

Individual and Contextual Aspects Associated with Malocclusion in Brazilian Adolescents

Brizon VSC¹, Rojas GCS¹, Paz DDS¹, Ambrosano GMB¹, Pereira AC¹, Gomes VE² and Oliveira AC²

¹Department of Community Dentistry, Piracicaba Dental School, State University of Campinas, São Paulo, Brazil

²Department of Social and Preventive Dentistry, Faculty of Dentistry, Federal University of Minas Gerais, Minas Gerais, Brazil

*Corresponding author: Rojas GCS, Department of Community Dentistry, Piracicaba Dental School, State University of Campinas, São Paulo, Brazil, Tel: +51986772119, E-mail: christieli@yahoo.es

Citation: Brizon VSC, Rojas GCS, Paz DDS, Ambrosano GMB, Pereira AC, et al. (2018) Individual and Contextual Aspects Associated with Malocclusion in Brazilian Adolescents. *J Dent Oral Care Med* 4(1): 103. doi: 10.15744/2454-3276.4.103

Received Date: January 11, 2018 **Accepted Date:** May 26, 2018 **Published Date:** May 28, 2018

Abstract

Aim: To verify the individual and contextual aspects associated with malocclusion in Brazilian adolescents.

Methods: Analytical cross-sectional study using data from the SB Brazil 2010. The dependent variable was malocclusion (absent, set, severe, very severe). Independent variables were classified into: individual (socio-demographic, oral health problems; education, utilization of dental services; self-perception, impact on activities) and contextual (Family Financial Grant, National Health System Development Index (IDSUS), Human Development Index (HDI) and interaction of Gross National Product (GNP) with fluoridated water). A multilevel analysis was executed.

Results: In total 5,445 adolescents were evaluated. In Model 1, there was significant variation in malocclusion between the cities ($p=0.008$). In Model 2, the adolescents who showed a high severity of malocclusion had lower income ($p=0.010$), less satisfaction with mouth and teeth ($p<0.001$), difficulty with speaking ($p=0.036$) and were ashamed to smile ($p<0.001$). In Model 3, the contextual variables were included and severity of malocclusion was observed to be identified in cities where there were more families that received Family Grant benefits ($p=0.001$), and lower interaction of GDP with fluoridated water ($p=0.016$).

Conclusion: Malocclusions were positively associated with individual and contextual variables, and offered parameters for planning oral health policies.

Keywords: Dental Health Surveys; Malocclusion; Adolescent; Brazil; Multilevel Analysis; Oral Health

Introduction

According to the World Health Organization (WHO), malocclusions are considered the dental public health problem ranked third according to the scale of priorities, exceeded only by caries and periodontal diseases [1-6]. This became clear when the Brazilian Ministry of Health, by means of Ministerial Administrative Ruling No. 718/SAS of 20/12/2010, began to finance specialized procedures in Orthodontics [5]. The results of the latest epidemiologic oral health survey conducted in Brazil showed a reduction in the levels of malocclusion in the age-range from 15 to 19 years (18.3%), ranging from 53.2% in 2004 to 38.8% in 2010 [1,2].

Occlusal problems may cause a negative impact on adolescents' quality of life due to compromising esthetics and harming speech and mastication. Problems of a psychological nature, such as social isolation, low self-esteem, difficulty with finding a job, and embarrassment were also associated with conditions of severe malocclusion [7].

This makes it important to approach the issues of adolescents from a psychosocial point of view, and to understand them as the result of the interaction of biological, mental and social developmental processes, socioeconomic conditions and cultural influences [8].

There are many orthodontic indices that combine physical and visual elements to provide a measure of the extent of a malocclusion. The Dental Aesthetic Index (DAI) assesses clinical and aesthetic components mathematically to produce a single score [9]. The DAI defines criteria for evaluating dentofacial anomalies including teeth, crowding, spacing, overjet, reverse overjet, open bite and molar ratio [10]. The DAI scoring system has been recommended by WHO to study orthodontic malocclusions in various communities and cultures, and it can be used by dentists and / or dental assistants [9]. It helps in making decisions about where to allocate government resources for the treatment of malocclusion [11].

There are some indicators of health and social factors that may contribute to a better identification of vulnerable groups /people. These indicators - called contextual variables - are important to detect the possible variability of the disease in the region or group in which the individual lives. In order to evaluate health services, the index for the evaluation of the Brazilian National Health Service Performance (*Índice de Avaliação de Desempenho do Sistema Único de Saúde-IDSUS*) was created. In the index in question, scores from zero to ten are attributed, with the lowest scores being identified in the worst performances of the National Health Service (*Sistema Único de Saúde-SUS*) in the municipalities, states and in Brazil [12].

Another indicator that allows information from the various social domains to be combined to give a more realistic view of the economic, cultural and social situation of a country is the Human Development Index (HDI). This is a comparative measure used to classify countries by their degree of “human development” and to separate developed (very high human development), developing (medium and high human development) and underdeveloped (low human development) countries and can be used for specific areas [13].

The “*Bolsa Família*” (Family Grant) Program today constitutes the major policy of conditional income transfer in Brazil. The program goal is to provide cash assistance to homes in a situation of poverty and extreme poverty [14]. Based on the guarantee of income, productive inclusion in and access to public services, the program is focused on the activities of 16 million Brazilians (around 8.5% of the general population) with a monthly family per capita income of under US\$35. Although it is not a specific indicator, the percentage of persons benefited by the program in a city, becomes an important datum of social vulnerability.

The assessment of oral health through epidemiological surveys has two main objectives: to evaluate the need for and priority of treatment; and to obtain information to formulate adequate planning of the resources required to provide treatment for the population [2]. In view of the foregoing discourse, the aim of the present study was to verify the individual and contextual aspects associated with malocclusion in Brazilian adolescents from 15 to 19 years of age.

Material and Methods

Ethical considerations

The Brazilian Oral Health Project was submitted to and approved by the National Ethics Council on Research in Human Beings under Protocol 15,498. The term of informed consent was obtained from all individuals who participated in the study [2].

Type of Study

This was a cross-sectional analytical study. Data from Epidemiological Survey of the Oral Health Conditions of the Brazilian Population denominated “*SB Brasil 2010*” were used [2].

Study Population

Brazil has a total population of 190,755,799 persons, among whom 16,990,872 are adolescents from 15 to 19 years of age [15].

National Oral Health Survey (*SB Brasil 2010*)

SB Brasil 2010 analyzed the oral health conditions of the Brazilian population in different age groups in urban and rural areas. In total, 37,519 individuals were examined in 27 State capitals and 150 municipalities in the interior of the country, with different sizes of population. The database generated in this survey is in the public domain, and there is free access to it [2].

Data Collection

Data collection was performed in dwellings, and included clinical oral exam and interviews through a structured questionnaire. Dental teams were composed of: a dental surgeon examiner, who used instruments (oral mirror and periodontal probe) recommended by the WHO, and an assistant note taker, who collected the clinical data [10].

Criteria used for malocclusion classification

Malocclusion was classified by means of the Dental Aesthetic Index (DAI). The basic principle of the DAI is a combination of measures (not only of occlusal problems), which in conjunction, as a set, express the individual’s occlusal status and his/her respective need for orthodontic treatment. The composition of the index considers not only occlusion, but esthetic compromise as well [9].

Sample Calculation

The sampling technique used by the survey was probabilistic through conglomerates. For the age-range from 15 to 19 years, three stratifications were used.

The first used domains and primary sampling units: capitals and municipalities in the interior of the country according to macroregion. The second consisted of subdividing the participating municipalities into: 27 capitals plus 30 municipalities in the

interior of each region. The third was determined by lottery to guarantee representativeness in the municipalities, census sectors and domiciles [2]. Of the total of 7012 selected adolescents in the age-range from 15 to 19 years, 5445 of them were effectively investigated, indicating a sampling loss of 22.3%. To calculate the sample size, the parameters used (value of z, variance, mean DMFT, acceptable margin of error (AME), effect of design and non reply rate) were those found in SB Brasil 2003 [1].

Calibration

The field teams were duly trained in workshops with duration of 20 hours. The capitals had 10 field teams and the municipalities in the interior had from two to six teams, depending on population size. The calibration technique adopted was consensus, calculating the agreement between each examiner and the results obtained by consensus of the team. We calculated the weighted kappa coefficient for each examiner, age group and aspects of malocclusion studied, with the minimum acceptable value of 0.65.

Studied Variables

Dependent Variables: The study outcome was malocclusion that was categorized as absent, set, severe and very severe [9].

Independent Variables: *Individual Variables* The variables and descriptions were categorized in Table 1 (demographic; oral health problems; socioeconomic of individuals; schooling morbidity and use of dental services; self-perception and impact on health). Don't know or refused of the exam were considered exclusion criteria (Table 1).

Independent variables		Categories
Demographic	Place of exam	0= state capital; 1= other city
	Region	1= north ; 2= northeast; 3= southeast; 4= south; 5= midwest
	Age	5 to 19 years
	Sex	0= male; 1= female
	Skin color	1= white; 2= black; 3= yellow; 4= mulatto; 5= indigenous
Oral health problems	Treatment need	0= absence; 1= presence
Socioeconomic of individuals	Number of persons	number of persons belonging to the family unit
	No. of rooms	total number of rooms
	No. of assets	quantity of assets in residence
	Per capita income (US\$)	1= up to 150; 2= 151 to 250 3= 251 to 750; 4= 751 to 1,250 5= 1,251 to 2,250 6= 2,251 to 4,750 7= over 4,750
Schooling, morbidity and use of dental services	Years of schooling	total years of schooling, with passes (without failing) - varies from 0 to 15 years – did not evaluate post-graduation
	Perception of need for treatment	0= no 1= yes
	Toothache	0= no 1= yes
	Severity of pain	1 to 10 (little to a great deal of pain)
	Visit to the dentist	0= no 1= yes
	Frequency of consultation	1= less than 1 year; 2= 1 to 2 years 3 = 3 or more years
	Place of consultation	1= public service ; 2= private service 3= health insurance/ agreements; 4= others
Self-perception and Impact on health	Reason for consultation	1= revision/prevention; 2= pain 3= extraction ; 4=treatment 5= others
	Satisfaction with teeth in the mouth	1= very satisfied; 2= satisfied 3= not satisfied or dissatisfied 4= dissatisfied; 5= very dissatisfied
	Difficulty with eating; Uncomfortable when brushing; Nervousness or irritation; Influence on leisure; Influence on sports; Difficulty with speaking, Ashamed to smile; Difficulty with studying/ working, Difficulty with going to sleep	0= no 1= yes

Table 1: Independent variables and respective categories

Variables relative to cities (contextual)

For contextual characterization the HDI was used; this is a measure that gathers information about longevity, income and schooling, gauged for Brazilian municipalities, by the regional office of the United Nations Development Program in Brazil [12].

For the “*Bolsa Família*” program the number of families benefited per municipality was obtained and divided by 1000, in order to standardize and facilitate comparison with other municipalities [14].

In the *Brazilian National Health Service Performance Assessment*, the municipality received in the evaluation was used, and number of the homogeneous group in which the municipality was grouped [12].

The Gross National Product (GNP) per capita corresponded to the sum of the salaries of the entire population of the municipality, divided by the number of inhabitants [15]. Fluoridated water the data were dichotomized into municipalities with or without fluoride in the water [15].

Data Analysis

Data were analyzed by the chi-square test and multilevel model, consisting of fixed components represented by random variables and components provided by the cities and the variations at different levels [16].

Adjustments were made to the multilevel model by the PROC MIXED procedure of the SAS statistical program in accordance with the methodology described in studies of Singer, Tellez *et al.* and Help from the SAS statistical program (SAS Institute Inc. 9.2, 2008) [17,18].

The variables relative to individuals were considered at Level 1, while variables relative to the cities were included in Level 2. Behavior of the variable malocclusion (Level 1) was evaluated as a function of the predictive variables of Levels 1 and 2.

A model was initially adjusted only with the intercept (Model 1). After this, the predictive effects of the level of individuals - Model 2 and cities- Model 3 were included. In the selection of variables, the theoretical referential and correlation analysis were used to evaluate multi-collinearity.

The quality of the adjustments was evaluated by convergence of the model, AIC, AICC and statistical criteria - 2 times the logarithm of the function of verosimilarity. In all the analyses, a level of significance of 5% was used.

Results

From 01 to 402 volunteers per city, in 174 cities in Brazil were evaluated, totaling 5445 adolescents per age-range from 15 to 19 years.

The prevalence of severe and very severe malocclusion in adolescents from 15 to 19 years of age was verified and showed no statistical differences among the regions, ranging from 15.0% in the Midwestern Region to 18.3% in the Northeastern region, with a national mean of 17.7%, with the percentage of adolescents with very severe malocclusion being 9.1% (Table 2).

Region	Malocclusion				Total n (100.0%)	Valor de p
	Absent n (%)	Set n (%)	Severe n (%)	Very severe n (%)		
North	760 (60.7)	266 (21.2)	110 (8.8)	116 (9.3)	1252	0,0704*
Northeast	749 (63.3)	218 (18.4)	110 (9.3)	107 (9.0)	1184	
Southwest	501 (65.1)	129 (16.8)	56 (7.3)	83 (10.8)	769	
South	369 (66.0)	93 (16.6)	49 (8.8)	48 (8.6)	559	
Midwest	429 (67.6)	111 (17.5)	50 (7.9)	45 (7.1)	635	
Total	2808 (63.8)	817 (18.6)	375 (8.5)	399 (9.1)	4399	

*Chi-square test

Table 2: Distribution of adolescents according to prevalence and severity of malocclusion (DAI) per region

In Table 3 the different estimated multilevel models are presented. As may be observed in Model 1, the mean score of the malocclusion index in the Brazilian cities investigated was 1.64 (standard error of 0.026). Statistically significant ($p=0.008$) variation in malocclusion was observed between the cities. However, variation between adolescents within the cities was around 28 times greater than the variation between cities. The intraclass correlation indicated that the variation between the cities represented approximately 3.0% of the total variation (Table 3).

When the variables of the individual level (Model 2) were included, the adolescents who presented a higher mean of the values obtained by the DAI were found to have: lower income ($p=0.010$); reported that they consulted a dentist ($p=0.003$), affirmed less satisfaction with the mouth and teeth ($p<0.001$); difficulty with speaking ($p=0,036$); and to be ashamed of smiling ($p<0.001$). All the significant values were controlled by the other predictors of this model.

In Model 3 the variables of the second level (cities) were included in order to evaluate the influence of these in the explanation of the variability of malocclusion. The characteristics of the cities (number of families benefited by “*Bolsa Família*” per 1000 inhabitants and GNP per capita) were observed to have an influence on the severity of malocclusion. Higher mean scores of the

malocclusion index were observed in the cities in which more families were receiving the “*Bolsa Família*” per 1000 inhabitants ($p=0.001$) and lower GNP per capita ($p=0.016$). All these significant values were controlled by the significant predictive variables of the individual and of the cities.

Variables	Model 1		Model 2		Model 3	
	Only the intercept		Variables of level 1		Complete model	
	Estimate Standard- error	p-value	Estimate Standard- error	p-value	Estimate Standard-error	p-value
Level 1 (individual)						
Intercept	1.648 (0.026)	<0.001	1.297(0.074)	<0.001	1.026(0.103)	<0.001
Income (Ref¹ over 4750 dollars/year)			0.036(0.014)	0.010	0.030(0.014)	0.035
Consultation² (Ref Yes)			-0.126(0.043)	0.003	-0.135(0.043)	0.011
Satisfaction (Ref Very satisfied)			0.110(0.015)	<0.001	0.110(0.015)	<0.001
Difficulty with speaking (Ref No)			0.144(0.068)	0.036	0.142(0.068)	0.037
Ashamed to smile (Ref No)			0.331(0.049)	<0.001	0.326(0.049)	<0.001
Level 2 (Cities)						
<i>Bolsa Família</i> program³					0.001 (0.001)	0.001
GNP per capita (Ref higher GNP)					5.50 x 10 ⁻⁶ (2.30 x 10 ⁻⁶)	0.016
Variances						
Variance between cities	0.032 (0.013)	0.008	0.014(0.008)	0.032	0.011(0.001)	0.039
Variance between adolescents within city	0.926 (0.020)	<0.001	0.884(0.019)	<0.001	0.883(0.019)	<0.001

¹Ref = reference / ²Consultation= Have you ever been to a dentist?

³< n° persons/ municipalities receiving “*Bolsa Família*” program

Table 3: Multilevel models for individual and contextual variables for malocclusion (DAI) in adolescents aged 15-19 years old, Brazil, 2010

Discussion

The epidemiological transition of oral diseases has occurred in the majority of developed countries, including Brazil. This was expressed by the reduction in dental caries in children and adolescents, allowing attention to be directed to other oral problems, including the treatment of malocclusions [19,20]. According to Vedovello *et al.*, the importance of factors associated with life style and standards of family and individual behavior, has been pointed out as being decisive in the epidemiological condition of malocclusion [7].

A higher mean malocclusion score (severe and very severe) was found in adolescents that had been to the dentist. While it is important to point out that different health needs may not be completely eliminated only with the use of health services, these services may favor qualified access and reduce inequalities in health [21]. After all, those who have access to dental services, especially public services, normally presented greater need for dental care, including orthodontic treatment. Another study verified an increase in the use of dental services and a reduction in the proportion of persons who had never been to the dentist, as well a reduction in extractions and improvement in oral health [22].

In this study, adolescents with more severe malocclusion were observed to be less satisfied with the arrangement of their teeth and found it difficult to smile. Adolescents' self-perception is of fundamental importance in understanding the impact of malocclusion on their daily lives, especially with regard to functional limitations and psychosocial wellbeing, at a time when great value is being placed on physical appearance and self-esteem [23,24]. In agreement with Bhatia *et al.* (2016), who showed that malocclusion had a social and psychological impact on adolescents, causing social shame and decreased self-esteem; however, these situations were progressively reversed with orthodontic treatment in the different types of malocclusion [25].

The more severe certain types of malocclusion are, the greater will be the psychological impact caused by these problems; they almost always tend to lead to adolescents becoming caricatures in the eyes of their peers, who may provoke them with disparaging remarks. This psychological aggression may cause behavioral disturbances, personality maladjustments and influence the quality of life of these individuals [26].

The severity of the malocclusion may predict self-perception among adolescents of the need for orthodontic treatment [27]. Esthetics was the subjective reason most frequently reported by adolescents when seeking orthodontic treatment [7]. The study by Silva *et al.* (2016) demonstrated that the perception of the need for treatment was associated with the normative need for orthodontic treatment. Adolescents reported needing treatment for aesthetic reasons attributed to their culture; the clinical examination corroborated this orthodontic treatment need [27].

More severe malocclusions were verified in the adolescents who reported difficulty in speaking. According to the Leavy *et al.* (2017) in the presence of malocclusion, particularly of an open bite greater than 2mm, it may be difficult or impossible to produce certain sounds/phonemes (/T/ and /S/). When malocclusion was severe there was a greater probability of speech disorders [28].

The present study demonstrated that per capita income was inversely associated with malocclusion. The adolescents with lower income presented more severe malocclusions. As in the present study, Healey *et al.* (2015) found a significant association between higher Dental Aesthetic Index and low socioeconomic status and Zhou *et al.* (2016) associated higher prevalence of malocclusion with lower family income [29,30]. At a contextual level, the influence of variables related to the socioeconomic context was observed. The adolescents living in cities in which more families were receiving the “*Bolsa Família*” and had a lower per capita GNP, presented higher mean malocclusion values. This result was probably obtained due to the fact that not all families could afford the cost of orthodontic treatment, especially those belonging to socially vulnerable groups. According to Laothong & Cheng (2017) economic status was one of the main factors that influenced patients’ decision to seek orthodontic treatment [31]. This became particularly visible when variables connected with income, both from individual and contextual aspects, presented clear allusion to the economic aspects involved in access to services and epidemiological conditions of the problem.

It is important to point out that multilevel analysis was chosen because it was more statistically efficient for investigating interactions between individual and contextual variables, when compared with a multivariate model such as logistic regression [32]. Brazil is a country marked by inequalities in access to the use of dental services, and it is important to know about the social conditions associated with the indicators of basic oral health care, with a view to implementing public policies with the goal of promoting health and seeking equality. Over the last few decades, social inequality in health has become one of the most relevant themes in public health, both in rich countries and those with medium or low incomes [11]. Therefore, the social variables associated with the highest mean values of malocclusion have shown evidence of the importance of a conjunctural analysis in the planning of services and financing of the health sector (specifically actions and programs in oral health). It may, for example, be suggested that greater government incentives should be given to cities with lower public health structuring and with the worst vulnerability conditions for the development of actions in public health services, in accordance with the guidelines of Administrative Ruling 718 of the Ministry of Health, which deals with the financing of dental procedures in Orthodontics for the public sector [5].

Although the present study design was strong, it had some limitations. One of the weaknesses of cross-sectional studies concerns the difficulty in establishing causal relationships based on a cross-section in time, thus limiting confidence in establishing the direction of the association [33]. The study design and assessment tool used to quantify malocclusion did not identify how long the individuals surveyed had been in a condition of the disease. This information could be useful for better understanding the role of individual variables and contextual influences on malocclusion as an individual, episodic or cyclic condition. Thus, longitudinal studies are needed to enable better understanding of the association between malocclusion and individual and contextual variables. Another limitation was dental caries; it was not used in the model and could be a confounder of the study, mainly relative to the issue that evaluated whether or not the adolescents had ever been to the dentist.

In view of the importance of knowledge about the etiology of malocclusions, the need for identifying the risk indicators of the complaints was verified. For this purpose, the individual in conjunction with the contextual variables must be taken into consideration. Thus, efficient actions of promotion, prevention, recovery and rehabilitation pertinent to the abnormalities of occlusion may be planned.

Conclusion

There was significant association of malocclusion with individual variables and with the context in which the individual was inserted. Importantly, while different health needs could not be completely eliminated with the use of health services only, these services could favor qualified access and reduce health inequalities. The need for longitudinal studies is suggested, to enable a better understanding of the association between malocclusion and individual and contextual variables.

Acknowledgements

The authors of this study would like to thank the Brazilian Ministry of Health Department of Oral Health for providing data from the epidemiological survey on oral health conditions of the Brazilian population.

They thank the National Council for Scientific and Technological Development (CNPq), Ministry of Science and Technology, Brazil for funding this study; and thank the Improvement of Coordination of Higher Education Personnel (CAPES) for the sponsorship by the National Program of Academic Cooperation (PROCAD).

References

1. Health Ministry of Brazil (2004) SB Brazil 2003 Project - Oral health conditions of the Brazilian population 2002-2003. Brasília, Brazil.
2. Health Ministry of Brazil (2010) SB Brazil 2010 Project - Oral health conditions of the Brazilian population. Brasília, Brazil.
3. Vadiakas G, Oulis CJ, Tsinidou K, Mamai-Homata E, Polychronopoulou A (2011) Socio-behavioural factors influencing oral health of 12 and 15 year old Greek adolescents. A national pathfinder survey. *Eur Arch Paediatr Dent* 12: 139-45.
4. Hebling SR, Pereira AC, Hebling E, Meneghim MC (2007) Remarks on drawing up a community health orthodontic assistance protocol. *Cien Saude Colet* 12: 1067-78.
5. Brazil (2010) National Coordination of Oral Health-Ordinance No. 718 of December 20, Brazil.
6. World Health Organization (2003) The World Oral Health Report 2003, Continuous improvement of oral health in the 21st century-the approach of the WHO Global Oral Health Programme, Geneva, Switzerland.
7. Vedovello SA, Ambrosano GM, Pereira AC, Valdrighi HC, Filho MV, et al. (2016) Association between malocclusion and the contextual factors of quality of life and socioeconomic status. *Am J Orthod Dentofacial Orthop* 150: 58-63.
8. Tsakos G (2008) Combining Normative and Psychosocial perceptions for assessing Orthodontic treatment needs. *J Dent Educ* 72: 876-85.
9. Cons NC, Jenny J, Kohout FJ (1987) DAI: the dental aesthetic index. Iowa City: College of Dentistry, University of Iowa, Iowa, USA. *Am J Orthod Dentofac* 92: 521-2.
10. World Health Organization (1997) Oral Health Surveys: basic methods (4th Edn) Geneva, Switzerland.
11. Marmot M, Bell R (2016) Social inequalities in health: a proper concern of epidemiology. *Ann Epidemiol* 26: 238-40.
12. Brazil. Ministry of Health (2011) IDSUS - "Índice de Desempenho do Sistema Único de Saúde", Brazil.
13. United Nations Development Programme (UNDP) Brazilian human development atlas, Brazil.
14. Brazil. Ministry of Social Development and Hunger Alleviation (MSD) Program "Bolsa Família", Brazil.
15. Brazilian Institute of Geography and Statistics (IBGE), Brazil.
16. Zanini RR, Moraes AB, Giugliani ER, Riboldi J (2011) Contextual determinants of neonatal mortality using two analysis methods, Rio Grande do Sul, Brazil. *Rev Saude Publica* 45: 79-89.
17. Singer JD (1998) Using SAS proc mixed to fit multilevel models, hierarchical models, and individual growth models. *J Educ Behav Stat* 24: 323-55.
18. Tellez M, Sohn W, Burt BA, Ismail AI (2006) Assessment of the relationship between neighborhood characteristics and dental caries severity among low-income African-Americans: A Multilevel Approach. *J Public Health Dent* 66: 30-6.
19. Gimenez T, Bispo BA, Souza DP, Viganó ME, Wanderley MT, et al. (2016) Does the Decline in Caries Prevalence of Latin American and Caribbean Children Continue in the New Century? Evidence from Systematic Review with Meta-Analysis. *PLoS One* 11: e0164903.
20. Lagerweij MD, Loveren CV (2015) Declining Caries Trends: Are We Satisfied? *Curr Oral Health Rep* 2: 212-7.
21. Gibson B, Blake M, Baker S (2016) Inequalities in oral health: the role of sociology. *Community Dent Health* 33: 156-60.
22. Eklund SA (2017) The Impact of Improved Oral Health on the Utilization of Dental Services. *J Dent Educ* 81: S110-9.
23. Twigg E, Roberts RM, Jamieson L, Dreyer CW, Sampson WJ (2016) The psycho-social impact of malocclusions and treatment expectations of adolescent orthodontic patients. *Eur J Orthodont* 38: 593-601.
24. Kolawole KA, Agbaje HO, Otuyemi OD (2014) Impact of malocclusion on oral health related quality of life of final year dental students. *Odontostomatol Trop* 37: 64-74.
25. Bhatia R, Winnier JJ, Mehta N (2016) Impact of malocclusion on oral health-related quality of life in 10-14-year-old children of Mumbai, India. *Contemp Clin Dent* 7: 445-50.
26. Singh A, Dhawan P, Gaurav V, Rastogi P, Singh S (2017) Assessment of oral health-related quality of life in 9-15 year old children with visual impairment in Uttarakhand, India. *Dent Res J (Isfahan)* 14: 43-9.
27. Silva LF, Thomaz EB, Freitas HV, Ribeiro CC, Pereira AL, et al. (2016) Self-perceived need for dental treatment and related factors. A cross-sectional population-based study. *Braz Oral Res* 30: 1-9.
28. Leavy KM, Cisneros GJ, LeBlanc EM (2016) Malocclusion and its relationship to speech sound production: Redefining the effect of malocclusal traits on sound production. *Am J Orthod Dentofacial Orthop* 150: 116-23.
29. Healey DL, Gauld RD, Thomson WM (2015) The socio-demographic and malocclusion characteristics of adolescents presenting for specialist orthodontic treatment in New Zealand practices. *Aust Orthod J* 31: 20-5.
30. Zhou Z, Liu F, Shen S, Shang L, Shang L, et al. (2016) Prevalence of and factors affecting malocclusion in primary dentition among children in Xi'an, China. *BMC Oral Health* 16: 2-11.
31. Laothong W, Cheng HC (2017) Comparison of factors affecting orthodontic treatment motivation of Taiwanese and Thai patients in two hospitals. *J Dent Sci* 12: 396-404.
32. Hox JJ (2002) Multilevel analysis: techniques and applications Mahwah: Lawrence Erlbaum Associates. USA.
33. Cozza P, Baccetti T, Franchi L, Mucedero M, Polimeni A (2007) Transverse features of subjects with sucking habits and facial hyperdivergency in the mixed dentition. *Am J Orthod Dentofacial Orthop* 132: 226-9.

Submit your next manuscript to Annex Publishers and benefit from:

- ▶ Easy online submission process
- ▶ Rapid peer review process
- ▶ Online article availability soon after acceptance for Publication
- ▶ Open access: articles available free online
- ▶ More accessibility of the articles to the readers/researchers within the field
- ▶ Better discount on subsequent article submission

Submit your manuscript at
<http://www.annexpublishers.com/paper-submission.php>