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Débora do Canto Assaf

ASSOCIAÇÃO ENTRE MÁ-OCLUSÃO COM ALTERAÇÕES FONOARTICULATÓRIAS E POSIÇÃO DE LÍNGUA EM CRIANÇAS NA DENTIÇÃO MISTA: ESTUDO TRANSVERSAL

Santa Maria, RS
2019

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Dissertação apresentada ao Curso de Pós-Graduação em Ciências Odontológicas, da Universidade Federal de Santa Maria (UFSM, RS) como requisito parcial para obtenção do título de **Mestre em Ciências Odontológicas com ênfase em Ortodontia.**

Orientadora: Profª. Drª. Mariana Marquezan

Coorientador: Prof. Dr. Vilmar Antônio Ferrazzo

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Aprovado em 07 de junho de 2019:

_____

Mariana Marquezan, Dra. (UFSM)
(Presidente/Orientadora)

_____

Vilmar Antônio Ferrazzo, Dr. (UFSM)
(Co-orientador)

_____

Luana Cristina Berwig, Dra. (HCPA)

_____

Fernanda Tomazoni, Dra. (UFSM)

Santa Maria, RS
2019

DEDICATÓRIA

Aos meus pais, Gizele e Jamal, que além da vida, me deram a melhor versão deles mesmos regadas com muito amor.

À eles, meu eterno muito obrigada!

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Transmitir conhecimento não é apenas falar o que sabe, mas inspirar novas atitudes.

(Juliano Kimura)

RESUMO

ASSOCIAÇÃO ENTRE MÁ-OCLUSÃO COM ALTERAÇÕES FONOARTICULATÓRIAS E POSIÇÃO DE LÍNGUA EM CRIANÇAS NA DENTIÇÃO MISTA: ESTUDO TRANSVERSAL

AUTORA: Débora do Canto Assaf
ORIENTADORA: Mariana Marquezan

O objetivo deste estudo foi avaliar a associação de alterações oclusais com alterações fonoarticulatórias e de posicionamento de língua. Este estudo transversal utilizou uma amostra de 547 crianças em fase de dentição mista, entre 07 e 13 anos de idade, estudantes de escolas estaduais da cidade de Santa Maria - RS. Adotou-se o procedimento de amostragem aleatória por conglomerado em duplo estágio, selecionando nove escolas aleatoriamente de acordo com as diferentes regiões administrativas. A amostra foi avaliada e os dados foram obtidos através de questionários, exames odontológicos e fonoaudiológicos. Para verificar os fatores de risco associados aos distúrbios articulatórios e alteração na posição de língua, foi utilizada a técnica de modelo de regressão de Poisson com variância robusta ajustada. As variáveis utilizadas no estudo foram: sobressaliência, sobremordida, mordida cruzada posterior, distúrbio articulatório, posição de língua, idade, sexo, raça e modo respiratório. Observou-se que os indivíduos com sobremordida profunda apresentam relação de proteção para o desenvolvimento de distúrbios articulatórios, enquanto que os indivíduos com mordida cruzada posterior apresentam 2,20 vezes maior probabilidade de apresentar esse problema. Com relação à alteração na posição da língua, ter mordida aberta anterior representa 2,36 vezes maior frequência do indivíduo apresentar essa alteração. A presença de sobremordida profunda e ser do sexo masculino, representam fatores de proteção para alterações de posição de língua. Por outro lado, possuir respiração oral/oronasal, representa 2,51 vezes mais prevalência de possuir alteração de posição lingual.

Palavras-Chave*:* Dentição Mista, Má-Oclusão, Ortodontia, Distúrbios Articulatórios, Terapia Miofuncional.

ABSTRACT

ASSOCIATION BETWEEN MALOCCLUSION WITH ARTICULATION DISORDERS AND TONGUE POSITION IN MIXED DENTITION CHILDREN: A CROSS-SECTIONAL STUDY

AUTHOR: Débora do Canto Assaf
ADVISOR: Mariana Marquezan

The aim of this study was to evaluate the association of occlusal alterations with articulation disorders and tongue positioning alterations. This cross-sectional study used a sample of 547 mixed-dentition children aged from 7 to 13 years old from state schools in the city of Santa Maria - RS. The procedure of random sampling by double-stage clustering was adopted, selecting nine schools randomly according to the different administrative regions. The sample was evaluated by questionnaires, dental and phonoaudiological examinations. To verify the risk factors associated with articulation disorders and tongue position alteration, the Poisson regression modeling technique was used. The variables used in the study were: overjet, overbite, posterior crossbite, articulation disorder, tongue position, age, sex, skin color and respiratory mode. Individuals with deep overbite present a protective relationship to articulation disorder, whereas individuals with posterior crossbite are 77% more likely to present this problem. Regarding the change in the position of the tongue, having anterior open bite represents 2.36 times more probability of the individual having this problem. The presence of deep overbite and being male, represent protection factors for alterations in tongue position. On the other hand, have oral/oronasal breathing, represents 2.51 times more frequency of having altered position of the tongue.

Keywords: Mixed Dentition, Malocclusion, Orthodontics, Articulation Disorders, Myofunctional Therapy.

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1 INTRODUÇÃO

A capacidade de se comunicar e interagir socialmente, são de grande importância para indivíduos de todas as idades, sendo a linguagem, fator fundamental para a comunicação entre as pessoas. A fala é o resultado do planejamento e execução de sequências de movimentos, que requerem coordenação neuromuscular muito precisa (WERTZNER, 2004).

Distúrbios articulatórios podem iniciar a partir da infância. A prevalência de desvios fonéticos foi aproximadamente de 22,3% em crianças de uma amostra brasileira (RABELO et al., 2015). Enquanto que a prevalência de má-oclusão no período da dentição mista pode chegar em torno de 89%, em crianças brasileiras (ALMEIDA et al., 2011). A etiologia dos problemas de fala é complexa, compreendendo fatores genéticos 11%, ambientais 83% (experiências sociais, dieta, exposição à toxinas) e mistos 6%, segundo a revisão de Rogers e colaboradores (2015).

Alterações de fala podem ser classificadas como fonéticas ou fonológicas. As alterações fonéticas são distúrbios articulatórios ou distorções de ponto articulatório representadas pelo ceceio anterior e lateral da fala e pela interdentalização, e são alterações de origem musculoesquelética, ou seja, existe uma alteração motora envolvida na produção do som (MARCHESAN, 2014). Segundo Marchesan (2014), alterações da forma da arcada dentária somadas à hipofunção de língua são os fatores mais frequentemente associados ao ceceio anterior e lateral.

Quanto às alterações fonológicas, estas são representadas pelas omissões e substituições de fonemas, as quais podem ter origem neurológica e estão mais relacionadas aos problemas de linguagem, não sendo relacionadas diretamente às estruturas musculoesqueléticas (MARCHESAN, 2014).

Entre outros fatores que influenciam a precisão dos pontos articulatórios, está a presença e posição dos dentes, a mobilidade de lábios, bochechas e palato mole e a posição e mobilidade da língua e mandíbula, além do espaço intraoral para a articulação e ressonância (MARCHESAN, 2014). Desvios nas funções de mastigação, deglutição e respiração também podem estar associados (MARCHESAN, 2004; BIANCHINI, 2000). Ainda com relação à posição dos dentes e das arcadas, sugere-se que o posicionamento dos dentes anteriores seja um dos principais fatores que alteram a articulação dos sons, visto que quase 90% de todas as consoantes são realizadas nesta região (LEAVY, CISNEROS, LEBLANC, 2016).

Quanto aos problemas de posicionamento de língua, estes podem ser classificados segundo o Protocolo de Avaliação Miofuncional Orofacial com Escores (AMIOFE) (FELÍCIO e FERREIRA, 2008). A língua em repouso está em posição normal quando aparece contida na cavidade oral, caso contrário apresenta-se alterada quando interposta aos arcos dentários, ultrapassando as faces incisais dos dentes anteriores e/ou as cúspides vestibulares dos dentes posteriores.

Alterações no modo respiratório também estão associados a distúrbios de linguagem e dificuldades na aprendizagem (HITOS et al., 2012) (RIBEIRO et al., 2015). Em uma amostra brasileira de 439 crianças respiradoras bucais de 4 a 12 anos de idade, foi diagnosticado alterações de fala em 31,2%, interposição de língua foi observada em 53,3% dos pacientes, seguida por troca articulatória (26,3%), ceceio frontal (21,9%) e duas ou mais alterações de fala ocorreram em 24,8% das crianças (HITOS et al., 2012) .

A literatura científica ainda é carente de estudos interdisciplinares com amostras representativas que avaliem a associação entre problemas articulatórios e de posicionamento de língua com os diferentes tipos de más-oclusões dentárias. Dessa maneira, o objetivo desse estudo foi avaliar a associação entre diferentes condições oclusais com alterações da fala e de posicionamento lingual em crianças em fase de dentição mista na cidade de Santa Maria, Rio Grande do Sul. A hipótese do estudo é que haja associação positiva entre alterações oclusais, alterações fonoarticulatórias e alteração na posição de língua.

2 ARTIGO – ASSOCIATION BETWEEN MALOCCLUSION WITH ARTICULATION DISORDERS AND TONGUE POSITION IN MIXED DENTITION CHILDREN: A CROSS-SECTIONAL STUDY.

Esse manuscrito será submetido no periódico American Journal of Orthodontics & Dentofacial Orthopedics (http://www.ajodo.org/content/authorinfo#idp1357376) (ANEXO 2).

TITLE PAGE

ASSOCIATION BETWEEN MALOCCLUSION WITH ARTICULATION DISORDERS AND TONGUE POSITION IN MIXED DENTITION CHILDREN: A CROSS-SECTIONAL STUDY

Débora do Canto Assaf

MSc Student, Dental Science Post Graduation Program, Universidade Federal Santa Maria (UFSM), Santa Maria, Rio Grande do Sul, Brazil. Contributed in the data collection and wrote the manuscript. Roraima Avenue 1000/26F, City of Santa Maria, State of Rio Grande do Sul, Country Brazil. Zip Code 97105-900.

deborassaf21@hotmail.com

Jessica Klöckner Knorst

MSc Student, Dental Science Post Graduation Program, Universidade Federal Santa Maria (UFSM), Santa Maria, Rio Grande do Sul, Brazil. Contributed performing statistical analysis and proofread manuscript. Roraima Avenue 1000/26F, City of Santa Maria, State of Rio Grande do Sul, Country Brazil. Zip Code 97105-900.
jessicaknorst1@gmail.com

Angela Ruviaro Busanello-Stella

PhD., Adjunct Professor, Department of Speech-Language Pathology, Universidade Federal Santa Maria (UFSM), Santa Maria, Rio Grande do Sul, Brazil. Contributed to study design and proofread manuscript. Roraima Avenue 1000/26, City of Santa Maria, State of Rio Grande do Sul, Country Brazil. Zip Code 97105-900.
angelafonoaudiologia@yahoo.com.br

Vilmar Antônio Ferrazzo

PhD., Associate Professor, Department of Stomatology, Universidade Federal Santa Maria (UFSM), Santa Maria, Rio Grande do Sul, Brazil. Contributed to proofread manuscript. Roraima Avenue 1000/26F, City of Santa Maria, State of Rio Grande do Sul, Country Brazil. Zip Code 97105-900.
vilmarferrazzo@uol.com.br

Ana Maria Toniolo da Silva

PhD., Adjunct Professor, Department of Speech-Language Pathology, Universidade Federal Santa Maria (UFSM), Santa Maria, Rio Grande do Sul, Brazil. Contributed to study design and proofread manuscript. Roraima Avenue 1000/26, City of Santa Maria, State of Rio Grande do Sul, Country Brazil. Zip Code 97105-900.
amariatoniolo@gmail.com

Luana Cristina Berwig
PhD., Speech Therapist, Clinical Hospital of Porto Alegre. Contributed to study design, data collection, and proofread manuscript. Ramiro Barcelos Street, 2350, City of Porto Alegre, State of Rio Grande do Sul, Country Brazil. Zip Code, 90035-007.
luanaberwig@gmail.com

Thiago Machado Ardenghi
PhD., Associate Professor, Department of Stomatology, Federal University of Santa Maria, Rio Grande do Sul, Brazil. Contributed in study design, statistical analysis and proofread manuscript. Roraima Avenue 1000/26F, City of Santa Maria, State of Rio Grande do Sul, Country Brazil. Zip Code 97105-900.
thiardenghi@hotmail.com

Mariana Marquezan
PhD., Adjunct Professor, Department of Stomatology, Federal University of Santa Maria, Rio Grande do Sul, Brazil. Contributed as advisor, participating in data collection, study design and proofread manuscript. Roraima Avenue 1000/26F, City of Santa Maria, State of Rio Grande do Sul, Country Brazil. Zip Code 97105-900.
mariana.marquezan@ufsm.br

Reprint requests to: Débora do Canto Assaf. Av. Presidente Vargas, 2355/ 1014, Centro, zip code: 97015-513, Santa Maria, RS - Brazil; +55 (55) 996763613; deborassaf21@hotmail.com

ABSTRACT

Introduction: Some factors that may influence the speech are the position of the teeth, mobility of lips, soft palate, tongue and mandible, as well as the intraoral space for articulation and resonance of the sounds. **Methods:** Cross-sectional study used a sample of 547 mixed-dentition children aged from 7 to 13 years old from south Brazilian schools. The sample was evaluated by questionnaires, dental and phonoaudiological examinations. The Poisson regression modeling technique was used. The variables were: overjet, overbite, posterior crossbite, articulation disorder, tongue position, age, sex, skin color and respiratory mode. **Results:** Individuals with deep overbite present a protective relationship to articulation disorders in relation to normal overbite, whereas individuals with posterior crossbite are 77% more likely to present this problem in relation to individuals without posterior crossbite. Regarding the change in the position of the tongue, having anterior open bite represents 2.36 times more frequency for the individual have this problem than children with regular overbite. Both the presence of deep overbite and being male represent protection factors for the abnormal tongue position in relation to normal overbite and female sex respectively. Having mouth/oronasal breathing represents 2.51 times more probability of having altered position of the tongue in relation to nasal breathing. **Conclusion:** The posterior crossbite was associated with speech distortion and altered tongue position, while the deep bite appears as a protection factor for problems in the articulation of sounds and the position of the tongue. Anterior open bites and mouth/oronasal breathing are also associated with the tongue in an altered position and the male sex appears as a protective factor of having the tongue in abnormal position.

Keywords: Mixed Dentiton, Malocclusion, Orthodontics, Speech-Language Pathologist, Myofunctional Therapy.

INTRODUCTION

The ability to communicate and interact socially is of high importance for individuals of all ages, and language is a key factor for communication between people. Speech is the result of the planning and execution of sequences of movements, which require very accurate neuromuscular coordination[1]. Articulation disorders can begin since childhood. Its prevalence is approximately 22.3% in children of a Brazilian sample[2]. However, its etiology is complex, comprising genetic factors 11%, environmental 83% (social experiences, diet, exposure to toxins) and mixed 6% according to the review of Rogers et al[3].

Among the factors that influence the articulatory points' precision are the presence and position of the teeth, mobility of the lips, cheeks and soft palate, and the position and mobility of the tongue and mandible, the intraoral space for articulation and resonance of the sounds[4], as well as changes in respiratory pattern of the individual[15]. Deviations from chewing, swallowing and breathing functions may also be associated[5,6]. Still concerning the position of the teeth and the arches, it is suggested that the position of anterior teeth is one of the main factors that alter the articulation of sounds, since almost 90% of all consonants are performed in this region[7].

The literature has shown that myofunctional therapy in children with anterior open bite and posterior crossbite was able to re-educate tongue positioning at rest, during swallowing of liquid and solid foods and to increase the force of tongue elevation, but it was not able to improve the articulation of some phonemes[17], suggesting that multidisciplinary treatments, including orthodontic correction, are necessary to fully solve the problem.

In the scientific literature, more studies with more representative samples are required to prove stronger associations between articulatory and tongue-positioning problems with different types of malocclusions. It is important for dentists and speech therapists to be aware of occlusal problems that may interfere with the articulation of sounds and tongue position, as such problems may interfere with the interpersonal relationships of individuals throughout their lives

The aim of this study was to evaluate the association between different occlusal conditions with articulation disorders and tongue positioning in children in the mixed dentition phase in the city of Santa Maria, Rio Grande do Sul. The hypothesis of the study is that articulation disorder and altered tongue position are associated with

occlusal changes.

MATERIAL AND METHODS

Study Design

The research consisted of a cross-sectional study carried out in the city of Santa Maria, Rio Grande do Sul, Brazil, in the year 2015, when the municipality had an estimated population of 261,031 inhabitants, of which 30,216 (11.57%) were enrolled in elementary education (Demographic Census of the Brazilian Institute of Geography and Statistics, 2015).

Sample

For the sampling process, the procedure of random sampling by double stage conglomerate was adopted. Knowing that in the year 2014, 10,569 students were enrolled in the 26 elementary schools of the state network, where nine of these schools were randomly selected according to the different administrative regions and size of the school. Thus, schools were considered primary sample unit and, the children, the secondary sample unit. From the lists of students enrolled in the nine selected schools, it was considered the number of children invited to participate in the study, computing an amount of 1,559 children.

Of the total number of students invited to participate in the study, 948 consented and had the Consent Form signed by parents or guardians (response rate 60.8%). Of the 948 children who agreed to participate in the study, 547 were included in the sample. All the children in the mixed dentition phase with the first erupted upper molars were included in the study. Exclusion criteria were previous or current orthodontic and/or speech therapy treatment, noticeable signs of syndromes and/or cognitive limitations. The losses of the studied sample were due to the following reasons: deciduous dentition, permanent dentition, not having permanent incisors to measure overjet and overbite, children who missed class on evaluation days and missing datas.

Demographic and socioeconomic variables were collected through a semi-structured questionnaire answered by parents or guardians (APPENDIX B), which included the following information: general health aspects, historical of current or previous orthodontic and/or speech therapy treatment, gender (female or male), skin

color (white or non-white), maternal and paternal schooling. Age was dichotomized by the median at <10 years and >10 years. Maternal and paternal schooling was collected in complete years of study and later dichotomized in elementary school incomplete (<8 years) and complete (>8 years).

Dental Evaluation

The children were examined by four previously trained and calibrated dentists (Kappa intra and inter-examiner > 0.70) to assess all variables considered through an evaluation form (APPENDIX C). The examinations were performed in schools, in rooms provided by the school board, under natural light conditions, the child and the professional in a seated position face to face. These tests were performed to classify the teething period (deciduous, mixed or permanent) and periods of mixed dentition (first transitional period, intertransitory period and second transitional period), as well as to evaluate occlusal alterations: anterior open bite (present / absent), unilateral or bilateral posterior crossbite, anterior crossbit, overjet (mm), overbite (mm), Angle molar relationship (Class I, II and III) and early dental loss. For overjet and overbite measurements, the World Health Organization (WHO) probe (Millennium - Golgran, São Caetano do Sul, SP, Brazil) was used to measure in millimeters. Regarding the overjet and overbite, the measurements between 0.5 and 3.5mm were considered adequate; measurements were considered increased when ≥ 4mm and decreased when ≤ 0mm[18].

Speech Language Evaluation

The children were evaluated by a single calibrated speech therapist (Kappa> 0.70) using an evaluation form composed of data extracted from the Orofacial Protocol with Scores (AMIOFE)[24] and data taken from the Orofacial Myofunctional Assessment Protocol (MBGR)[25] (APPENDIX D). From this evaluation, the respiratory mode of the participants was verified through spontaneous observation of the patient, classified as nasal, mouth or oronasal according to AMIOFE. The positioning of the tongue was evaluated during rest and during the speech evaluation, classified as normal (contained in the oral cavity) or altered (interposed to dental arches with the following subclassifications: adaptation, dysfunction or excessive protrusion) according to

AMIOFE protocol. The participant's speech was also evaluated through automatic speech, asking the children to count from 1 to 20, telling the days of the week and the letters of the alphabet, later they were asked to describe engravings on a drawing board, so they were classified as absence of speech distortion or as presence of distortion speech, according to MBGR protocol.

Statistical analysis

Data were analyzed using the STATA 14 statistical program (StataCorp, 2014. Stata Statistical Software: Release 14.1, College Station, TX: StataCorp LP). This study considered two outcomes: (1) speech distortion (absent/present) and (2) tongue position (normal/altered). It was performed a descriptive analysis of the demographic, socioeconomic and clinical characteristics of the sample, such as: age, sex, skin color, father and mother schooling, overjet (adequate, accentuated and anterior cross bite), overbite (adequate, deep bite and anterior open bite), posterior crossbite and respiratory mode, according to the distribution of outcome variables.

Unadjusted analyses were performed to provide a preliminary assessment of the association between predictor variables and outcomes. Poisson regression models with adjusted robust variance were used to evaluate the association between the characteristics of the sample and the prevalence of speech distortion and tongue position. The exploratory variables that presented a value of $p \leq 0.20$ in the univariate analysis were included in the multivariate model. Results are presented as prevalence ratio (PR) and respective 95% confidence interval (95% CI). A significance level of 0.05 was considered.

RESULTS

Five hundred and forty-seven children participated in the study, of which 54.7% were girls and 45.3% were boys, 66.6% of the sample was composed of children aged from 7 to 10 years. White people (79.2%) represent the great majority of the sample. Regarding the data from the occlusal evaluation, posterior crossbites were present in 11.1%, and anterior open bites in 10.1%. Adequate overbite was observed in 43.3% of the sample, while 67.8% of the sample presented adequate overjet. Sample distribution according demographic, socioeconomics characteristics, occlusal conditions and respiratory mode are expressed in Table I.

The presence or absence of articulation disorders and tongue position according to demographic, socioeconomics characteristics, occlusal conditions and respiratory mode is expressed in Table II. The prevalence of children with some type of articulation disorder was found in 31.4% of the sample. The percentage of children with some type of alteration in the position of the tongue was 35.8%. The majority of children with articulation disorder and altered tongue position had ages between 7 and 10 years.

Articulation disorder association with demographic, socioeconomics characteristics, occlusal conditions and respiratory mode is shown in Table III (unadjusted and adjusted association obtained using Poisson regression with robust variance). When the multivariate model was performed, the variables overbite and posterior crossbite showed association with articulation disorder. It can be observed that individuals with deep bite present a protective relation to articulation disorder. The presence of deep bite represents 59% more prevalence of having speech considered normal in relation to normal overbite. While individuals with posterior crossbite are at risk for articulation disorder. Having posterior crossbite is 77% more likely to present articulation disorder when compared to individuals without posterior crossbite.

Tongue position association with demographic, socioeconomics characteristics, occlusal conditions and respiratory mode is shown in Table IV (unadjusted and adjusted association obtained using Poisson regression with robust variance). The presence of anterior open bite represents 2.36 times more frequency for the individual to have an alteration in the position of the tongue in relation to the individuals with adequate overbite. Concerning the presence of a deep bite and being male, they represent protection factors to have the tongue in a normal position. Having deep bite represents 61% more probability of having the tongue in normal position comparing to normal overbite, and being male represents 35% more probability of not having an alteration in tongue position in relation to female sex. Regarding the respiratory mode, participants who have altered respiratory mode, mouth or oronasal breathing, are 2.51 times more likely to have a position of the tongue altered when compared to those with normal (nasal) breathing.

DISCUSSION

The results of this cross-sectional study, which evaluated 547 children in the mixed dentition, showed that 31.4% of the children had speech distortion and 35.8% presented alteration in the position of the tongue. These findings are in agreement with two studies conducted in Brazilian populations[2,19], where 22.3% and 42% of the children presented some type of alteration in the articulation of sounds. Studies in other countries showed lower prevalence of speech distortion, such as a study conducted in Australia where prevalence was 13% [20], and in USA was 20% [7].

The majority of children with speech distortion and language impairment were younger than 10 years, but this result did not present a statistically significant difference, agreeing with the studies of Rabelo et al; of 2011 and 2015[2,21], where there was no association between age and speech problems, except for children under 5 years of age.

There was no association between gender and speech distortion, in agreement with studies by Rabelo[2] and Goulart[19]. However, the male gender was shown to be a protective factor for altered tongue position.

In the association between malocclusion and speech distortion, a positive association was found between posterior crossbite, presence of speech distortion and alteration in tongue position. The presence of posterior crossbite represent a risk factor for speech distortion. This result is in agreement with the findings of Farret et al.[22] who carried out a study in the same city investigated here. However, it disagrees with Farronato's work in 2012[23], which evaluated 880 Italian children and considered posterior crossbite as a low risk for sound articulation problems.

Deep overbite has a negative association with speech distortion and tongue position. Having deep overbite is a protective factor for speech distortion and altered position of the tongue. Previous studies do not corroborate this result. While Laine[12] and Leavy[7] found no association between these variables, Farronato[23] and Lubit[13] found an association between deep bite and speech problems. This finding leads us to reflect on the real need to refer young patients for treatment of mild to moderate deep bites, considering that the correction of this malocclusion may constitute over-treatment and lead to future articulatory difficulties.

The anterior open bite was not associated with speech distortion, in disagreement with Leavy[7] and Ocampo-Parra[10]. Probably the small number of children in the sample who presented anterior open bite was not sufficient to express such

association.

The increased overjet and the decreased overjet that would represent an Angle Class II and Class III relationship in the anterior region, respectively, were not associated with speech problems in the present study, contrary to some findings in the literature, such as in the study of Farronato[23], where the Class II relationship was considered low risk but the Class III relationship was considered as a high risk for speech problems.

Respiratory mode was not associated with speech distortion; it was only associated with alteration in tongue position, partially agreeing with Hitos et al.,[15] where speech changes were present in 31.2% of mouth/oronasal breathers and the tongue position was altered in 53.3% of these patients.

The strength of the study is the evaluation of a representative sample, so the results can be extrapolated to all the children (in the range age) in the city of Santa Maria, RS.

As a limitation of this study, we can cite the low sample size of children with anterior open bite and anterior crossbite. Further investigations are needed to substantiate the relationships between malocclusions, speech disorders, language position and respiratory mode, especially longitudinal studies for the cause-effect relationship to be established.

The high sample size of this study, combined with a complete occlusal evaluation, considering the three occlusion components (vertical, transverse and sagittal), respiratory mode evaluation, tongue position and specific diagnosis of articulation disorder have potential to clarify doubts about the association between malocclusion, changes in the position of the tongue and articulation disorders, enabling dental surgeons and speech therapists, when observing certain alterations, to plan interdisciplinary treatments, guaranteeing an adequate occlusal relationship and phonoarticulatory function. Also, this study demonstrated that some occlusal disorders (overbite) could be treated at appropriate times, without interfering with the child's language development.

CONCLUSION

The posterior crossbite was associated with speech dysfunction and altered tongue position, while the deep bite appears as a protection factor for problems in the

articulation of sounds and the position of the tongue. Anterior open bites and mounth/oronasal breathing are also associated with the tongue in an altered position and the male gender appears as a protective factor to have the tongue in a normal position.

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REFERENCES

1. Wertzner HF. Fonologia: Desenvolvimento e alterações. *Tratado Fonoaudiol.* 2004;1(5):772–86.

2. Rabelo ATV, Campos FR, Friche CP, et al. Speech disorders in students in Belo Horizonte. *J Soc Bras Fonoaudiol.* 2011; Dec; 33(4):344–50. Available at: http://dx.doi.org/10.1016/j.rppede.2015.08.008.

3. Rogers CR, Nulty KL, Betancourt MA, DeThorne LS. Causal effects on child language development: A review of studies in communication sciences and disorders. *J. Commun. Disord.* 2015;57:3–15. Available at: http://dx.doi.org/10.1016/j.jcomdis.2015.06.004.

4. Marchesan, I.Q; Silva, H.J; Tomé M. *Tratado das especialidades em fonoaudiologia*. 1st ed. (guanabara koogan, ed.). São Paulo; 2014.

5. Marchesan I. Alterações de fala de origem musculoesquelética. *Tratado Fonoaudiol.* 2004;1(5):292–303.

6. Bianchini EM. Avaliação fonoaudiológica da motricidade oral: anamnese, exame clínico, o quê e por quê avaliar. *Pró-Fono Rev. Atualização Científica.* 2000;6(3):191–254.

7. Leavy KM, Cisneros GJ, LeBlanc EM. Malocclusion and its relationship to speech sound production: Redefining the effect of malocclusal traits on sound production. *Am. J. Orthod. Dentofac. Orthop.* 2016;150(1):116–23. Available at: http://dx.doi.org/10.1016/j.ajodo.2015.12.015.

8. Lee ASY, Whitehill TL, Ciocca V, Samman N. Acoustic and perceptual analysis of the sibilant sound /s/ before and after orthognathic surgery. *J. Oral Maxillofac. Surg.* 2002;60(4):364–72.

9. Jesus LMT, Costa IM, Araújo A. Speech production in two occlusal classes. *Onomazein* 2014;29(1):129–51.

10. Ocampo-Parra A, Escobar-Toro B, Sierra-Alzate V, Rueda ZV, Lema MC. Prevalence of dyslalias in 8 to 16 year-old students with anterior open bite in the municipality of Envigado, Colombia. *BMC Oral Health* 2015;15(1):1–6. Available at: http://dx.doi.org/10.1186/s12903-015-0063-1.

11. Kawamura, M., Nojima, K., Nishii, Y., & Yamaguchi, H. A cineradiographic study of deglutitive tongue movement in patients with anterior open bite. *Bull. Tokyo Dent. Coll.* 2003;44(3):133–9.

12. Laine T, Linnasalo AL, Jaroma M. Articulatory disorders in speech among Finnish-speaking students according to age, sex, and speech therapy. *J. Commun. Disord.* 1987;20(4):327–38.

13. Lubit E. The relationship of malocclusion and faulty speech articulation. *J. Oral Med.* 1967;22(1):47–55.

14. Laine T. Articulatory disorders in speech as related to size of the alveolar arches. *Eur. J. Orthod.* 1986;8(3):192–7.

15. Hitos SF, Arakaki R, Solé D, Weckx LLM. Oral breathing and speech disorders in children. *J. Pediatr. (Rio. J).* 2013;89(4):361–5. Available at: http://dx.doi.org/10.1016/j.jped.2012.12.007.

16. Ribeiro GCA, dos Santos ID, Santos ACN, Paranhos LR, César CPHAR. A influência do modo respiratório no processo de aprendizagem: uma revisão sistemática da literatura. *Braz. J. Otorhinolaryngol.* 2016;82(4):466–78. Available at: http://dx.doi.org/10.1016/j.bjorl.2015.08.026.

17. Van Dyck C, Dekeyser A, Vantricht E, et al. The effect of orofacial myofunctional treatment in children with anterior open bite and tongue dysfunction: A pilot study. *Eur. J. Orthod.* 2016;38(3):227–34.

18. Proffit, W. R.; Fields, H. W.; Sarver DM. *Contemporary Orthodontics*. 5th ed. Rio de Janeiro: Elsevier; 2012.

19. Goulart, B. N; Chiari, G, B. M. Prevalence of speech disorders in schoolchildren and its associated factors. *Rev. Saude Publica* 2007;41(5):726–31. Available at: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed8&NEWS=N&AN=17923893.

20. McLeod S, Harrison LJ. Epidemiology of Speech and Language Impairment in a Nationally Representative Sample of 4- to 5-Year-Old Children. *J. Speech, Lang. Hear. Res.* 2009;52(5):1213–29.

21. Rabelo, A. T. V., Campos, F. R., Friche, C. P., Silva, B. S. V. da, Friche, A. A. de L., Alves, C. R. L., & Goulart, L. M. H. de F. (2015). *Speech and language disorders in children from public schools in Belo Horizonte. Revista Paulista de Pediatria (English Edition), 33(4), 453–459.*

22. Farret MM, Jurach EM, Brandão L, Moraes DC, Brandão SR SS. Relationship between malocclusion and fonoarticulatory disorders. *Int J Orofac. Myol.* 1998;24(2):6–20.

23. Farronato, G; Giannini, L; Riva, R; Gabalti, G; Maspero C. Correlations between malocclusions and dyslalias. *Eur. J. Paediatr. Dent.* 2012;13(1):178–83.

24. Felício, C.M; Ferreira, C.L. Protocol of orofacial myofuncional evaluation with scores. *Int J Otorhinolaryngol.* 2008;72(3):367-375.

25. Marchesan, I.Q; Berretin-Félix, G; Genaro, K.F. MBGR Protocol of orofacial myofunctional evaluation with scores. *International Journal of Orofacial Myology.2012;38(1): 1-77.*

TABLES

Table I. Sample distribution according to demographic, socioeconomic and clinical characteristics (n = 547).

Variables	n	%
Demographic and socioeconomic variables		
Sex		
Female	299	54.7
Male	248	45.3
Age		
7-10 years	363	66.6
11-13 years	182	33.4
Skin color		
White	433	79.2
Non-white	114	20.8
Mother's education		
≤ 8 years	171	32.7
> 8 years	352	67.3
Father's education		
≤ 8 years	203	41.7
> 8 years	284	58.3
Clinical Variables		
Overjet		
Normal	339	67.8
Anterior crossbite	21	4.2
Increased	140	2.0
Overbite		
Normal	222	43.3
Anterior open bite	52	10.1
Deep bite	239	46.6
Posterior crossbite		
Absent	478	88.9
Present	60	11.1
Respiratory mode		
Normal	344	63.0
Oral/Oronasal	202	37.0

Values less than 547 are due to missing data.

Table II. Demographic, socioeconomic and clinical variables according to speech articulation disorders and tongue position.

Variables	Articulation Disorders[n(%)]		Tongue position [n (%)]	
	Absent	Present	Normal	Altered
Demographic and socioeconomic variables				
Sex				
Female	252 (84.3)	47 (15.7)	237 (79.3)	62 (20.7)
Male	209 (84.6)	38 (15.4)	208 (84.9)	37 (15.1)
Age				
7-10 years	298 (76.0)	64 (24.0)	291 (80.6)	70 (19.4)
11-13 years	161 (88.5)	21 (11.5)	153 (84.5)	28 (15.5)
Skin color				
White	363 (84.0)	69 (16.0)	353 (82.1)	77 (17.9)
Non-white	98 (86.0)	16 (14.0)	92 (80.7)	22 (17.3)
Mother's education				
≤ 8 years	144 (84.2)	27 (15.8)	141 (82.5)	30 (17.5)

> 8 years	297 (84.6)	54 (15.4)	284 (81.4)	65 (18.6)
Father's education				
≤ 8 years	172 (84.7)	31 (15.3)	160 (78.8)	43 (21.2)
> 8 years	236 (83.4)	47 (16.6)	234 (83.3)	47 (16.7)
Clinical Variables				
Overjet				
Normal	284 (84.0)	54 (16.0)	290 (85.8)	48 (14.2)
Anterior crossbite	16 (76.2)	5 (23.8)	18 (85.7)	3 (14.3)
Increased	126 (90.0)	14 (10.0)	111 (80.4)	27 (19.6)
Overbite				
Normal	177 (80.1)	44 (19.9)	177 (80.5)	43 (19.5)
Anterior open bite	36 (69.2)	16 (30.8)	23 (44.2)	29 (55.8)
Deep bite	221 (92.5)	18 (7.5)	222 (93.3)	16 (6.7)
Posterior crossbite				
Absent	409 (85.7)	68 (14.3)	396 (83.4)	79 (16.6)
Present	44 (73.3)	16 (26.7)	41 (68.3)	19 (31.7)
Respiratory mode				
Normal	292 (84.9)	52 (15.1)	306 (89.2)	37 (10.8)
Oral/Oronasal	169 (83.7)	33 (16.3)	139 (69.2)	62 (30.8)

Values less than 547 are due to missing data.

Tabela III. Unadjusted and adjusted association between the independent variables for articulation disorders, determined using Poisson regression with robust variance.

Variables	**Unadjusted RP[a] (IC[b] 95%)**	**P-value**	**Adjusted RP[a] (IC[b] 95%)**
Demographic and socioeconomic variables			
Sex		0.915	
Female	1		-
Male	0 .97 (0.66-1.45)		
Age		**0.069**	
7-10 years	1		1
11-13 years	0.65 (0.41-1.03)		0.78 (0.48-1.27)
Skin color		0.615	
White	1		-
Non-white	0.87 (0.53-1.45)		
Mother's education		0.905	
≤ 8 years	1		-
> 8 years	0.97 (0.63-1.48)		
Father's education		0.693	
≤ 8 years	1		-
> 8 years	1.08 (0.71-1.64)		
Clinical Variables			
Overjet		**0.098**	
Normal	1		1
Anterior crossbite	1.49 (0.66-3.33)		0.79 (0.33-1.91)
Increased	0.62 (0.35- 1.08)		0.69 (0.39-1.23)
Overbite		**0.000**	
Normal	1		1
Anterior open bite	1.54 (0.95-2.51)		1.63 (0.86-3.11)
Deep bite	0.37 (0.22-0.63)		0.41 (0.24-0.71)**
Posterior crossbite		**0.010**	
Absent	1		1
Present	1.87 (1.16-3.00)		1.77 (1.09-2.88)*
Respiratory mode		0.704	
Normal	1		-

Oral/Oronasal	1.08 (0.72-1.61)	

*P-value <0.05; **P-value <0.01;
[a]RP, prevalence ratio,
[b]IC, confidence interval

Table IV. Unadjusted and adjusted association between the independent variables for tongue position, determined using Poisson regression with robust variance.

Variables	**Unadjusted RP[a] (IC[b] 95%)**	**P-value**	**Adjusted RP[a] (IC[b] 95%)**
Demographic and socioeconomic variables			
Sex		**0.094**	
Female	1		1
Male	0 .72 (0.50-1.05)		0.65 (0.44-0.95)*
Age		0.269	
7-10 years	1		-
11-13 years	0.79 (0.53-1.19)		
Skin color		0.731	
White	1		-
Non-white	1.07 (0.70-1.65)		
Mother's education		0.765	
≤ 8 years	1		-
> 8 years	1.06 (0.71-1.57)		
Father's education		0.214	
≤ 8 years	1		-
> 8 years	0.78 (0.54-1.14)		
Clinical Variables			
Overjet		0.991	
Normal	1		-
Anterior crossbite	1.00 (0.34-2.96)		
Increased	1.37 (0.89-2.11)		
Overbite		**0.000**	
Normal	1		1
Anterior open bite	2.85 (1.98-4.09)		2.36 (1.59-3.49)**
Deep bite	0.34 (0.19-0.59)		0.39 (0.23-0.67)**
Posterior crossbite		**0.000**	
Absent	1		1
Present	1.90 (1.24-2.90)		1.21 (0.79-1.87)
Respiratory mode		**0.000**	
Normal	1		1
Oral/Oronasal	2.85 (1.97-4.13)		2.51 (1.70-3.71)**

*P-value <0.05; **P-valuer <0.01;
[a]RP, prevalence ratio,
[b]IC, confidence interval

3 CONSIDERAÇÕES GERAIS

Apesar dos objetivos propostos nesse estudo serem cumpridos, evidências científicas mais fortes são necessárias para maior entendimento da progressão, desenvolvimento e das relações causa-efeito entre más-oclusões, distúrbios de fala, posição de língua e modo respiratório.

REFERÊNCIAS

ALMEIDA, M. R., PEREIRA, A.L.P., ALMEIDA, R.R., ALMEIDA-PEDRIN, R.R., SILVA FILHO, O. G. Prevalence of malocclusion in children aged 7 to 12 years. ***Dental Press J Orthod***. 16(4):123-31, 2011.

BIANCHINI, E.M.G. Avaliação fonoaudiológica da motricidade oral: anamnese, exame clínico, o quê e por quê avaliar. In: BIANCHINI E.M.G. (org). Articulação temporomandibular: implicações, limitações e possibilidades fonoaudiológicas. ***Carapicuíba: Pró-fono*****;** 20(3):191-254, 2000.

FARRET, M.M., JURACH, E.M., BRANDÃO, L., MORAES, D.C., BRANDÃO, S.R. Relationship between malocclusion and fonoarticulatory disorders. ***Int J Orofac. Myol****.* 24(2):6–20, 1998.

FARRONATO, G; GIANNINI, L; RIVA, R; GABALTI, G; MASPERO C. Correlations between malocclusions and dyslalias. ***Eur. J. Paediatr. Dent.***13(1):178–83, 2012.

FELÍCIO, C.M; FERREIRA, C.L. Protocol of orofacial myofuncional evaluation with scores. ***Int J Otorhinolaryngol.*** 72(3):367-375, 2008.

GOULART, B. N; CHIARI, G, B. M. Prevalence of speech disorders in schoolchildren and its associated factors**.** ***Rev. Saude Publica***. 41(5):726–31, 2007. Available at: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed8&NEWS=N&AN=17923893.

HITOS, S. F., ARAKAKI. R., SOLÉ, D., WECKX, L. L. M. Oral breathing and speech disorders in children. ***J. Pediatr.*** Rio de Janeiro*.* 89(4):361–5, 2013. Available at: http://dx.doi.org/10.1016/j.jped.2012.12.007.

JESUS, L.M.T., COSTA, I.M., ARAÚJO, A. Speech production in two occlusal classes. ***Onomazein*****.** 29(1):129–51, 2014.

KAWAMURA, M., NOJIMA, K., NISHII, Y., & YAMAGUCHI, H. A cineradiographic study of deglutitive tongue movement in patients with anterior open bite. ***Bull. Tokyo Dent. Coll.*** 44(3):133–9, 2003.

LAINE, T., LINNASALO, A.L., JAROMA, M. Articulatory disorders in speech among Finnish-speaking students according to age, sex, and speech therapy. ***J. Commun. Disord.*** 20(4):327–38, 1987.

LEAVY, K.M.; CISNEROS, G.J.; LEBLANC, E.M. Malocclusion and Its Relationship to Speech Sound Production: Redefining the Effect of Malocclusal Traits on Sound Production. ***American Journal of Orthodontics and Dentofacial Orthopedics,*** 150(8):116–123, 2016.

LEE, A.S.Y., WHITEHILL, T.L., CIOCCA, V., SAMMAN, N. Acoustic and perceptual analysis of the sibilant sound /s/ before and after orthognathic surgery. ***J. Oral Maxillofac. Surg.*** 60(4):364–72, 2002.

LUBIT, E. The relationship of malocclusion and faulty speech articulation. ***J. Oral Med****.* 22(1):47–55, 1967.

MARCHESAN, I.Q. Alterações de fala de origem musculoesquelética. In: FERREIRA P. (org*).* ***Tratado de Fonoaudiologia***. São Paulo: Roca. 1(5): 292-303, 2004.

MARCHESAN, I.Q; SILVA, H.J; TOMÉ, M.C. ***Tratado das especialidades em fonoaudiologia.*** São Paulo: Guanabara Koogan, 1ª ed, p. 351- 357, 2014.

MCLEOD, S., HARRISON, L.J. Epidemiology of Speech and Language Impairment in a Nationally Representative Sample of 4- to 5-Year-Old Children. ***J. Speech, Lang. Hear. Res.*** 52(5):1213–29, 2009.

OCAMPO-PARRA, A., ESCOBAR-TORO, B., SIERRA-ALZATE, V., RUEDA, Z.V., LEMA, M.C. Prevalence of dyslalias in 8 to 16 year-old students with anterior open bite in the municipality of Envigado, Colombia**.** ***BMC Oral Health***. 15(1):1–6, 2015. Available at: http://dx.doi.org/10.1186/s12903-015-0063-1.

PROFFIT, W. R.; FIELDS, H. W.; SARVER DM. ***Contemporary Orthodontics***. 5ª ed. Rio de Janeiro: Elsevier; 2012.

RABELO, A T. V., CAMPOS, F. R., FRICHE, C. P., et al. Speech and language disorders in children from public schools in Belo Horizonte. ***Rev. Paul. Pediatr.*** 33(4):453–9, 2015. Available at: http://dx.doi.org/10.1016/j.rppede.2015.08.008.

RABELO, A.T.V., CAMPOS, F.R., FRICHE, C.P., ET AL. Speech disorders in students in Belo Horizonte. ***J Soc Bras Fonoaudiol.*** Dec; 33(4):344–50, 2011. Available at: http://dx.doi.org/10.1016/j.rppede.2015.08.008.

RIBEIRO, G.C.A., DOS SANTOS, I.D., SANTOS, A.C.N., PARANHOS, L.R., CÉSAR, C.P.H.A.R. A influência do modo respiratório no processo de aprendizagem: uma revisão sistemática da literatura. ***Braz. J. Otorhinolaryngol****.* 82(4):466–78, 2016. Available at: http://dx.doi.org/10.1016/j.bjorl.2015.08.026.

ROGERS, C.R., NULTY, K.L., BETANCOURT, M.A., DETHORNE, L.S. Causal effects on child language development: A review of studies in communication sciences and disorders. ***J. Commun. Disord****.* 57(2):3–15, 2015. Available at: http://dx.doi.org/10.1016/j.jcomdis.2015.06.004.

VAN DYCK, C., DEKEYSER, A., VANTRICHT, E. The effect of orofacial myofunctional treatment in children with anterior open bite and tongue dysfunction: A pilot study**.** ***Eur. J. Orthod.*** 38(3):227–34, 2016.

WERTZNER, H.F. Fonologia: Desenvolvimento e alterações. In: FERREIRA P, BELFI-LOPES, D.M; LIMONGI, S.C.O. (org). ***Tratado de Fonoaudiologia*****.** São Paulo: Roca, 23(1): 772-786, 2004.

APÊNDICES

APÊNDICE A - TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

UNIVERSIDADE FEDERAL DE SANTA MARIA – UFSM
CENTRO DE CIÊNCIAS DA SAÚDE - CCS
PROGRAMA DE PÓS GRADUAÇÃO EM DISTÚRBIOS DA COMUNICAÇÃO HUMANA
PROJETO: "Caracterização e Avaliação Integradas dos distúrbios da Motricidade Orafacial e da Postura Corporal-Fase 2"

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

As informações contidas neste documento têm por objetivo esclarecer detalhadamente os objetivos e procedimentos desta pesquisa e obter por escrito autorização para participação na mesma, com livre arbítrio e sem coação.
O projeto é executado por alunos de graduação em fonoaudiologia e fisioterapia, bem como mestrandos e doutorandos do Programa de Pós-Graduação em Distúrbios da Comunicação Humana, do Centro de Ciências da Saúde, da Universidade Federal de Santa Maria, sob orientação da Profª. Drª. Ana Maria Toniolo da Silva (Curso de Fonoaudiologia), e Profª. Drª. Eliane Corrêa (Curso de Fisioterapia).
Objetivo: avaliar os diversos aspectos relacionados à motricidade orofacial e à postura corporal para verificar se existe algum problema que dificulte a respiração, deglutição, mastigação e fala e agilizar o tratamento de tais alterações.
Justificativa: as alterações relacionadas à motricidade orofacial e à postura corporal, geralmente causam problemas que aumentam, quando em conjunto. Assim, a importância da realização desta pesquisa está em obter informações precisas e objetivas acerca destas alterações, para melhor direcionar o processo terapêutico.
Esta pesquisa não implica prejuízoe/ou risco aos participantes, pelo contrário, traz benefícios, uma vez que propõem sem custos avaliação fonoaudiológica, fisioterapêutica, otorrinolaringológica e odontológica, a fim de detectar os sujeitos com alterações de motricidade orofacial e/ou de postura corporal, encaminhando-as para as intervenções necessárias. Os eventuais riscos que podem ocorrer referem-se ao deslocamento até os locais de avaliação (universidade e clínicas particulares) ou naquelas avaliações em que seja necessário o uso de adesivos na pele, no que se refere a sua retirada.
Procedimentos: Após consentimento para participação no estudo, será realizada triagem fonoaudiológica para selecionar os sujeitos que se enquadram nos critérios do estudo. Em seguida, os participantes **poderão** realizar avaliação fonoaudiológica, fisioterapêutica, otorrinolaringológica, odontológica com moldagem do palato, cefalométrica,antropométrica, fotográfica, eletromiográfica e baropodométrica, entre outros. Previamente às avaliações, será realizada uma breve entrevista com o paciente e/ou responsável para obtenção de informações sobre possíveis queixas que irão direcionar e complementar as avaliações. **Cabe destacar, que as avaliações serão selecionadas de acordo com o objetivo da pesquisa, sendo que alguns sujeitos não realizarão todas as avaliações citadas.**
Nestas avaliações serão realizados os seguintes procedimentos:
1. Avaliação fonoaudiológica: Avaliação das estruturas e funções do rosto (lábios, língua, bochechas, céu da boca e as funções de respiração, mastigação,deglutição, sucção e fala).
2. Avaliação fisioterapêutica: Resposta de questionário com perguntas sobre os seus hábitos de vida. O modo de respirar será avaliado com um aparelho no qual se deve puxar e soltar o ar em um tubo de borracha, e com outro aparelho em que apenas irão soprar. Também será analisada a diferença entre a inspiração e expiração, com o uso de uma fita métrica. Haverá ainda, uma avaliação da postura corporal, na qual os pacientes serão fotografados nas posições de frente, perfil e costas. As fotos serão analisadas em um programa de computador.
3. Avaliação otorrinolaringológica: Será realizada pelo médico por meio do exame de nasofibrofaringoscopia composto por cabo flexível e fino colocado no nariz do paciente após aplicação de um anestésico tópico, para visualização da garganta e do nariz. Esta avaliação não traz nenhum risco ao paciente, sendo que se causar algum desconforto mediante manifestação de vontade de não se submeter ao exame, o mesmo não será realizado.
4. Avaliação odontológica e moldagem do palato (céu da boca): Será realizada por um dentista que verificará o período da dentição, o estado de conservação dos dentes e possíveis alterações na dentição. Também será realizada a moldagem do palato (céu da boca) e dos dentes superiores com alginato (uma massinha com sabor de tuti-fruti que endurece na boca em poucos segundos). Depois de retirado o molde da boca, o mesmo será passado para o gesso. O molde de palato eventualmente causa desconforto em algumas crianças que se assustam como procedimento. Caso isso ocorra, a moldagem
não será realizada.
5. Avaliação cefalométrica e tomográfica: será realizada em um centro de radiografia e documentação ortodôntica. Esta avaliação não dói, não é invasiva, não causa nenhum prejuízo ao paciente e possibilita a realização medidas de algumas dimensões da cabeça, através de uma radiografia. Nestes exames poderão ser utilizados meios de contraste.
6. Avaliação antropométrica: serão marcados alguns pontos no rosto do paciente com lápis ou delineador de maquiagem e realizadas medidas a partir destas marcações. O instrumento utilizado para medir é um paquímetro, um aparelho de metal, não invasivo, que terá suas hastes levemente encostadas na pele da criança. Essa avaliação é indolor e não causa desconforto. Eventualmente o sujeito poderá ser avaliado pelo método de antropometria computadorizado, onde o único instrumento a encostar na pele do paciente será o delineador para marcação dos pontos da face.
7. Avaliação fotográfica: serão tiradas fotos do rosto (dentro e fora da boca) para complementar a avaliação odontológica e cefalométrica.
8. Avaliação eletromiográfica: este exame é um procedimento que não dói, não é invasivo, feito com eletrodos (adesivos) colados na superfície da pele. Não causa nenhum prejuízo ou dano ao indivíduo e verifica a atividade dos músculos, sua "força". Durante realização do exame, o paciente permanecerá na posição sentada confortável e com os olhos abertos.Para este exame será feita a limpeza da pele do local avaliado com álcool etílico 70%. O único desconforto que os participantes poderão sentir é em função da retirada de eletrodos da pele, pois estes possuem adesivos que colam, porém tal retirada será feita com cuidado a fim de minimizar qualquer sensação desagradável. A duração desta avaliação é de cerca de uma hora e trinta minutos, sendo o exame mais demorado do projeto.
9. Avaliação baropodométrica: o exame da descarga de peso é feito de pés descalços em cima de uma plataforma computadorizada e também não trás riscos ou desconforto.

As avaliações acima poderão ser acompanhadas pelo responsável, quando for menor de idade, sendo que o exame poderá ser suspenso a qualquer momento, caso ocorra a vontade de interromper os testes por algum motivo, não sendo obrigado a concluir os testes se não o desejar. As avaliações serão realizadas nas dependências das escolas (no caso decrianças) e no Laboratório de Motricidade Oral, do Serviço de Atendimento Fonoaudiológico (SAF) da UFSM. Após esta primeira etapa, serão oferecidas ao participante e responsáveis as informações sobre os resultados das avaliações e quais as condutas sugeridas para o caso, que poderão ser: encaminhamento para terapia fonoaudiológica e/ ou fisioterapia; avaliação médica ou a outros profissionais, quando houver necessidade.
Será mantida a confidencialidade das informações referentes à identidade dos pacientes. Os
dados coletados serão armazenados em banco de dados no laboratório de motricidade orofacial por 10 anos, sob responsabilidade das coordenadoras do projeto, e ao término deste período os mesmos serão incinerados. Como se trata de um serviço de clínica-escola dentro de uma Universidade, os dados levantados a partir deste projeto serão analisados com objetivo científico e poderão ser desenvolvidas pesquisas que serão publicadas em revistas da área,com objetivo de informar a população e pesquisadores com relação aos dados coletados. Para tanto, estes dados farão parte de um banco de dados.

Declaração dos participantes

• Fui informado detalhadamente por LUANA CRISTINA BERWIG sobre os objetivos, condições, natureza, procedimentos e duração do estudo. As vantagens e desvantagens me foram explicadas de forma detalhada.
• Tive tempo suficiente para fazer perguntas e essas me foram respondidas de forma completa e detalhada. Além disso, posso, a qualquer momento, solicitar novos esclarecimentos.
• Li e compreendi a folha de informação, havendo recebido uma cópia da mesma.
• Estou ciente de que posso a qualquer tempo reverter minha decisão de permitir a (minha/ e meu filho) participação no estudo, sem precisar apresentar razões e sem por isso incorrer em qualquer sanção.
• Tenho conhecimento de que todos os dados pessoais serão mantidos em total confidencialidade, ou seja, em nenhuma hipótese serão citados nomes, na divulgação de resultados deste estudo.

Assim sendo, eu _____,
RG nº _____, abaixo assinado, responsável por
_____ (nome do aluno), declaro que, após a leitura e esclarecimento deste documento, concordo na participação nesta pesquisa, livre de qualquer forma de constrangimento e coação.

_____
Responsável

_____
Pesquisador responsável

Santa Maria, _____/_____/_____ .

Declaração dos participantes menores de idade

( )CONCORDO **( ) NÃO CONCORDO**

Se você tiver alguma consideração ou dúvida sobre a ética da pesquisa, entre em contato: Comitê de Ética em Pesquisa - CEP-UFSM, Av. Roraima, 1000 - Prédio da Reitoria – 7º andar – Campus Universitário – 97105-900 – Santa Maria-RS - tel.: (55) 32209362 - email: comiteeticapesquisa@mail.ufsm.br
Os telefones de contato para quaisquer esclarecimentos são (55) 3220 9239 (Serviço de Atendimento Fonoaudiológico) ou 3220 8541 (Departamento de Fonoaudiologia da UFSM), com as professoras responsáveis citadas anteriormente.

Observação: O Termo de Consentimento Informado, baseado no item IV das Diretrizes e Normas Regulamentadoras Para a Pesquisa em Saúde, do Conselho Nacional de Saúde (resolução 196/96), será assinado em duas vias, de igual teor, ficando uma via em poder do participante da pesquisa ou do seu representante legal e outra com o(s) pesquisador(es) responsável(eis).

APÊNDICE B - QUESTIONÁRIO AOS PAIS

Agradecemos por participar desta pesquisa! Estas perguntas SÃO MUITO IMPORTANTES para melhor conhecer a saúde de seu filho. Por favor, tente responder todas as perguntas! Qualquer dúvida, entre em contato comigo pelo telefone: Luana – 9949 1938.

1) Nome da criança: _____

2) Data de nascimento da criança: _____/_____/_____

2) Telefones para contato:_____

3) Sexo: ( ) Feminino ( ) Masculino

4) Você considera seu filho(a) da raça:
( ) branca ( ) negra ( ) mulato ( )outro (oriental, índio), qual?_____

5) Seu filho (a) mamou no peito (seio materno)? ( ) Não ( )Sim, até quando? _____ (informar anos e/ou meses)

6) Seu filho (a) usou chupeta? ( ) Não ( )Sim, até quando? _____ (informar anos e/ou meses)

7) Seu filho (a) chupou dedo? ( ) Não ( ) Sim, até quando?_____ (informar anos e/ou meses)

8) Seu filho (a) começou a caminhar sozinho sem apoio quando? _____ (informar anos e/ou meses)

9) Possui problema neurológico (convulsões), síndrome ou má formação na face? ( ) Não ( ) Sim, especifique:_____

10) Realizou ou realiza tratamento fonoaudiológico? ( ) Não ( ) Sim, por quê? _____
_____

11) Realizou ou realiza tratamento ortodôntico, fazendo uso de aparelho dentário móvel ou fixo? ( )Não ( )Sim

12) Quanto ao sono de seu filho(a), marque se é verificado: ( ) ronco ( ) baba no travesseiro
( ) acorda para ingerir água ( ) agitação ( ) boca aberta enquanto dorme

13) Quanto a respiração do seu filho (a), quando acordado (a), esta ocorre: ( ) pelo nariz ( ) pela boca

14) Seu filho (a), possui alguma dificuldade na fala? ( ) Não ( )Sim, qual?_____

15) Em relação aos problemas respiratórios do seu filho (a), marque os que ele (a) possui com frequência: ( ) asma ( ) resfriados frequentes (mais de 6 episódios/ano) ( ) problemas de garganta ( ) mau hálito ( ) bronquite ( ) pneumonia ( ) rinite ( ) sinusite ( ) obstrução nasal ( ) coceira no nariz ( )nariz escorrendo ( ) espirros.

16) Seu filho (a):
- Fala outra língua? ( ) Não ( )Sim
- Apresenta dores de ouvido frequentes (otites)? ( ) sim ( ) não
- Apresenta dificuldades para escutar? ( ) não ( ) sim Usa aparelho para ouvir? ( ) não ( ) sim
- Apresenta dificuldades para enxergar? ( ) não ( ) sim Usa óculos? ( ) não ( ) sim
- Apresenta alguma dificuldade para falar? ( ) não ( ) sim. Descreva: _____
- Apresenta dificuldade para compreender a fala? ( ) não ( ) sim. Descreva: _____
_____
- Apresenta ou apresentou doença grave (por ex. epilepsia, tumor, meningite, pneumonia) ou psiquiátricas (depressão, transtorno de déficit de atenção e hiperatividade, psicoses)? ( ) não ( ) sim,
Qual / quais? _____ Faz tratamento? ( ) sim ( ) não

17) Com que idade a criança entrou na escola? _____

18) A criança tem ou teve problemas para aprender a ler e escrever? ( ) não ( ) sim Qual? _____

19) A criança repetiu alguma série? ( ) não ( ) sim Qual(is)?_____

20) Como você classifica o rendimento (ou desempenho) escolar de seu filho?
Regular ( ) Bom ( ) Muito bom ( ) Ótimo ( )

21) Outras Informações que achar importante sobre seu(sua) filho(a): _____
_____
_____
_____

22) No mês passado, quanto receberam em Reais, juntas, todas as pessoas que moram na sua casa? (incluindo salários, bolsa família, pensão, aposentadoria e outros rendimentos)_____
23) Quantos cômodos tem a casa (exceto banheiro)? _____
24) Quantas pessoas, incluindo o Sr(a), moram na casa?_____

Qual a escolaridade da mãe (ou a responsável)
( ) Analfabeto
( )1ª a 4ª séries incompletas – última série que frequentou:
( ) 1ª a 4ª séries completas (primário ou ensino fundamental I)
( ) 5ª a 8ª séries incompletas – última série que frequentou:
( ) 5ª a 8ª séries completas (ginasial ou ensino fundamental II)
( ) 1º ao 3º anos incompletos – último ano que frequentou:
( ) 1º ao 3º anos completos (colegial, científico ou ensino médio)/curso técnico, qual?
( ) Ensino superior incompleto – quantos anos frequentou:
( ) Ensino superior completo
Qual a escolaridade do pai (ou responsável)
( ) Analfabeto/
( )1ª a 4ª séries incompletas – última série que frequentou:
( ) 1ª a 4ª séries completas (primário ou ensino fundamental I)
( ) 5ª a 8ª séries incompletas – última série que frequentou:
( ) 5ª a 8ª séries completas (ginasial ou ensino fundamental II)
( ) 1º ao 3º anos incompletos – último ano que frequentou:
( ) 1º ao 3º anos completos (colegial, científico ou ensino médio)/curso técnico, qual?
( ) Ensino superior incompleto – quantos anos frequentou:
( ) Ensino superior completo
Qual a Profissão da mãe? Ocupação?
Qual a Profissão do pai? Ocupação?
Tem irmãos? ( ) sim Quantos: ___ ( ) não.
Quais e quantos desses itens sua família possui? TV em cores: _____ Vídeos-cassetes/DVD: _____ Rádios: _____ Banheiros: _____ Carros: _____ Empregados mensalista: _____ Máquina de lavar: _____ Freezer (separado ou 2ª porta da geladeira):

APÊNDICE C - FICHA DE AVALIAÇÃO ODONTOLÓGICA

Ficha de avaliação oclusal

Nome: _____ Turma:_____
Escola:_____ Data: ___/___/_____
Avaliador: _____

Período da dentição:
☐ Mista ☐ 1º período transitório ☐ Período intertransitório ☐ 2º período transitório

Avaliação sagital:
☐ Classe I
☐ Classe II ☐ Divisão 1 ☐ Subdivisão D
☐ Divisão 2 ☐ Subdivisão E
☐ Classe III ☐ Subdivisão D
☐ Subdivisão E
Overjet: _____mm ☐ acentuado (mais que 4 mm)
(medir nos incisivos) ☐ mordida cruzada anterior (dentes:_____) ☐ com desvio funcional

Avaliação vertical:
Overbite: _____mm ☐ Mordida aberta
☐ Mordida profunda (mais que 4mm)

Avaliação transversal:
Em MIH
☐ Normal
☐ Mordida cruzada posterior ☐ L ☐ Bilateral
☐ V ☐ Unilateral ☐ Direita
☐ Esquerda

Em RC
☐ Normal
☐ Presença de desvio funcional
☐ Mordida cruzada posterior ☐ Bilateral
☐ Unilateral ☐ Direita
☐ Esquerda

Avaliação intra-arcos:

Diastemas	Superior	Inferior
	☐ Presentes	☐ Presentes
	☐ Ausentes	☐ Ausentes
	☐ não se pode avaliar	☐ não se pode avaliar

Apinhamentos	Superior	Inferior
	☐ Presentes	☐ Presentes
	☐ Ausentes	☐ Ausentes
	☐ não se pode avaliar	☐ não se pode avaliar

Perdas dentárias:

Decíduos		Permanentes	

Observações (cáries, freios, IPV e ISG): _____
_____
_____
_____
_____

APÊNDICE D - FICHA DE AVALIAÇÃO MIOFUNCIONAL

Ficha de Avaliação Miofuncional

Nome:_____
Data: ____/____/____ Idade: _____ Escola: _____ Turma:____

AVALIAÇÃO QUANTITATIVA DO PALATO EM BOCA COM PAQUÍMETRO

LARGURA CANINA	
LARGURA 1OS PRÉ-MOLARES	
LARGURA 2OS PRÉ-MOLAR	
LARGURA 1OS MOLAR	

AVALIAÇÃO QUANTITATIVA DO PALATO EM BOCA COM COMPASSO

PROFUNDIDADE CANINA	
LARGURA CANINA	
PROFUNDIDADE 2OS PRÉ-MOLAR	
LARGURA 2OS PRÉ-MOLAR	

DIMA:_____ DIMALP:_____

APARÊNCIA E CONDIÇÃO POSTURAL/POSIÇÃO

Condição Postural dos Lábios		**Escorês**
Oclusão normal dos lábios	Normal	(3)
Oclusão dos lábios com tensão	Atividade aumentada dos lábios e Mm. Mentual	(2)
Ausência de oclusão labial	Disfunção leve (entreabertos)	(2)
	Disfunção severa (totalmente abertos)	(1)
Postura vertical da mandíbula		
Postural normal	Mantém espaço funcional livre	(3)
Oclusão dos dentes	Sem espaço funcional livre	(2)
Boca aberta	Disfunção leve	(2)
Excessiva abertura de boca	Disfunção severa	(1)

Aparência de bochechas		
Normal		(3)
Volume aumentado ou flácida/arqueadas	Leve	(2)
	Severa	(1)
Posição da língua		
Contida na cavidade oral	Normal	(3)
Interposta aos arcos dentários	Adaptação ou disfunção	(2)
	Protruída em excesso	(1)
Aparência do palato duro		
Largura adequada	Normal	(3)
Largura diminuída (estreito)	Leve	(2)
	Severo	(1)
Profundidade palato duro (MBGR): ( )adequada ( )aumentada (alto) - ( ) Leve ( ) Severo		
Forma do lábio superior		
( ) Normal *(1º arco do cupido)* ( )Asa de gaivota *(1º e 2º arco do cupido)*		
Forma do lábio inferior		
( ) Normal ( ) Eversão discreta ( ) Eversão acentuada		
Comprimento do lábio superior		
( ) Cobre ⅓ dos incisivos ( ) Cobre mais que ⅓ ( ) Cobre menos que ⅓		
Mucosa externa dos lábios		
( ) Normal ( ) Com saliva ( ) Ressecada ( ) Ferida		

FUNÇÕES

Respiração		**Escore**
Respiração nasal	Normal	(3)
Respiração oronasal	Leve (ON)	(2)
	Severa (O)	(1)
Possibilidade de uso nasal: ( ) 2 min ou mais ( ) entre 1 e 2 min ( ) menos que 1 min		
( ) resfriado ou em crise de rinite ( ) necessário reavaliar ( ) modo respiratório gera dúvida		

Fala: automática – contagem de 1 a 20, dias da semana, meses do ano, alfabeto (MBGR)				
Omissão	( )ausente	( ) assistemática	( ) sistemática	Fone(s):
Substituição	( )ausente	( ) assistemática	( ) sistemática	Fone(s):
Distorção	( )ausente	( ) assistemática	( ) sistemática	Fone(s):

Fala: Nomeação de figuras da prancha (MBGR)				
Omissão	( )ausente	( ) assistemática	( ) sistemática	Fone(s):
Substituição	( )ausente	( ) assistemática	( ) sistemática	Fone(s):
Distorção	( )ausente	( ) assistemática	( ) sistemática	Fone(s):

Em caso de distorção: [ ] interdental anterior [ ] interdental lateral [ ] ausência ou pouca vibração do ápice [ ] vibração múltipla do ápice [ ] elevação do dorso [ ] rebaixamento do dorso [ ] outras:

Frênulo:	extensão: (0) adequada	(1) longa	(1) curta
	fixação na língua: (0) parte média	(1) entre à parte média e o ápice	(2) no ápice
	fixação no assoalho: (0) entre as carúnculas	(1) na crista alveolar	
	outras características: (0) não há	(1) submerso (1) espesso	(1) com fibrose
( ) Normal ( ) Anteriorizado ( ) Curto ( ) Curto e anteririzado ( ) Anquiloglossia			

CONDUTA: ( ) Fonoterapia ( ) Av ORL ( ) Tratamento da oclusão é prioridade ( ) Orientação aos pais

ANEXOS

ANEXO 1 – PARECER CONSUBSTANCIADO DO CEP

UNIVERSIDADE FEDERAL DE SANTA MARIA/ PRÓ-REITORIA DE PÓS-GRADUAÇÃO E

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: CARACTERIZAÇÃO E AVALIAÇÃO INTEGRADAS DOS DISTÚRBIOS DA MOTRICIDADE OROFACIAL E DA POSTURA CORPORAL - FASE 2
Pesquisador: ANA MARIA TONIOLO DA SILVA
Área Temática:
Versão: 4
CAAE: 08105512.0.0000.5346
Instituição Proponente: Universidade Federal de Santa Maria/ Pró-Reitoria de Pós-Graduação e
Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 937.461
Data da Relatoria: 10/03/2015

Apresentação do Projeto:
O proponente apresenta emenda ao projeto intitulado "Caracterização e avaliação integradas dos distúrbios da motricidade orofacial e da postura corporal - fase 2a".

A justificativa para a emenda é a que segue: "A emissão deste documento foi necessária tendo em vista a inclusão de um pequeno aspecto metodológico nas avaliações já previstas e a atualização do grupo de participantes, pois alguns deixaram de participar do projeto e outros necessitam ser incluídos. O Termo de Consentimento Livre e Esclarecido precisou ser atualizado, a fim de contemplar o aspecto metodológico incluído."

Pelo que foi apresentado, entende-se que a emenda pode ser aprovada.

Objetivo da Pesquisa:

.

Avaliação dos Riscos e Benefícios:

.

Endereço: Av. Roraima, 1000 - prédio da Reitoria - 2º andar
Bairro: Camobi **CEP:** 97.105-970
UF: RS **Município:** SANTA MARIA
Telefone: (55)3220-9362 **E-mail:** cep.ufsm@gmail.com

Comentários e Considerações sobre a Pesquisa:

.

Considerações sobre os Termos de apresentação obrigatória:

Foram apresentados de modo suficiente.

Recomendações:

Veja no site do CEP - http://w3.ufsm.br/nucleodecomites/index.php/cep - na aba "orientações gerais", modelos e orientações para apresentação dos documentos. Acompanhe as orientações disponíveis, evite pendências e agilize a tramitação do seu projeto.

Conclusões ou Pendências e Lista de Inadequações:

.

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

Considerações Finais a critério do CEP:

SANTA MARIA, 23 de Janeiro de 2015

Assinado por:
CLAUDEMIR DE QUADROS
(Coordenador)

ANEXO 2 – NORMAS DO PERIÓDICO – American Journal of Orthodontics & Dentofacial Orthopedics

General Information

The *American Journal of Orthodontics and Dentofacial Orthopedics* publishes original research, reviews, case reports, clinical material, and other material related to orthodontics and dentofacial orthopedics.

Submitted manuscripts must be original, written in English, and not published or under consideration elsewhere. Manuscripts will be reviewed by the editor and consultants and are subject to editorial revision. Authors should follow the guidelines below.

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Rolf G. Behrents, Editor-in-Chief
E-mail: behrents@gmail.com

Send other correspondence to:
Chris Burke, Managing Editor
American Journal of Orthodontics and Dentofacial Orthopedics
University of Washington
Department of Orthodontics, D-569
HSC Box 357446
Seattle, WA 98195-7446
Telephone (206) 221-5413
E-mail:ckburke@aol.com

Before You Begin

Ethics in publishing

Please see our information pages on Ethics in publishing and Ethical guidelines for journal publication.

Studies in humans and animals

If the work involves the use of human subjects, the author should ensure that the work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. The manuscript should be in line with the Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals and aim for the inclusion of representative human populations (sex, age and ethnicity) as per those recommendations. The terms sex and gender should be used correctly.

Authors should include a statement in the manuscript that informed consent was obtained for experimentation with human subjects. The

privacy rights of human subjects must always be observed.

All animal experiments should comply with the ARRIVE guidelines and should be carried out in accordance with the U.K. Animals (Scientific Procedures) Act, 1986 and associated guidelines, EU Directive 2010/63/EU for animal experiments, or the National Institutes of Health guide for the care and use of Laboratory animals (NIH Publications No. 8023, revised 1978) and the authors should clearly indicate in the manuscript that such guidelines have been followed. The sex of animals must be indicated, and where appropriate, the influence (or association) of sex on the results of the study.

Conflict of interest

Each author should complete and submit a copy of the International Committee of Medical Journal Editors Form for the Disclosure of Conflicts of Interest, available at http://www.icmje.org/conflicts-of-interest/.

Submission declaration and verification

Submission of an article implies that the work described has not been published previously (except in the form of an abstract, a published lecture or academic thesis, see 'Multiple, redundant or concurrent publication' for more information), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. To verify originality, your article may be checked by the originality detection service Crossref Similarity Check.

Use of inclusive language

Inclusive language acknowledges diversity, conveys respect to all people, is sensitive to differences, and promotes equal opportunities. Articles should make no assumptions about the beliefs or commitments of any reader, should contain nothing which might imply that one individual is superior to another on the grounds of race, sex, culture or any other characteristic, and should use inclusive language throughout. Authors should ensure that writing is free from bias, for instance by using 'he or she', 'his/her' instead of 'he' or 'his', and by making use of job titles that are free of stereotyping (e.g. 'chairperson' instead of 'chairman' and 'flight attendant' instead of 'stewardess').

Contributors

Each author is required to declare his or her individual contribution to the article: all authors must have materially participated in the research and/or article preparation, so roles for all authors should be described. The statement that all authors have approved the final article should be true and included in the disclosure.

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