D, Allen F. What do measures of 'oral health-related quality of life' measure?. Community Dent Oral Epidemiol. 2007;35(6):401-411.
21. Sanders AE, Spencer AJ, Slade GD. Evaluating the role of dental behaviour in oral health inequalities. Community Dent Oral Epidemiol. 2006;34(1):71-79.
22. Pahel BT, Rozier RG, Slade GD. Parental perceptions of children's oral health: the Early Childhood Oral Health Impact Scale (ECOHIS). Health Qual Life Outcomes. 2007;5:6.
23. Dini EL, McGrath C, Bedi R. An evaluation of the oral health quality of life (OHQoL) instrument in a Brazilian population. Community Dent Health. 2003;20(1):40-44.
24. Adulyanon S, Vourapukjaru J, Sheiham A. Oral impacts affecting daily performance in a low dental disease Thai population. Community Dent Oral Epidemiol. 1996;24(6):385-389.
25. Leao A, Sheiham A. The development of a socio-dental measure of dental impacts on daily living. Community Dent Health. 1996;13(1):22-26.
26. Locker D, Miller Y. Subjectively reported oral health status in an adult population. Community Dent Oral Epidemiol. 1994;22(6):425-430.
27. Hunt RJ, Slade GD, Strauss RP. Differences between racial groups in the impact of oral disorders among older adults in North Carolina. J Public Health Dent. 1995;55(4):205-209.
28. Atchison KA, Dolan TA. Development of the Geriatric Oral Health Assessment Index. J Dent Educ. 1990;54(11):680-687.
29. Abreu LG, Melgaço CA, Abreu MH, Lages EM, Paiva SM. Effect of malocclusion among adolescents on family quality of life. Eur Arch Paediatr Dent. 2015;16(4):357-363.
30. Basha S, Mohamed RN, Swamy HS, Parameshwarappa P. Untreated Gross Dental Malocclusion in Adolescents: Psychological Impact and Effect on Academic Performance in School. Oral Health Prev Dent. 2016;14(1):63-69.
31. Tang EL, Wei SH. Recording and measuring malocclusion: a review of the literature. Am J Orthod Dentofacial Orthop. 1993;103(4):344-351.
32. Kok YV, Mageson P, Harradine NW, Sprod AJ. Comparing a quality of life measure and the Aesthetic Component of the Index of Orthodontic Treatment Need (IOTN) in assessing orthodontic treatment need and concern. J Orthod. 2004;31(4):312-301.
33. Manzanera D, Montiel-Company JM, Almerich-Silla JM, Gandía JL. Diagnostic agreement in the assessment of orthodontic treatment need using the Dental Aesthetic Index and the Index of Orthodontic Treatment Need. Eur J Orthod. 2010;32(2):193-198.
34. Bittencourt JM, Martins LP, Bendo CB, Vale MP, Paiva SM. Negative effect of malocclusion on the emotional and social well-being of Brazilian adolescents: a population-based study. Eur J Orthod. 2017;39(6):628-633.
35. Abreu LG, Melgaco CA, Abreu MH, Lages EM, Paiva SM. Perception of parents and caregivers regarding the impact of malocclusion on adolescents' quality of life: a cross-sectional study. Dental Press J Orthod. 2016;21(6):74-81.
36. Sheldon GH. Psychological factors in the etiology of malocclusion. N Y State Dent J. 1969;35(5):277-284.
37. Grippaudo C, Paolantonio EG, Antonini G, Saulle R, La Torre G, Deli R. Association between oral habits, mouth breathing and malocclusion. Acta Otorhinolaryngol Ital. 2016;36(5):386-394.

38. Behbehani F, Artun J, Al-Jame B, Kerosuo H. Prevalence and severity of malocclusion in adolescent Kuwaitis. Med Princ Pract. 2005;14(6):390-395.
39. Alhammadi MS, Halboub E, Fayed MS, Labib A, El-Saaidi C. Global distribution of malocclusion traits: A systematic review [published correction appears in Dental Press J Orthod. 2019 Aug 01;24(3):113]. Dental Press J Orthod. 2018;23(6):40.e1-40.e10.
40. Dabone C, Delisle HF, Receveur O. Poor nutritional status of schoolchildren in urban and peri-urban areas of Ouagadougou (Burkina Faso). Nutr J. 2011;10:34.
41. 74th Congress of the Italian Society of Pediatrics : Rome, Italy. 12-16 June 2018. Ital J Pediatr. 2018;44(Suppl 3):149.
42. Bilgic F, Gelgor IE, Celebi AA. Malocclusion prevalence and orthodontic treatment need in central Anatolian adolescents compared to European and other nations' adolescents. Dental Press J Orthod. 2015;20(6):75-81.
43. Gaçe E PH, Dulli R. Malocclusions and dental anomalies in Albanian children with disabilities. Alban Med J 2015;3:34-42.
44. Bhardwaj VK, Veeresha KL, Sharma KR. Prevalence of malocclusion and orthodontic treatment needs among 16 and 17 year-old school-going children in Shimla city, Himachal Pradesh. Indian J Dent Res. 2011;22(4):556-560.
45. Behbehani F, Artun J, Al-Jame B, Kerosuo H. Prevalence and severity of malocclusion in adolescent Kuwaitis. Med Princ Pract. 2005;14(6):390-395.
46. Onyeaso CO. Prevalence of malocclusion among adolescents in Ibadan, Nigeria. Am J Orthod Dentofacial Orthop. 2004;126(5):604-607.
47. Gaikwad SS, Gheware A, Kamatagi L, Pasumarthy S, Pawar V, Fatangare M. Dental caries and its relationship to malocclusion in permanent dentition among 12-15 year old school going children. J Int Oral Health. 2014;6(5):27-30.
48. Ashari A, Mohamed AM. Relationship of the Dental Aesthetic Index to the oral health-related quality of life. Angle Orthod. 2016;86(2):337-342.
49. Dimberg L, Arnrup K, Bondemark L. The impact of malocclusion on the quality of life among children and adolescents: a systematic review of quantitative studies. Eur J Orthod. 2015;37(3):238-247.
50. Alajlan SS, Alsaleh MK, Alshammari AF, Alharbi SM, Alshammari AK, Alshammari RR. The prevalence of malocclusion and orthodontic treatment need of school children in Northern Saudi Arabia. J Orthod Sci. 2019;8:10.
51. Sun L, Wong HM, McGrath CPJ. The factors that influence oral health-related quality of life in 15-year-old children. Health Qual Life Outcomes. 2018;16(1):19.
52. Claudino D, Traebert J. Malocclusion, dental aesthetic self-perception and quality of life in a 18 to 21 year-old population: a cross section study. BMC Oral Health. 2013;13:3.
53. Oliveira DC, Ferreira FM, Morosini Ide A, Torres-Pereira CC, Martins Paiva S, Fraiz FC. Impact of Oral Health Status on the Oral Health-Related Quality of Life of Brazilian Male Incarcerated Adolescents. Oral Health Prev Dent. 2015;13(5):417-425.
54. Kragt L, Dhamo B, Wolvius EB, Ongkosuwito EM. The impact of malocclusions on oral health-related quality of life in children-a systematic review and meta-analysis. Clin Oral Investig. 2016;20(8):1881-1894.
55. Andiappan M, Gao W, Bernabé E, Kandala NB, Donaldson AN. Malocclusion, orthodontic treatment, and the Oral Health Impact Profile (OHIP-14): Systematic review and meta-analysis. Angle Orthod. 2015;85(3):493-500.
56. Araki M, Yasuda Y, Ogawa T, et al. Associations between Malocclusion and Oral Health-Related Quality of Life among Mongolian Adolescents. Int J Environ Res Public Health. 2017;14(8):902.

57. Siluvai S, Kshetrimayum N, Reddy CV, Siddanna S, Manjunath M, Rudraswamy S. Malocclusion and related quality of life among 13- to 19-year-old students in Mysore City - a cross-sectional study. Oral Health Prev Dent. 2015;13(2):135-141.
58. Masood Y, Masood M, Zainul NNB, Araby N, Hussain SF, Newton T. Impact of malocclusion on oral health related quality of life in young people. Health Qual Life Outcomes . 2013;11:25.
59. Kaur P, Singh S, Mathur A, et al. Impact of Dental Disorders and its Influence on Self Esteem Levels among Adolescents. J Clin Diagn Res. 2017;11(4):ZC05-ZC08.
60. Olivieri A, Ferro R, Benacchio L, Besostri A, Stellini E. Validity of Italian version of the Child Perceptions Questionnaire (CPQ11-14). BMC Oral Health. 2013;13:55.
61. Kavaliauskiene A, Sidlauskas A, Zaborskis A. Relationship Between Orthodontic Treatment Need and Oral Health-Related Quality of Life among 11–18-Year-Old Adolescents in Lithuania. Int J Environ Res Public Health. 2018;15(5):1012.
62. Peres MA, Barros AJ, Peres KG, et al. Oral health follow-up studies in the 1993 Pelotas (Brazil) birth cohort study: methodology and principal results. Every Public Health. 2010;26(10):1990-1999.
63. Peres KG, Peres MA, Demarco FF, Tarquínio SB, Horta BL, Gigante DP. Oral health studies in the 1982 Pelotas (Brazil) birth cohort: methodology and principal results at 15 and 24 years of age. Every Public Health. 2011;27(8):1569-1580.
64. Tan, Jo-Pei & Rumaya, Juhari & Yaacob, Siti. (2012). Malaysian Adolescents' Life Satisfaction. Archives of Science -Geneve.65. 1661-464.
65. Santos IS, Barros AJ, Matijasevich A, Domingues MR, Barros FC, Victora CG. Cohort profile: the 2004 Pelotas (Brazil) birth cohort study. Int J Epidemiol. 2011;40(6):1461-1468.
66. Victora CG, Barros FC. Cohort profile: the 1982 Pelotas (Brazil) birth cohort study. Int J Epidemiol. 2006;35(2):237-242.
67. Jaber MA. Dental caries experience, oral health status and treatment needs of dental patients with autism. J Appl Oral Sci. 2011;19(3):212-217.
68. de Silva AM, Hegde S, Akudo Nwagbara B, et al. Community-based population-level interventions for promoting child oral health. Cochrane Database Syst Rev. 2016;9(9):CD009837.
69. Ashari A, Mohamed AM. Relationship of the Dental Aesthetic Index to the oral health-related quality of life. Angle Orthod. 2016;86(2):337-342.
70. Barros AJ, Victora CG. [A nationwide wealth score based on the 2000 Brazilian demographic census]. Rev Public Health. 2005;39(4):523-529.
71. Aggarwal VP, Mathur A, Dileep CL, Batra M, Makkar DK. Impact of sociodemographic attributes and dental caries on quality of life of intellectual disabled children using ECOHIS. Int J Health Sci (Qassim). 2016;10(4):480-90.
72. Onoriobe U, Rozier RG, Cantrell J, King RS. Effects of enamel fluorosis and dental caries on quality of life. J Dent Res. 2014;93(10):972-979.
73. Peres KG, Peres MA, Araujo CL, Menezes AM, Hallal PC. Social and dental status along the life course and oral health impacts in adolescents: a population-based birth cohort. Health Qual Life Outcomes. 2009;7:95.
74. Scapini A, Feldens CA, Ardenghi TM, Kramer PF. Malocclusion impacts adolescents' oral health-related quality of life. The Angle orthodontist. 2013;83(3):512-8.
75. Carvalho FSd, Carvalho CAPd, Sales-Peres A, Bastos JRdM, Sales-Peres SHdC. Epidemiology of malocclusion in children and adolescents: a critic review. Revista Gaúcha de Odontologia. 2014;62(3):253-60.

76. Peres KG, Cascaes AM, Leao AT, Cortes MI, Vettore MV. Sociodemographic and clinical aspects of quality of life related to oral health in adolescents. Rev Public Health. 2013;47 Suppl 3:19-28.
77. Anosike AN, Sanu OO, da Costa OO. Malocclusion and its impact on quality of life of school children in Nigeria. West Afr J Med. 2010;29(6):417-24.

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Appendices

1. ECOHIS Questionnaire

(The Early Childhood Oral Health Impact Scale ECOHIS)

Response options: 1. Never, 2. Hardly ever, 3. Occasionally, 4.Often, 5. Very often and 6. Don't know.

a) How often has your child had pain in teeth, mouth or jaws? (Child symptoms domain)

How often has your child …….. because of dental problems or dental treatments (Child function domain)

b) Had difficulty drinking hot or cold beverages

c) Had difficulty eating some foods

d) Had difficulty pronouncing any words

e) Missed preschool, day care, or school

How often has your child ……because of dental problems or dental treatments (Child psychological domain)

f) Had trouble sleeping

g) Been irritated or frustrated

How often has your child …because of dental problems or dental treatments (Child social interaction domain)

h) Avoided smiling or laughing when around the children

i) Avoided talking with other children

How often have you or another family member ….because of your child's dental problems or dental treatments (Parent distress domain)

j) Been upset

k) Felt guilty

How often……. (Family function domain)

l) Have you or another family member taken time off from work because of your child's dental problem or dental treatments

m) Has your child had dental problems or dental treatments that had a financial impact on your family?

2. CPQ_{11-14} questionnaire

a) In the past3 months, how often have you …… (had/been)… because of your teeth/mouth?

- Pain in teeth/mouth
- Bad breath
- Mouth sores
- Food caught between teeth
- Difficulty chewing firm foods
- Difficulty saying words
- Taken longer to eat a meal
- Upset
- Felt irritable/frustrated
- Felt shy
- Concerned what people think about your mouth/teeth
- Teased/called names
- Avoided smiling/laughing
- Argued with children/family

3. Pelotas questionnaire (2004) at 5 years of age

Block A – Opinions

Response options: 1. Agree, 2. Disagree or 3. Don't know.

a) It is very stressful to say no to child when she wants to eat sweet?

b) I can't get child to brush his/her teeth at least twice a day?

c) I feel that I am able to brush the child teeth?

d) I don't have time to brush child teeth twice a day?

e) I control the number of times the child eats food/drinks between meals?

f) It is worth giving candies/cookies for the child when he/she behaves well?

Block B – Identification

a) Does the child go to school/day care?

b) What year/ class is the child attending? E.g.: Pre or First or 1st year.

c) What is the name of the school/day care that child frequents?

d) Gender of the child: observe and note;

e) Child's skin colour: observe and note;

f) In terms of skin colour or race, what is the option that applies the child?

g) Comparing with children the same age as child, do you consider the health of his/her mouth and teeth to be:

Block c – The child and his teeth

Response options: 1. Straight tap water, 2. Filtered tap water/filter, 3. Mineral water,

4. Well water, 5. Another, 6. Does not drink water (NSA) and 7. IGN.

a) Where does the water that the child usually drinks in preparing juice/teas?

b) What water is used to cook the food that child eats?

c) Have you ever received guidance on how to prevent people from?

d) Who guided you?

e) What guidance have you received?

f) Did the child brushed their teeth/ someone used to brush their teeth?

Some parents brush their children's teeth, others just help, there are also some children who brush their teeth alone and others who do not brush their teeth.

g) Could you tell me how it happened from birth until today with the child?

Age: Initial and final age in months

Who brush/brush: 0 – no brush/clean, 1- alone, 2- receives help from an adult, 3- brushing is an adult, 8- NSA, 9- IGN

Folder use: 0 – no, 1 – yes, 2 – sometimes, 8 – NSA, 9 – IGN.

Folder type: 0 – common folder, 1 – fluoride free paste, 2 – folder with little fluoride, 8 – NSA, 9 – IGN.

h) Could you point out to me on this card what amount of paste more similar that child usual use?

i) What option best describes how the child brush their teeth these days?

j) In general how many times in a day does the child brush his teeth?

k) Does the child brush his/her teeth before going to sleep?

l) Does the child use floss/mouth wash fluids when brushing his/her teeth?

BLOCK D - FEEDING HABITS AND DENTIST CONSULTATION

27. Does the <child> take or take a bottle at night before sleeping with milk, teas or juice?

Read the alternatives

If (0) skip to question 31 If (2) skip to question 29

If (9) skip to question 31

[D01]

Never took 0 Yes, but already stopped 1 Yes, still takes 2 IGN 9

28. How old were you? ___months [D02] __ (8) NSA (9) Ignored

29. At what age did you start taking it? ___months [D03] __ (8) NSA (9) Ignored

30. Did this bottle contain sugar, thickeners or chocolate milk?

never 0 sometimes 1 always 2 NSA 8 IGN 9

31. How many times a day does the <child> eat sweet food between meals?

Ex: stuffed cookies, candies, lollipops, chewing gum, chocolates, etc.

Read the alternatives

[D05]

never eat 0 less than once a day 1 once a day 2 twice a day 3 three times a day or more 4 NOS 8 IGN 9

32. How many times a day does the <child> drink sweet drinks like sweetened juices or soft drinks between meals?

Read the alternatives

[D06]

never take 0 less than once a day 1 once a day 2 twice a day 3 three times a day or more 4 NOS 8 IGN 9

33. Has the <child> ever consulted the dentist? If (0) skip to question 40

If (9) skip to question 40

[D07]

No 0 Yes 1 IGN 9

34. How old was the <child> when you went to the dentist for [D08] __ __ months first time? (88) NSA (99) IGN

35. What was the main reason for this consultation?

(18) Others_____

[D09]

Routine consultation / maintenance 10 Pain 11 Broken tooth / trauma 12 Cavities in teeth / caries / restoration / obturation 13 Sore, lumps or stains in the mouth 14 Swollen face 15 Removing a tooth that was soft 16 Extractions / pulling out the tooth (due to caries) 17 Others 18 NSA 88 IGN 99

36. Where was the <child> served?

Other _____

[D10]

Health Centre 0 Faculty of Dentistry 1 School that the child studies 2 Private practice 3 Agreement 4 Other 5 NSA 8 IGN 9

37. How old was the <child> the last time he went to the dentist?

If the child only went to the dentist once write down 77 and jump to 40 If it was never 88

[D11] __ __ months

38. What was the main reason for this consultation?

(10) Others_____

[D12]

Routine consultation / prevention 10 Pain 11 Broken tooth / trauma 12 Cavities in teeth / caries / restoration / obturation 13 Sore, lumps or stains in the mouth 14 Swollen face 15 Removing a tooth that was soft 16 Extractions / pulling out the tooth (due to caries) 17 Braces 18 Dental prosthesis 19 Others 20 NSA 88 IGN 99

39. Where was the <child> served?

(5) Other _____

[D13]

Health Centre 0 Faculty of Dentistry 1 School that the child studies 2 Private practice 3 Agreement 4 Other 5 NSA 8 IGN 9

40. Do you think the <child> is afraid to go to the dentist? Read the alternatives

[D14]

No 0 A little 1 Yes 2 Yes, a lot 3 IGN 9

41. Do you think that the <child> currently needs to go to the dentist?

If (0) skip to question 43 If (2) skip to question 44 If (9) skip to question 44

[D15]

No 0 Yes 1 Is being treated by a dentist 2 IGN 9

42. For what reason do you need to go to a dentist appointment?

After that question jump to 44

[D16]

Routine consultation / prevention 10 Pain 11 Broken tooth / trauma 12 Cavities in teeth / caries / restoration / obturation 13 Sore, lumps or stains in the mouth 14 Swollen face 15 Removing a tooth that was soft 16 Extractions / pulling out the tooth (due to caries) 17 Braces 18 Dental prosthesis 19 Others 20 NSA 88 IGN 99

43. For what reason do you not need to go to a dentist appointment?

(2) Other_____

[D17]

Why everything is fine with your teeth 0 Although he / she has a problem, it can wait 1 Other 2 NSA 8 IGN 9

BLOCK E - SATISFACTION AND ORAL PROBLEMS

Read to mom:

Problems with teeth, mouth and jaws (bones of the mouth) and their treatments can affect the well-being and daily life of children and their families. For each of the following questions,

please choose the answer options that best describe the <child's> experiences or your own. Consider the <child's> entire life, from birth until now, when answering each question. After each question read the options:

(1) never, (2) almost never, (3) sometimes (from time to time), (4) often, (5) very often, (9) I don't know

44. Has the <CHILD> ever felt pain in the teeth, mouth or jaws [E01] 1 2 3 4 5 9 (bones of the mouth)?

45. Has the <CHILD> ever had difficulty drinking hot or cold drinks due to problems with teeth or dental treatments?

[E02] 1 2 3 4 5 9

46. The <CHILD> has already had difficulty eating certain foods due to [E03] 1 2 3 4 5 9 problems with teeth or dental treatments

47. Has the <CHILD> ever had difficulty pronouncing (speaking) any word [E04] 1 2 3 4 5 9 due to problems with teeth or dental treatments?

48. Has the <CHILD> missed day care, kindergarten or school due to [E05] 1 2 3 4 5 9 problems with teeth or dental treatments?

49. <CHILD> has already stopped doing daily activities (eg playing,
jumping, running, etc.) due to problems with teeth or treatments [E06] 1 2 3 4 5 9 dental?

50. Has the <CHILD> ever had difficulty sleeping due to problems with [E07] 1 2 3 4 5 9 teeth or dental treatments?

51. Has the <CHILD> ever been irritated by problems with his teeth or [E08] 1 2 3 4 5 9 dental treatments?

52. Has the <CHILD> ever avoided smiling or laughing due to problems with the teeth [E09] 1 2 3 4 5 9 or dental treatments?

53. Has the <CHILD> ever avoided talking due to problems with his teeth or [E10] 1 2 3 4 5 9 dental treatments?

54. Have you or someone else in the family ever been upset because of problems [E11] 1 2 3 4 5 9 with <CHILD>> teeth or dental treatments?

55. Have you or someone else in the family ever felt guilty because of [E12] 1 2 3 4 5 9 problems with the <CHILD's> teeth or dental treatments?

56. Have you or someone else in the family missed work due to [E13] 1 2 3 4 5 9 problems with <CHILD >'s teeth or dental treatments?

57. The <CHILD> has already had problems with his teeth or had treatments

dental problems that caused a financial impact (problem, difficulty) on [E14] 1 2 3 4 5 9 your family?

58. Since the last 4 weeks, has the <child> had a toothache? [E15] No 0

If (1) skip to question 60

Yes 1 NSA 8 IGN 9

59. In the last 6 months, did the <child> have toothache? If (0) □ skip to question 63

If (8) skip to question 63

If (9) skip to question 63

[E16]

No 0 Yes 1 NSA 8 IGN 9

60. Could you show me which tooth was this pain in? (ask the mother [E17] __ __ point the tooth and write down the number of the tooth)

If the mother shows several teeth write down 77 If the mother does not know write down 99 88 NSA

61. What was the purpose of the solver?

Other _____

0 Taken to the dentist 1 Taken to the doctor 2 There was no need to do anything, as the pain passed 3 Other 4 NOS 8 IGN 9

62. Could you point out on this card which drawing represents [E19] __ better the pain that the <child> felt? (wait for the answer and note in the

right column) (8) NSA (9) IGN

63. Do you usually look at the <child's> mouth from the inside? [E20] Yes 0 No 1 sometimes 2 IGN 9

NOW TO FINISH, I WILL ASK A FEW QUESTIONS ABOUT YOUR ORAL HEALTH

BLOCK F - ISSUES RELATED TO THE MOTHER OR CAREGIVER

64. I am going to read a few sentences and I would like you to say which one [F01] __ best describes your consultations with the dentist: Read the

alternatives

(1) I never go to the dentist

(2) I go to the dentist when I have pain or when I have a problem with my teeth or gums.

(3) I go to the dentist sometimes, having a problem or not.

(4) I go to the dentist on a regular basis.

65. What option best describes how you brush your [F02] I never brush 0 teeth? Read the alternatives I brush, but not every day 1

If (0) skip to question 70 If (1) skip to question 67

I always brush, at least once a day 2

66. In general, how often do you brush your teeth a day? [F03] Once a day 0 Twice a day 1 Three times a day or more 2 NOS 8 IGN 9

Do you use <item> when brushing your teeth?

67. Folder

Read the alternatives

[F04]

Never 0 Sometimes 1 Always 2 NSA 8 IGN 9

68. Floss

Read the alternatives

[F05]

Never 0 Sometimes 1 Always 2 NSA 8 IGN 9

69. Mouthwash fluids

Read the alternatives

[F06]

Never 0 Sometimes 1 Always 2 NSA 8 IGN 9

70. Comparing to people your age, you consider the health of your teeth, mouth and gums:

Read the alternatives

[F07]

very good 0 good 1 regular 2 bad 3 very bad 4 IGN 9

71. Could you point out how the health of your teeth, mouth and [F08] __ __ gums influences your life? 1 (one) means influence

very bad and 10 (ten) very good influence (dial the number at

right)

72. Are you afraid to go to the dentist?

Read the alternatives

[F09]

No 0 A little 1 Yes 2 Yes, a lot 3 IGN 9

73. Remembering your top teeth, you have: [F10] 10 natural teeth or more 0

Read the alternatives

Less than 10 natural teeth 1 No natural teeth 2 IGN 9

74. Remembering your lower teeth, you have: [F11] 10 natural teeth or more 0

Read the alternatives

Less than 10 natural teeth 1 No natural teeth 2 IGN 9

75. Has any dentist ever said that you have or have had cavities? [F12] No 0 Yes 1 NSA 8

1. The Early Childhood Oral Health Impact Scale (ECOHIS)

Response options: 1. Never, 2. Hardly ever, 3. Occasionally, 4. Often, 5. Very often and 6. Don't know.

1. How often has your child had pain in the teeth, mouth or jaws? *(Child symptoms domain)*

How often has your child.....because of dental problems or dental treatments? *(Child function domain)*

2. had difficulty drinking hot or cold beverages

3. had difficulty eating some foods

4. had difficulty pronouncing any words

5. missed preschool, day care or school

How often has your child.....because of dental problems or dental treatments? *(Child psychological domain)*

6. had trouble sleeping

7. been irritable or frustrated

How often as your child.....because of dental problems or dental treatments? *(Child self-image/social interaction domain)*

8. avoided smiling or laughing when around other children

9. avoided talking with other children

How often have you or another family member.....because of your child's dental problems or dental treatments? *(Parent distress domain)* 10. been upset

11. felt guilty

How often.... *(Family function domain)*

12. have you or another family member taken time off from work .....because of your child's

dental problems or dental treatments 13. has your child had dental problems or dental treatments that had a financial impact on your family?