Association between history of orthodontic treatment and sociodemographic factors in adolescents

Gustavo H.S. Merlo[1], Carla C. Piardi[2], Ezequiel Gabrielli[1],
Francisco Wilker M.G. Muniz[2], Cassiano K. Rösing[2],
Paulo Roberto G. Colussi[1]

[1] Universidade de Passo Fundo, Faculdade de Odontologia,
 Passo Fundo, Rio Grande do Sul, Brasil.
[2] Universidade Federal do Rio Grande do Sul, Faculdade de Odontologia,
 Porto Alegre, Rio Grande do Sul, Brasil.

ABSTRACT

The aim of this study was to assess history of orthodontic treatment and its determinants in adolescents. This was a cross-sectional study conducted in the city of Passo Fundo, Brazil, on a representative sample of adolescents aged 15 to 19 years, regularly enrolled in 20 high schools. A structured questionnaire was applied to assess demographic, behavioral and health variables. The association between history of orthodontic treatment and the dependent variables was analyzed by the chi-square test or Fisher's exact test. Additionally, multivariate regression with robust variance was performed. A total 736 students were examined and interviewed, of whom 57.6% had undergone orthodontic treatment, while 42.4% had not. In the multivariable analysis, the following variables were significantly associated with history of orthodontic treatment: female (PR= 1.26; 95% CI: 1.11 – 1.43), white (PR= 1.32; 95% CI: 1.11 – 1.56), mothers with higher level of education (PR=1.49; 95% CI: 1.28 – 1.74), tooth loss (PR=1.21; 95% CI: 1.06 – 1.39), and concern about oral health (PR=0.69; 95% CI: 0.61 – 0.78). Attending a private school was not significantly associated with history of orthodontic treatment (p>0.05). This study found a high rate for history of orthodontic treatment among adolescents, associated with gender, ethnicity, adolescent's mother with higher education, and tooth loss. Concern about oral health was a protective factor for orthodontic treatment.

Key words: *Adolescence; Esthetics, dental; Orthodontics.*

Associação entre histórico de tratamento ortodôntico e fatores sociodemográficos em adolescentes

RESUMO

Esse estudo objetivou verificar o histórico de tratamento ortodôntico e seus fatores associados. Esse estudo transversal foi conduzido na cidade de Passo Fundo, Brasil, com uma amostra representativa dos adolescentes regularmente matriculados no ensino médio, com idades entre 15 e 19 anos, de 20 escolas. Um questionário estrutura foi aplicado para acessar variáveis demográficas, comportamentais e de saúde. As associações entre histórico de tratamento ortodôntico e as variáveis independentes foram analisadas pelos testes de qui-quadrado ou exato de Fisher. Além disso, regressão multivariada com variância robusta foi realizada. 736 estudantes foram examinados e entrevistados. Tratamento ortodôntico foi realizado por 57,6% dos adolescentes, enquanto que 42,4% dos participantes não o mencionaram. Na análise multivariada, as seguintes variáveis estiveram significativamente associadas com histórico de tratamento ortodôntico: sexo feminino (PR= 1,26; 95%CI: 1,11 – 1,43), branco (PR= 1,32; 95%CI: 1,11 – 1,56), mães com alto nível educacional (PR=1,49; 95%CI: 1,28 – 1,74), perda dentária (PR=1,21; 95%CI: 1,06 – 1,39) e preocupação com a saúde bucal (PR=0,69; 95%CI: 0,61 – 0,78). Ir a uma escola privada não esteve significativamente associado com histórico de tratamento ortodôntico (p>0,05). Esse estudo demonstrou que altos níveis de histórico de tratamento ortodôntico são encontrados em adolescentes e isso está associado com sexo, etnia, alta escolaridade da mãe do adolescente e perda dentária. Preocupação com a saúde bucal mostrou-se como um fator protetor para o tratamento ortodôntico.

Autores: *Adolescência-Estética, Dentária- Ortodontia.*

INTRODUCTION

Malocclusion is the third largest oral health problem in terms of public health[1], and may influence appearance, with impact on self-esteem and quality of life[2,3]. Epidemiological studies on occlusion patterns in a given population are important because they reveal the prevalence of malocclusions and their impairment severity, indicating the normative need for orthodontic treatment[4]. Such data are used for planning treatment priorities in public health, based on the principle of equity in oral healthcare[5]. The Index of Orthodontic Treatment Need (IOTN) developed by Brook and Shaw[6], is one of the instruments that assess treatment need. It classifies

the need for orthodontic treatment considering the importance and severity of occlusal aspects for health and dental function[7]. According to the latest national survey in Brazil[8], prevalence of malocclusions among 15- to 19-year-olds was 35.6%, of which 20.3% were classified as definite malocclusion, 6.2% as severe malocclusion, and 9.1% as very severe malocclusion. Following these criteria based on the DAI, 64.4% of Brazilian adolescents would have little or no treatment need, 20.3% would have elective treatment need, 6.2% would have highly desirable treatment need, and 9.1% would have mandatory treatment need[9]. It is estimated that about one third of the population presents an obvious need for orthodontic treatment[10].

The national survey in Brazil did not report exposure to orthodontic treatment, either current or in the past. Generally, the country's public system does not provide such treatment, and these patients usually seek private clinicians. Moreover, their treatment needs are evaluated on an individual basis.

Prevalence of malocclusion varies widely depending on the method of evaluation. A study in India found that the prevalence of children with malocclusion who do not require immediate orthodontic treatment was 63% higher than those who do not need treatment[11]. Another study, conducted at the University of Leuven in Belgium, evaluated the orthodontic treatment needs of 11- to 16-year-olds[12], finding orthodontic treatment need for the esthetic component in 38.3% of the subjects. When the dental component was evaluated separately, the treatment need increased to 80.3%.

However, few studies have addressed the history of orthodontic treatment, either completed or in progress. There seems to be a difference between the prevalence of malocclusion and the normative need for treatment. The aim of this study was therefore to assess history of orthodontic treatment among high school adolescent students from public and private schools in a city in southern Brazil. The null hypothesis is that there is no statistically significant difference in the history of orthodontic treatment in adolescents regarding gender, ethnicity, mother's level of education, type of school, self-reported health problems, tooth loss, and concern about oral health in general.

MATERIAL AND METHODS
Study design and location
This cross-sectional study examined 15- to 19-year-olds enrolled in public and private high schools of the city of Passo Fundo, which is located in the north of the state of Rio Grande do Sul, Brazil, 300 km from the state capital, Porto Alegre. The population is about 190,000, according to the Brazilian Institute of Geography and Statistics[13]. More than 95% of the population lives in the urban area, with a poverty incidence of 27.91% and a Gini Index of 0.41. In 2012, the city recorded 7,558 students enrolled in regular high school in 23 schools, comprising 16 public schools and 7 private schools, all in the urban area. Of this total, 6,256 (82.78%) students attended public schools, and 1,302 (17.22%) attended private schools[14].

Ethical considerations
The Institutional Review Board of the University of Passo Fundo approved the present study following the authorization from the 7th Regional Office of Education to carry out the study at public schools, and after formal approval by the principals of the private schools. All selected students provided an Informed Consent Form signed by their parents or legal guardians, and everyone present on the day of the survey was examined.

Sample
The study coordinator visited all 23 high schools and invited them to participate. The sample consisted of thirty percent of the students from each accepting school, who were randomly chosen by draw from the lists of all students aged 15 to 19 years, regardless of their school schedule. Randomization was performed in two blocks, according to the distribution of male and female students.

The research team visited all classrooms that included selected students to present the aims of the study. After the explanation, the selected students received the Informed Consent Form to be signed by their parents or guardians. In case of absence, a second contact was made. The study included 736 students, who are representative of the adolescents regularly enrolled in the Passo Fundo high school system.

Clinical examination and questionnaire completion

A structured questionnaire, including demographic data, socioeconomic condition, general health behavior, health record, and oral health self-perception, was applied with the use of a set of questions from the PCATool-SB Brazil adult version, validated in Brazil[15]. Aspects regarding oral esthetics and concern about oral health were obtained through the application of a questionnaire validated for Brazilians[16]. The questionnaire explores the perception of the appearance of teeth and oral health concerns, which consider the last two months or the adolescent's current self-perception. We used four questions of the abovementioned questionnaire to assess the adolescents' concern regarding oral health, the appearance of their teeth, and tooth alignment and color[16].

All participants were asked the following question: "Have you ever been under any type of orthodontic treatment?" The answer to this question was used to classify the sample into "no orthodontic treatment", "history of orthodontic treatment", and "current orthodontic treatment". The research team asked the adolescents all the questions and completed the questionnaire.

Interviews followed by clinical examinations were conducted at the schools from April to July 2012. Clinical examinations were performed with the help of a wooden spatula, to verify ongoing orthodontic treatment and count all teeth except third molars.

The examinations and interviews were conducted by teams of five dental students who had been trained and validated by the study coordinator to ensure standard procedures. The training consisted of theoretical classes including a review of the literature on the subject, as well as reading and receiving an explanation of each question from the questionnaire. In order to assess reproducibility, after one week, the study coordinator re-examined and re-interviewed ten percent of the participating students randomly chosen by draw. The agreement rate between tests for tooth count was 98%. Teeth that could somehow be restored were counted, and teeth or roots indicated for extraction were not counted.

Statistical analysis

History of orthodontic treatment was considered the main outcome of this study. Adolescents under orthodontic treatment at the time of the examination and those who reported previous treatment were categorized as having a history of orthodontic treatment. All the independent variables analyzed are shown in Figure 1.

The independent variables were categorized as follows. Ethnicity was classified as white or non-white, with non-white including subjects who referred to themselves as being black, yellow, brown or indigenous. Socioeconomic condition was assessed by information on income and education. Mother's level of education was classified into three groups: complete or incomplete higher education, complete or incomplete high school, and up to elementary school. Type of school (public or private) was used as an income proxy, as students from public schools were considered to come from lower income families.

General health problem was dichotomized as either yes or no. Tooth loss was dichotomized as "yes" with at least one tooth loss, and as "no" for those who had 28 teeth. Concern about oral health was dichotomized as "yes" for those who were concerned about the health of their teeth, and "no" for those who were not concerned. Dental esthetics was assessed through three questions: whether the subjects were bothered by the appearance of their teeth, and whether they were concerned about tooth alignment and tooth color. These answers were dichotomized as yes or no.

Associations between the dependent variable and independent variables were assessed by either the chi-square test or Fisher's exact test. Uni- and multivariate analyses were performed using Poisson regression to assess the association between dependent and independent variables. The
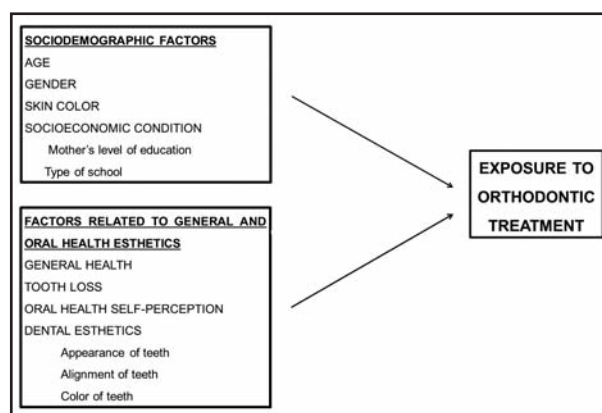

Fig. 1: Explanatory variables for history of orthodontic treatment.

covariates were chosen based on either association in univariate analysis (p<.25) or from conceptual basis. The significance level applied was 5%. Data analysis was performed using the statistical package SPSS 18 (SPSS Inc., Chicago, United States).

RESULTS

Of the 23 schools invited, 20 accepted to take part in the study, including all 16 public and 4 private schools. Of the 6,122 students eligible for the study at the 20 schools selected, 1,836 students were

chosen by draw and invited to participate. Seven hundred and thirty-six adolescents (736) accepted the invitation, all of whom were interviewed and received oral examination, generating a 40.08% rate of participation. The main reasons for exclusion are shown in Figure 2, and all adolescent were included in the final statistical analyses. Of these, 323 (43.9%) were males, and 413 (56.1%) were females. Of the total 736 participants, 620 (84.2%) were from public schools and 116 (15.8%) from private schools. These rates were similar to overall
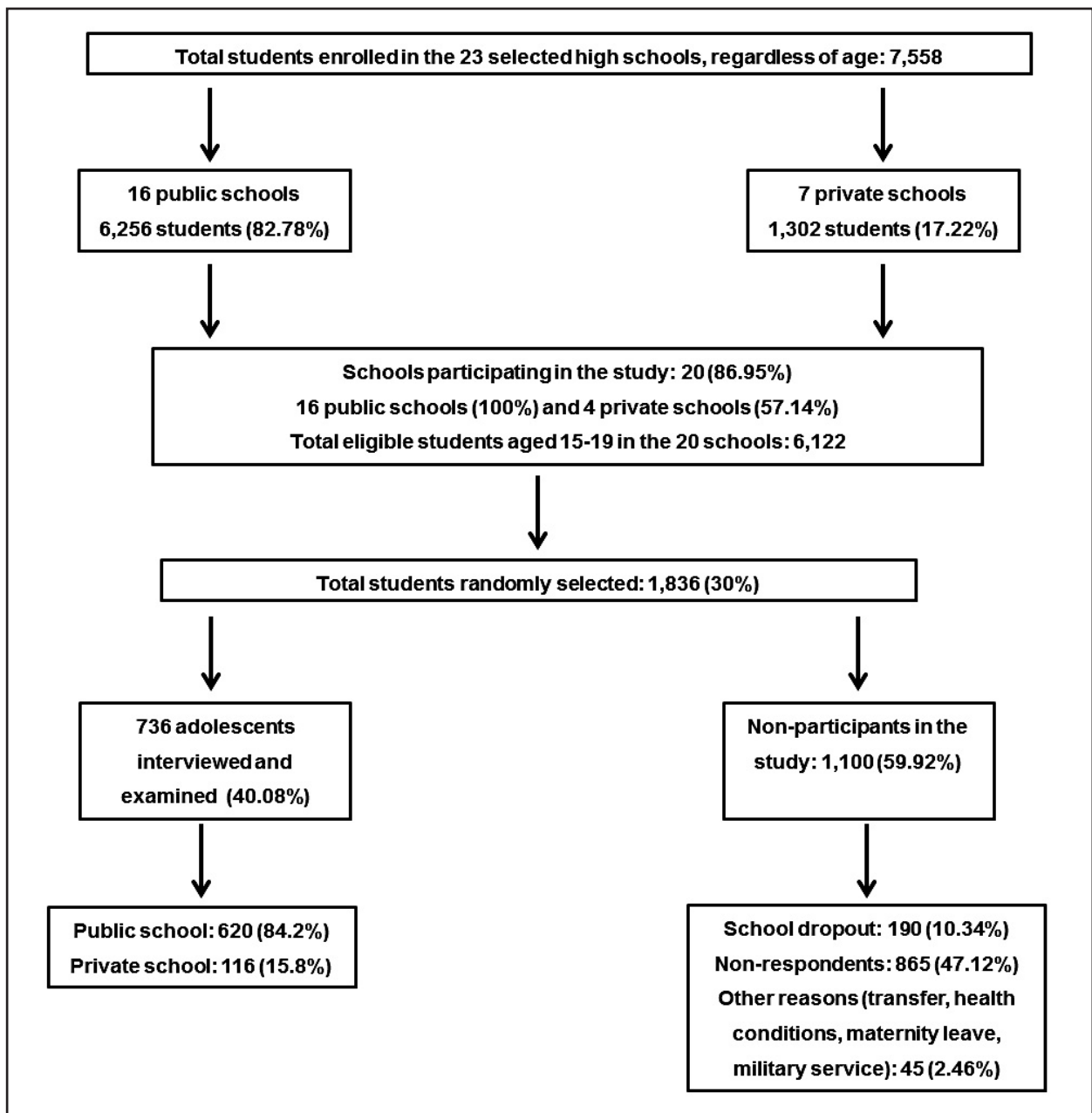

Fig. 2:Flowchart of the participants through the study.

city rates. History of orthodontic treatment was 57.6%. Of the total study population, 32.7% were under orthodontic treatment, 24.9% had completed orthodontic treatment, and only 42.4% had no experience of orthodontic treatment.

Sociodemographic aspects were associated with history of orthodontic treatment. Subjects who were female, white, enrolled at private schools, and with mothers with higher level of education were associated with higher history of orthodontic treatment (Table 1). Aspects related to oral health presented inverse association. Adolescents who reported no concern about oral health had 70.02% rate of history of orthodontic treatment, while 46.53% were concerned about oral health (p=0.0001). Tooth loss was not associated with history of orthodontic treatment in this analysis (p=0.13). Aspects related to appearance and esthetics were also associated with history of orthodontic treatment. Those who reported concern about appearance had 62.00% rate of history of treatment, compared to 51.46% for those not concerned about appearance (p=0.003). Concerns about alignment and color of the teeth were inversely and significantly associated with history of orthodontic treatment (p=0.0001 for both associations).

Table 2 shows the univariate analysis of this study. Female gender, white ethnicity, mother's level of education, attending to private schools, concern about oral health, appearance of the teeth bothering the adolescent, and concern about teeth alignment and color were significantly associated with history of orthodontic treatment

All those variables and tooth loss were included in the multivariable analyses. Only female gender

Table 1: Frequency distribution of exposures regarding history of orthodontic treatment among adolescents aged 15 to 19 years, Passo Fundo, Brazil.				
		History of orthodontic treatment?		
		Yes	No	P-value*
		n (%)	n (%)	
Age	15	123 (52.11%)	113 (47.89%)	0.07
	16	161 (64.14%)	90 (35.86%)	
	17	99 (56.57%)	76 (43.43%)	
	18	34 (58.62%)	24 (41.38%)	
	19	7 (43.75%)	9 (56.25%)	
Gender	Male	164 (50.78%)	159 (49.22%)	0.0001
	Female	260 (62.95%)	153 (37.05%)	
Ethnicity/skin colour	White	330 (64.57%)	181 (35.43%)	0.0001
	Non-white	94 (41.78%)	131 (58.22%)	
Mother's level of education	Complete or incomplete higher education	123 (75.00%)	41 (25.00%)	0.0001
	Complete or incomplete high school	162 (61.13%)	103 (38.87%)	
	Up to elementary school	139 (45.27%)	168 (54.73%)	
Type of school	Public	333 (53.70%)	287 (46.30%)	0.0001
	Private	91 (78.44%)	25 (21.56%)	
General health problem	Yes	53 (58.24%)	38 (41.76%)	0.50
	No	366 (57.63%)	269 (42.37%)	
Tooth loss	Yes	96 (61.94%)	59 (38.06%)	0.13
	No	328 (56.45%)	253 (43.55%)	
Concern about oral health	Yes	181 (46.53%)	208 (53.47%)	0.0001
	No	243 (70.02%)	104 (29.98%)	
Bothered by appearance	Yes	266 (62.00%)	163 (38.00%)	0.003
	No	158 (51.46%)	149 (48.54%)	
Concern about tooth alignment	Yes	156 (48.29%)	167 (51.71%)	0.0001
	No	268 (64.90%)	145 (35.10%)	
Concern about tooth color	Yes	211 (51.84%)	196 (48.16%)	0.0001
	No	213 (64.74%)	116 (35.26%)	

*Chi-square test or Fisher's exact test

Table 2: Univariate analysis model associating history of orthodontic treatment among adolescents 15 to 19 years old, Passo Fundo, 2012.

		Prevalence Ratio (95%CI)	P-value
Gender	Female	1.24 (1.09 – 1.41)	0.001
Age		1.01 (0.953 – 1.08)	0.683
Ethnicity	White	1.55 (1.31 – 1.83)	<0.001
Mother's level of education	Complete or incomplete higher education Complete or incomplete high school	1.66 (1.42 – 1.93) 1.35 (1.16 – 1.58)	<0.001 <0.001
Type of school	Private	1.46 (1.30 – 1.65)	<0.001
General health problems	Yes	1.01 (0.84 – 1.22)	0.913
Tooth loss	Yes	1.10 (0.95 – 1.27)	0.203
Concern about oral health	Yes	0.66 (0.59 – 0.75)	<0.001
Bothered by appearance	Yes	1.21 (1.06 – 1.37)	0.005
Concern about tooth alignment	Yes	0.74 (0.65 – 0.85)	<0.001
Concern about tooth color	Yes	0.80 (0.71 – 0.91)	<0.001

Table 3: Multivariate analysis model associating history of orthodontic treatment among adolescents 15 to 19 years old, Passo Fundo, 2012.

		Prevalence Ratio (95%CI)	P-value
Gender	Female	1.26 (1.11 – 1.43)	<0.001
Ethnicity	White	1.32 (1.11 – 1.56)	0.001
Mother's level of education	Complete or incomplete higher education Complete or incomplete high school	1.49 (1.28 – 1.74) 1.26 (1.08 – 1.46)	<0.001 0.003
Tooth loss	Yes	1.21 (1.06 – 1.39)	0.006
Concern about oral health	Yes	0.69 (0.61 – 0.78)	<0.001

(PR=1.26; 95% CI: 1.11 – 1.43), white ethnicity (PR=1.32; 95% CI: 1.11 – 1.56), higher mother's level of education (PR=1.49; 95% CI: 1.08 – 1.46), tooth loss (PR=1.21; 95% CI: 1.06 – 1.39) were significantly associated with history of orthodontic treatment in this analysis (Table 3). On the other hand, concern with oral health presented as a protective factor to history of orthodontic treatment (PR=0.69; 95% CI: 0.61 – 0.78).

DISCUSSION

The aim of this study was to assess the history of orthodontic treatment among adolescents and to establish factors associated with such history, including sociodemographic factors, oral and general health factors, and oral esthetic factors.

The results showed that 57.6% of adolescents had at some time undergone orthodontic treatment, including both those who had already received treatment and those currently under treatment. These results show a high orthodontic treatment rate among Brazilian adolescents compared to studies that assess the true need for treatment. According to the latest national survey[9], the need for treatment obtained through the DAI was about 35%, of which 15% represented highly desirable and mandatory treatment. It is important to highlight that the DAI presents many disadvantages, such as its subjective nature, high variability in its classification, and the lack of assessment of all occlusal traits[17]. The higher history of orthodontic treatment in this sample is a matter of concern and should be contrasted with the true need of treatment.

The results of the present study show that adolescents who claimed to be white were more likely to receive this type of treatment. White adolescents in Brazil have a higher level of

education and income than adolescents who claim to be non-white [13]. Thus, they have more access to dental care, more knowledge, and more attitude regarding oral hygiene care and esthetic needs. Female adolescents were also associated with greater orthodontic experience, which may be explained by the fact that they seek more dental services, and are more concerned with oral health and aspects related to esthetics[18].

Adolescents with mothers with higher level of education were associated with higher orthodontic treatment experience. The association between mother's level of education and better oral health conditions of their children has been previously demonstrated in the literature[19]. This may include a higher concern from mothers about matters related to their children's appearance.

The multivariable analysis showed that tooth loss was significantly associated with history of orthodontic treatment, with tooth loss being 21% higher in adolescents who had undergone orthodontic treatment than in those who had not. Another study showed that 23.5% of tooth loss in children and adolescents was due to orthodontic reasons[20]. Although extractions may be needed during orthodontic treatment to gain space easily[21], it should be considered that they may not provide significant esthetic improvement.

Adolescents who reported concern about their oral health presented 31% less history of orthodontic treatment. The literature shows that the primary motivation for orthodontic treatment is improving dental appearance, and improvement in oral function is not necessarily involved in this process[22]. However, esthetic factors were not significant in the multivariate analysis. Furthermore, it may be hypothesized that adolescents who have already undergone orthodontic treatment and probably have regular access to oral health services could respond that they are not concerned about their general health. In contrast, adolescents who do not have access to these services may for that very reason express concern.

The literature reports that adults who express concern about their oral health tend to have more symptomatic visits to the dentist[23]. It may be speculated that the situation is similar in adolescents. Moreover, adolescents from private schools also presented more history of orthodontic treatment only in the univariate analysis. Another study found that the type of school is associated with oral health differences among adolescents[24]. Not only do these differences concern proper oral health behavior, but also show that students from private schools have greater access to sophisticated and expensive treatments.

Among adolescents who reported concern about appearance, 62% had orthodontic treatment history, while among those who were not concerned about appearance, only 51.46% had orthodontic treatment history (p=0.003). However, in the multivariable analysis, none of the factors related to oral esthetics differed significantly regarding history of orthodontic treatment. Another study showed that dissatisfaction with appearance is directly related to the desire for treatment, leading people to seek orthodontic treatment[25]. It should be noted that overtreatment is undesirable not only because of the expense involved, but also due to its potential association with adverse effects. Moreover, awareness needs to be raised regarding the fact that orthodontic therapy is not indicated strictly for esthetic problems.

Sample size was not calculated in this study. Analytical epidemiological studies need a minimum amount of 40-50 individuals for each variable tested. We estimated that inviting 30% of the adolescents at the schools would suffice for the different analyses to be performed. A census would not be possible, and other studies in this field have used smaller sample size than this study[26,27]. The literature also reports studies with similar sample sizes[28,29].

Among strengths of this study, we can highlight the number of participants, the reliability and use of validated methods, and the use of a random sample from all schools, achieving similar proportions to the actual distribution of enrolled students. The main limitation was the response rate, which was probably limited by the change of school and the need to provide informed consent from parents.

Studies providing associations are important in order to frame questions for further research. The evidence found in the current study contributes to understanding which factors predict whether or not adolescents have experience of orthodontic therapy. The findings of this study showed a high rate of history of orthodontic treatment among Brazilian adolescents. It was associated with sociodemographic factors, tooth loss and absence of concern about oral health. The history of orthodontic treatment in this sample does not match the data for malocclusion in Brazil, so overtreatment may be suspected.

CORRESPONDENCE
Dr. Cassiano K. Rösing
Ramiro Barcelos, 2492. 90035-003
Porto Alegre, RS, Brazil
ckrosing@hotmail.com

REFERENCES

1. Singh VP, Sharma A. Epidemiology of Malocclusion and Assessment of Orthodontic Treatment Need for Nepalese Children. Int Sch Res Notices 2014; 2014:768357.
2. Choi SH, Kim JS, Cha JY, Hwang CJ. Effect of malocclusion severity on oral health-related quality of life and food intake ability in a Korean population. Am J Orthod Dentofacial Orthop 2016; 149:384-390.
3. 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.
4. Peres KG, Traebert ES, Marcenes W. Differences between normative criteria and self-perception in the assessment of malocclusion. Rev Saude Publica 2002; 36:230-236.
5. Borzabadi-Farahani A. A review of the oral health-related evidence that supports the orthodontic treatment need indices. Prog Orthod 2012; 13:314-325.
6. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. Eur J Orthod 1989; 11:309-320.
7. Cons NC, Jenny J, Kohout FJ. DAI: The Dental Aesthetic Index. Iowa City: College of Dentistry University of Iowa, 1986.
8. Brasil. Ministério da Saúde. Projeto SB Brasil 2010. Pesquisa Nacional de Saúde Bucal. Resultados Principais. In: Brasília, Brasil, 2012.
9. Garbin A, Perin P, Garbin C, Lolli L. Prevalência de oclusopatias e comparação entre a Classificação de Angle e o Índice de Estética Dentária em escolares do interior do estado de São Paulo-Brasil. Dental Press Journal of Orthodontics 2010; 4:94-102.
10. Borzabadi-Farahani A. An insight into four orthodontic treatment need indices. Prog Orthod 2011; 12:132-142.
11. Prabhakar RR, Saravanan R, Karthikeyan MK, Vishnuchandran C, Sudeepthi. Prevalence of malocclusion and need for early orthodontic treatment in children. J Clin Diagn Res 2014; 8:ZC60-61.
12. Ghijselings I, Brosens V, Willems G, Fieuws S, Clijmans M, Lemiere J. Normative and self-perceived orthodontic treatment need in 11- to 16-year-old children. Eur J Orthod 2014; 36:179-185.
13. IBGE. Instituto Brasileiro de Geografia e Estatística. Ministério do Planejamento, Orçamento e Gestão. Censo Demográfico 2010: Características da população e domicílios – resultados gerais. Rio de Janeiro, Brasil, 2011.
14. Passo Fundo. 7ª Coordenadoria Regional de Educação – Passo Fundo – Setor de Estatística PF, RS: Secretaria da Educação, Passo Fundo, Brasil, 2011.
15. Fontanive VT. Adaptação do Instrument Primary Care Assessment Tool – Brasil versão usuários dirigido à saúde bucal. [Master degree dissertation]. Porto Alegre: Faculdade de Medicina, Universidade Federal do Rio Grande do Sul; 2011.
16. Furtado GE, Sousa ML, Barbosa TS, Wada RS, Martínez-Mier EA, Almeida ME. Perceptions of dental fluorosis and evaluation of agreement between parents and children: validation of a questionnaire. Cad Saude Publica 2012; 28:1493-1505.
17. Borzabadi-Farahani A. A review of the evidence supporting the aesthetic orthodontic treatment need indices. Prog Orthod 2012; 13:304-313.
18. Barbato PR, Peres MA. Tooth loss and associated factors in adolescents: a Brazilian population-based oral health survey. Rev Saude Publica 2009; 43:13-25.
19. Perera I, Ekanayake L. Social gradient in dental caries among adolescents in Sri Lanka. Caries Res 2008; 42: 105-111.
20. Olatosi OO, Sote EO. Causes and pattern of tooth loss in children and adolescents in a Nigerian tertiary hospital. Nig Q J Hosp Med 2012; 22:258-262.
21. Rinchuse DJ, Busch LS, DiBagno D, Cozzani M. Extraction treatment, part 1: the extraction vs. nonextraction debate. J Clin Orthod 2014; 48:753-760.
22. Tuominen ML, Tuominen RJ. Factors associated with subjective need for orthodontic treatment among Finnish university applicants. Acta Odontol Scand 1994; 52: 106-110.
23. Azodo CC, Onyeagba MI, Odai CD. Does concern about halitosis influence individual's oral hygiene practices? Niger Med J 2011; 52:254-259.
24. Campus G, Cagetti MG, Senna A, Spano G, Benedicenti S, Sacco G. Differences in oral health among Italian adolescents related to the type of secondary school attended. Oral Health Prev Dent 2009; 7:323-330.
25. Hamamci N, Başaran G, Uysal E. Dental Aesthetic Index scores and perception of personal dental appearance among Turkish university students. Eur J Orthod 2009; 31: 168-173.
26. Al-Jobair AM, Baidas LF, Al-Hamid AA, Al-Qahtani SG, Al-Najjar AT, Al-Kawari HM. Orthodontic treatment need among young Saudis attending public versus private dental practices in Riyadh. Clin Cosmet Investig Dent. 2016; 8:121-129.
27. Pithon MM, Nascimento CC, Barbosa GC, Coqueiro RaS. Do dental esthetics have any influence on finding a job? Am J Orthod Dentofacial Orthop. 2014; 146:423-429.
28. Feldens CA, Dos Santos Dullius AI, Kramer PF, Scapini A, Busato AL, Vargas-Ferreira F. Impact of malocclusion and dentofacial anomalies on the prevalence and severity of dental caries among adolescents. Angle Orthod. 2015; 85:1027-1034.
29. Tumurkhuu T, Fujiwara T, Komazaki Y, Kawaguchi Y, et al. Association between maternal education and malocclusion in Mongolian adolescents: a cross-sectional study. BMJ Open. 2016; 6:e012283.