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REFERÊNCIA

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Original Article

Artigo Original

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Nasalance of Brazilian Portuguese-speaking populations from two different states

Nasalância de populações falantes do português brasileiro de dois estados distintos

Keywords

Speech
Voice
Reference Values
Speech Production Measurement
Gender

ABSTRACT

Purpose: To measure the nasalance scores of Brazilian Portuguese-speaking young adults from the states of Sao Paulo and Minas Gerais in order to investigate whether dialect variations and gender affect these scores. **Methods:** Nasalance was assessed in 36 individuals: 20 native residents of Sao Paulo state (mean age=23 y.o.) and 16 native residents of Minas Gerais state (mean age=24 y.o.), following the same criteria. Nasalance measures were taken using the Nasometer II 6400 (KayPentax) device based on the reading of three texts (nasal-1, nasal-2, and oral). Intergroup nasalance scores were compared using the unpaired Student's *t* test considering two experimental groups. **Results:** The nasalance scores in individuals from the states of Sao Paulo and Minas Gerais were 52.7% and 48.8% for the nasal-1 text, 49.6% and 49.9% for the nasal-2 text, and 14.3% and 9.8% for the oral text, respectively. Statistical analysis comparing the mean nasalance scores in both groups showed significant difference (p=0.03) only for the oral text, in which individuals from Sao Paulo state presented higher scores. **Conclusion:** Although nasalance scores were lower in individuals from Minas Gerais state compared with those of individuals from Sao Paulo state, both groups presented values within the normal range. The variable gender was not relevant in the nasalance assessment; however, a tendency for higher scores was observed in women compared with men from Minas Gerais state in the same group in the reading of the nasal-2 text. This study contributes to the knowledge of nasalance reference scores for two different populations of Brazilian Portuguese speakers; however, the results herein reported should be interpreted with caution due to the small study sample size.

Descritores

Fala
Voz
Valores de Referência
Medida da Produção da Fala
Gênero

RESUMO

Objetivo: Obter valores de nasalância de jovens adultos, falantes do português brasileiro dos estados de São Paulo e Minas Gerais, para investigar a existência de fatores influenciadores, como variação dialetal e gênero. **Método:** Foi avaliada a nasalidade de 36 indivíduos, 20 oriundos do Estado de São Paulo (idade média: 23 anos) e 16 de Minas Gerais (idade média: 24 anos), de ambos os gêneros, pelo Nasômetro II modelo 6400 (KayPENTAX®) durante a leitura de três textos (nasal1, nasal2 e oral). A comparação dos valores de nasalância entre os grupos foi feita pelo teste t de *Student* não pareado, considerando dois grupos experimentais. **Resultados:** Os valores de nasalância encontrados nas populações paulista e mineira foram, respectivamente, 52,7% e 48,8% para o texto nasal1; 49,6% e 49,9% para o texto nasal2 e 14,3% e 9,8% para o texto oral. Na análise comparativa da média dos valores, verificou-se diferença no texto oral (p=0,03), sendo a nasalância dos paulistas maior que a dos mineiros, já o fator gênero não apresentou diferença significativa. **Conclusão:** Ambas as populações apresentaram valores de nasalância dentro dos padrões de normalidade, porém a nasalância dos mineiros foi menor que a dos paulistas. O fator gênero não mostrou influência sobre esses valores, ainda que, no texto nasal2, as mulheres mineiras mostraram uma tendência de maior valor de nasalância que os homens mineiros. Nosso estudo contribui para o conhecimento dos valores de referência para populações distintas, falantes do português brasileiro, contudo, deve ser interpretado com ponderação, visto o número reduzido da amostra.

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INTRODUCTION

Speech, the main form of human communication, results from the effective coordination between various physical subsystems, including respiration, phonation, resonance, and articulation[1]. Speech resonance is influenced by factors such as the impedance provided by the oral cavity, the lips, and nasal permeability. The combination of these elements can produce balanced, hypernasal, or hyponasal speech resonance[2].

Perceptual assessment is the main method used by speech-language pathologists to evaluate speech nasality[2,3]. It is a subjective method which depends on the experience of the examiners, with risk of intra- and/or inter-rater discordance[4-6]. Therefore, the use of instrumental methods is important to complement this clinical evaluation, as well as to allow better planning and monitoring of the results of therapeutic procedures[4,7,8].

Because the Nasometer is a non-invasive and simple-to-use instrument, it is widely described in both the national and international literatures to objectively and directly assess speech resonance in different population samples[9-11]. The Nasometer quantifies nasalance as the percentage ratio between the acoustic data obtained by two microphones, one nasal and one oral. Nasalance is the acoustic correlate of nasality which, in turn, corresponds to the subjective perception of a listener about the nasal acoustic energy produced during speech[12].

Nasality is present in different languages and can be easily identified during the production of nasal sounds. It can vary within the same language and within the different dialects of this language. It may be associated with geographical area owing to the phonological effects of linguistic variation in the different regions of a country[13-15], and may also be influenced by gender[14,16-18] and age[7,9,19-21].

Despite the evidence of linguistic diversity and plurilingualism in the Brazilian territory, studies addressing the dialectal differences between native residents of the states of Minas Gerais and Sao Paulo are scarce. Different regional linguistic characteristics are known in the state of Minas Gerais, such as nasality on unstressed syllables, retroflexed [r], and reduction of non-final diphthongs[22].

Considering that dialectal difference may influence speech resonance and that these aspects are not clear in populations of the states of Sao Paulo and Minas Gerais, the main hypothesis of the present study is that there is differentiation between the nasalance of these populations. This knowledge will facilitate the process of recognition of speech production and linguistic diversity in these regions, as well as assist with the diagnosis and rehabilitation of various speech disorders.

Therefore, the objective of this study was to measure the nasalance scores of Brazilian Portuguese-speaking young adults from the states of Sao Paulo and Minas Gerais aiming to investigate whether dialect variations and gender affect such scores.

METHODS

The present study was approved by the Research Ethics Committee of the "Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo" - HCFMRP-USP under protocol no. 2840/2009.

The study sample comprised 36 literate Brazilian Portuguese-speaking individuals selected without distinction of race and socioeconomic status. Of these, 20 (10 men and 10 women) were native residents of the state of Sao Paulo aged 18-31 years (mean age=23 years two months; SD=3.3) and 16 (six males and 10 females) were native residents of the state of Minas Gerais aged 18-35 years (mean age=24 years three months; SD=5.0).

To characterize the sample and select the study participants according to the inclusion and exclusion criteria, a protocol containing a questionnaire and a brief orofacial evaluation were applied as described ahead. Inclusion criteria comprised normal Brazilian Portuguese-speakers, native residents of both states, without region restriction. Exclusion criteria comprised individuals with clinical signs of nasal obstruction at the time of examination, history of hearing loss, presence of cleft lip and palate or any other craniofacial deformity, orthodontic appliance, history of vocal disorders, speech and/or oral language alterations, and who had been living outside their home state for more than two years.

Chart 1 shows the description of the participants according to their region in the states of Sao Paulo and Minas Gerais. It is worth noting that the data were collected in the municipality of Ribeirao Preto, Sao Paulo state, and some of the participants were residents of that city but others were not.

Chart 1. Number of study participants distributed according to the regions of the states of Sao Paulo and Minas Gerais

States			
Sao Paulo state (N=20)		Minas Gerais state (N=16)	
Regions		Regions	
North	14	South / Southwest	10
Northwest	2	Triângulo Mineiro and Alto Paranaíba	4
Southeast	2	Vale do Rio Doce	2
East	2		

Procedures

All participants signed an Informed Consent Form (ICF) prior to study commencement. Each volunteer was individually submitted to an interview containing data on identification, origin and data regarding respiratory alterations, hearing loss, orofacial surgeries, face trauma, and changes in nutrition and the voice. They were then submitted to a clinical orofacial evaluation, which analyzed the habitual position of the lips and tongue, the morphology of the hard and soft palate, and palatine tonsils, and the mobility of the palatine veil; the respiratory function, identifying nasal, oral, or oronasal respiration and nasal airflow; finally, the perceptual investigation of speech was conducted through the repetition of sentences and spontaneous conversation, analyzing the intelligibility and resonance of speech.

All volunteers were instructed to perform nasal hygiene with water and saline solution. After that, the nasal airflow of these individuals was evaluated using the Altmann's millimetric

mirror® according to the instruction manual. The mirror was sanitized using some cotton soaked in alcohol prior to each assessment.

After the nasal airflow assessment, the study participants were submitted to nasalance measurement (nasometry) using the Nasometer II 6400 (KayPENTAX®, New Jersey, USA). The Nasometer is equipped with a headset containing two directional microphones separated by a horizontal plate, which should be tightly fitted between the upper lip and the nose. These microphones, one pointed at the mouth and the other at the nose, capture signals from the nasal and oral components of speech as standardized texts are read on the computer screen. The acoustic signals are filtered, scanned, and analyzed by nasometry-specific software installed in a host personal computer. Nasalance is calculated in the frequency range of 300-600 Hz and is the ratio of nasal acoustic energy to the sum of nasal plus oral acoustic energy, expressed as a percentage.

The Nasometer was sanitized with alcohol and calibrated using its own sound source prior to each data collection. The following data were considered for analysis: mean nasalance scores of the first technically acceptable emission of each word that constituted each sentence, that is, produced without errors and within the accepted intensity limit of the device.

The assessment was conducted during the reading of 15 sentences of Brazilian Portuguese: five sentences containing high percentage of nasal consonants (nasal-1 text), five sentences with high percentage of nasal consonants and devoid of pressure consonants (nasal-2 text), and five sentences containing no nasal consonants (oral text). The proofs were selected based on the article by Trindade et al.[7]; the nasal-1 text corresponds to NASAL-BR, the nasal-2 text corresponds to NASAL2-BR, and the oral text to ZOO-BR.

Statistical analysis

The data of this study were computed in tables for statistical investigation. After obtaining positive results in the normality test, a parametric statistical test was chosen and, therefore, the nasalance scores of the groups were compared by means of the unpaired Student's *t* test for independent samples, considering that the study was composed of two experimental groups. The Graph Pad InStat 3.0 software for Windows 95 was used with significance difference ($p<0.05$).

RESULTS

No statistically significant difference was observed in nasalance scores between men and women both for the Sao Paulo state group and the Minas Gerais state group in the different texts presented (Table 1). Statistical analysis comparing the mean nasalance scores in both groups showed significant difference ($p=0.03$) only for the oral text, in which individuals from Sao Paulo state presented higher scores. These results, as well as the reference values for both groups, are presented in Table 2.

Table 1. Mean values and standard deviation of nasalance (%) for the groups of young adults from the states of Sao Paulo and Minas Gerais according to gender

	Nasalance (%)					
	Sao Paulo state			Minas Gerais state		
Text	Female (N=10)	Male (N=10)	p value	Female (N=10)	Male (N=6)	p value
Nasal-1	50.7 (6.5)	54.6 (13.5)	0.42	50.3 (7.8)	46.3 (7.5)	0.33
Nasal-2	48.5 (5.7)	50.2 (9.6)	0.63	52.6 (6.1)	45.5 (7.0)	0.05
Oral	16.3 (6.3)	12.2 (6.9)	0.18	10.8 (5.3)	8.2 (3.2)	0.29

Unpaired Student's t test - $p < 0.05$
Caption: N = number of individuals

Table 2. Mean values and standard deviation of nasalance (%) for the groups of young adults from the states of Sao Paulo and Minas Gerais

Text	Nasalance (%)		p value
	Sao Paulo state (N=20)	Minas Gerais state (N=16)	
Nasal-1	52.7 (10.5)	48.8 (7.7)	0.23
Nasal-2	49.6 (7.8)	49.9 (7.2)	0.82
Oral	14.3 (6.8)	9.8 (4.7)	0.03*

*Statistically significant difference ($p<0.05$) - unpaired Student's t test
Caption: N = number of individuals

DISCUSSION

The means of nasalance scores in individuals from the states of Sao Paulo and Minas Gerais were 49.6% and 49.9% for the nasal-2 text and 14.3% and 9.8% for the oral text, respectively; therefore, within the normality range for the Brazilian population with this type of speech stimulus[7,23].

Dialectal influence on nasalance scores has been investigated by several authors worldwide; however, whereas some authors have found differences between the dialects investigated[15,24,25], others have reported that this is not a significant factor[13,14,20,26].

This study revealed higher nasalance scores for residents of Sao Paulo state compared with those of individuals from Minas Gerais state regarding the oral text. The results show that, although both groups present scores within the normality range for nasalance, there are differences that suggest a slight modification in the functional dynamics during speech, in the velopharyngeal sphincter region, possibly due to the linguistic variations of each dialect. In the dialect of Minas Gerais state, for instance, nasality is observed on unstressed syllables in the northernmost region of that state, the retroflexed [r] is spoken in the southern region, and between these two regions, reduction of non-final diphthongs and insertion of the [y] semivowel in final syllables and in syllables preceded by sibilant sounds is used[22].

Further studies based on instruments that visualize the dynamics of the velopharyngeal function associated with nasometry, but which nevertheless do not influence its function, could complement the findings of the present research. No studies addressing dialectal influence conducted with adult individuals in

the populations herein studied have been found in the consulted literature. A study conducted with children from the states of Sao Paulo and Minas Gerais, aged six to ten years, showed no difference between the participants' naturalness in both the oral and nasal texts[13]. Some authors have reported that nasalance scores increase with age[7,9,19-21,27] as a result of changes in the size and shape of the vocal tract resonance cavities caused by growth[7,20,21,28]. Therefore, this fact justifies the absence of difference between nasalance scores in the populations of the states of Sao Paulo and Minas Gerais at early age.

Many studies have been conducted to investigate the influence of gender in nasalance scores; some found no significant differences[7,24,26], whereas others described a tendency for the female gender to present higher scores compared with those of the male gender[14,15,17,25]. In this study, no difference was observed between the male and female genders in both groups for the three texts, corroborating the findings of other studies in the literature[7,24,26]. However, verification of the data revealed a trend of higher nasalance scores in women from Minas Gerais state compared with those of men in the same group for the nasal-2 text, as observed in some studies with adult populations[14,17,25,29]. This tendency is justified by differences in the velopharyngeal sphincter mechanism and in the vocal tract length between the genders[9,14,17,21,24,28]. Perhaps if the sample size of this study were larger, this difference would be more evident.

Other studies have also investigated the influence of dialect and gender on nasalance measures, but not with Brazilians[14,17,20,24,26]. A study compared the nasalance values of young adults, normal speakers of Flemish and other languages, during the reading of three sets of sentences (one oral, one nasal, and one oronasal). The analysis of nasalance regarding gender indicated differences in the nasal and oronasal sentences, describing women with higher nasalance scores than men in the nasal set[17]. Similarly, a study conducted in Saudi Arabia that assessed the influence of age and gender on individuals from several regions of the country showed that women presented higher nasalance scores in the adult population[18]. However, this difference was not so evident in the present study, perhaps because of its reduced sample size, although a tendency was indicated herein by the *p* value (p=0.05) of higher scores in women.

A survey conducted in Japan showed significant statistical difference in nasalance scores between genders for all sentences and vowels analyzed, but no significant difference was observed between regions in both genders[14], contrary to the findings of this study. A study conducted in Greece[24], which evaluated 80 healthy young adults (40 males and 40 females) monolingual speakers of Greek, showed that, in addition to the fact that no significant difference was found between genders, Greek obtained lower nasalance scores than other languages examined in previous surveys. In a study conducted in Belgium, which evaluated the influence of gender and the effects of five different dialects of Flemish on nasalance, no statistically significant differences were found[26].

These studies show that there are variations according to the population and language studied. Therefore, more in-depth studies are needed to understand how this occurs in the Brazilian population. Further studies should be conducted with larger samples to confirm this difference (greater nasality of native residents of Sao Paulo state), considering sociolinguistic factors, as well as verifying how residence time in a different state or region could influence nasalance.

CONCLUSION

The nasalance scores in individuals from the states of Sao Paulo and Minas Gerais were 52.7% and 48.8% for the nasal-1 text, 49.6% and 49.9% for the nasal-2 text, and 14.3% and 9.8% for the oral text, respectively. With respect to dialect, native residents of Minas Gerais state presented lower nasalance scores compared with those of native residents of Sao Paulo state, suggesting that the dialectal difference was a factor of influence, considering that the variable gender did not seem to influence these values.

The preliminary findings of this study contribute to the knowledge of reference nasalance scores for Brazilian Portuguese-speaking young adults of distinct populations, filling the gap of previous studies conducted on nasometry. However, given that the study sample was composed of a small number of individuals, these findings should be interpreted with caution.

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REFERENCES

1. Kummer AW. Resonance disorders and velopharyngeal dysfunction. In: Kummer AW. Cleft palate and craniofacial anomalies: the effects on speech and resonance. 3. ed. New Albany: Delmar Cengage Learning; 2013. Chapter 7; p. 182-224.
2. Genaro KF, Yamashita RP, Trindade IEK. Avaliação clínica e instrumental da fala na fissura labiopalatina. In: Fernandes FDM, Mendes BCA, Naves ALPG. Tratado de Fonoaudiologia. 2. ed. São Paulo: Roca; 2010. p. 488-503.
3. Baylis AL, Munson B, Moller KT. Perceptions of audible nasal emission in speakers with cleft palate: a comparative study of listener judgments. Cleft Palate Craniofac J. 2011;48(4):399-411. PMid:20572776. http://dx.doi.org/10.1597/09-201.
4. Brunnegård K, Lohmander A, Van Doorn J. Comparison between perceptual assessments of nasality and nasalance scores. Int J Lang Commun Disord. 2012;47(5):556-66. PMid:22938066. http://dx.doi.org/10.1111/j.1460-6984.2012.00165.x.
5. Lee A, Whitehill TL, Ciocca V. Effect of listener training on perceptual judgement of hypernasality. Clin Linguist Phon. 2009;23(5):319-34. PMid:19399664. http://dx.doi.org/10.1080/02699200802688596.

6. Scarmagnani RH, Oliveira ACAS, Fukushiro AP, Salgado MH, Trindade IEK, Yamashita RP. O impacto da concordância entre avaliadores no julgamento perceptivo da nasalidade da fala. CoDAS. 2014;26(5):357-9. PMid:25388067. http://dx.doi.org/10.1590/2317-1782/20142014068.

7. Trindade IEK, Genaro KF, Dalston RM. Nasalance scores of normal Brazilian Portuguese speakers. Braz J Dysmorphol Speech Hear Disord. 1997;1:23-34.

8. Van Lierde KM, Wuyts FL, Bonte K, Van Cauwenberge P. The nasality severity index: an objective measure of hypernasality based on a multiparameter approach. Folia Phoniatr. 2007;59(1):31-8. PMid:17172784. http://dx.doi.org/10.1159/000096548.

9. Abou-Elsaad T, Quriba A, Baz H, Elkassaby R. Standardization of nasometry for normal egyptian arabic speakers. Folia Phoniatr Logop. 2012;64(6):271-7. PMid:23328484. http://dx.doi.org/10.1159/000343999.

10. Iqueda APD, Ricz H, Takeshita TK, Reis N, Aguiar-Ricz L. Nasalância e nasalidade da voz traqueosofágica em laringectomizados totais. CoDAS. 2013;25(5):469-74. PMid:24408552. http://dx.doi.org/10.1590/S2317-17822013000500011.

11. Blanton A, Watterson T, Lewis K. The differential influence of vowels and palatal covering on nasalance scores. Cleft Palate Craniofac J. 2015;52(1):82-7. PMid:24805775. http://dx.doi.org/10.1597/13-092.

12. Fletcher SG. "Nasalance" vs. listener judgements of nasality. Cleft Palate J. 1976;13:31-44. PMid:1060524.

13. Narece IL. Nasalância de crianças com fissura labiopalatina e nasalidade de fala normal: uma comparação dos dialetos mineiro e paulista [dissertação]. São Carlos: Universidade de São Paulo; 2007 [citado em 2015 Mar 22]. Disponível em: http://www.teses.usp.br/teses/disponiveis/82/82131/tde-14022008-111531/

14. Mishima K, Sugii U, Yamada T, Imura H, Sugahara T. Dialectal and gender differences in nasalance scores in Japanese population. J Craniomaxillofac Surg. 2008;36(1):8-10. PMid:17988887. http://dx.doi.org/10.1016/j.jcms.2007.07.008.

15. Awan SN, Bressmann T, Poburka B, Roy N, Sharp H, Watts C. Dialectical effects on nasalance: a multicenter, cross-continental study. J Speech Lang Hear Res. 2015;58(1):69-77. PMid:25260176. http://dx.doi.org/10.1044/2014_JSLHR-S-14-0077.

16. Suguimoto MLCP, Pegoraro-Krook MI. Avaliação nasométrica em adultos normais falantes do Português Brasileiro. Pró-Fono. 1996;7(2):3-9.

17. Van Lierde KM, Wuyts FL, De Bodt M, Van Cauwenberge P. Nasometric values for normal nasal resonance in the speech of young Flemish adults. Cleft Palate Craniofac J. 2001;38(2):112-8. PMid:11294538. http://dx.doi.org/10.1597/1545-1569(2001)038<0112:NVFNNR>2.0.CO;2.

18. El-Kassabi RM, Hassan S, Mesallam TA, Malki KH, Farahat M, Alfaris A. Standardization of nasalance scores in normal Saudi speakers. Logoped Phoniatr Vocol. 2015;40(2):77-85. PMid:24854781. http://dx.doi.org/10.3109/14015439.2014.907339.

19. Di Ninno CQMS, Vieira JM, Teles-Magalhães LC, Padovani CR, Pegoraro-Krook MI. Determinação dos valores de nasalância para falantes normais do Português Brasileiro. Pró-fono Rev Atualização Científica. 2001;13(1):71-7.

20. Brunnegård K, Van Doorn J. Normative data on nasalance scores for Swedish as measured on the Nasometer: influence of dialect, gender, and age. Clin Linguist Phon. 2009;23(1):58-69. PMid:19148813. http://dx.doi.org/10.1080/02699200802491074.

21. Van Lierde KM, Wuyts FL, De Bodt M, Van Cauwenberge P. Age-related patterns of nasal resonance in normal Flemish children and young adults. Scand J Plast Reconstr Surg Hand Surg. 2003;37(6):344-50. PMid:15328773. http://dx.doi.org/10.1080/02844310310004307.

22. Martins EF. Atlas linguístico do Estado de Minas Gerais: o princípio da uniformidade da mudança linguística nas características fonéticas do português mineiro. ReVEL. 2006;4(7):1-13.

23. Marino V, Dutka JC, de Boer G, Cardoso VM, Ramos RG, Bressmann T. Normative Nasalance Scores for Brazilian Portuguese Using New Speech Stimuli. Folia Phoniatr Logop. 2015;67(5):238-44. PMid:26844554. http://dx.doi.org/10.1159/000441976.

24. Okalidou A, Karathanasi A, Grigoraki E. Nasalance norms in Greek adults. Clin Linguist Phon. 2011;25(8):671-88. PMid:21668367. http://dx.doi.org/10.3109/02699206.2010.549993.

25. Kim HK, Yu XM, Cao YJ, Liu XM, Huang ZM. Dialectal and gender differences in nasalance for a Mandarin population. Clin Linguist Phon. 2016;30(2):119-30. PMid:26853731. http://dx.doi.org/10.3109/02699206.2015.1116111.

26. D'haeseleer E, Bettens K, De Mets S, De Moor V, Van Lierde K. Normative data and dialectical effects on nasalance in flemish adults. Folia Phoniatr Logop. 2015;67(1):42-8. PMid:25998177. http://dx.doi.org/10.1159/000374110.

27. Bettens K, Wuyts FL, De Graef C, Verhegge L, Van Lierde KM. Effects of age and gender in normal-speaking children on the nasality severity index: an objective multiparametric approach to hypernasality. Folia Phoniatr Logop. 2013;65(4):185-92. PMid:24356338. http://dx.doi.org/10.1159/000356462.

28. Kummer AW. Anatomy and physiology: facial, oral, and velopharyngeal structures. In: Kummer AW. Cleft palate and craniofacial anomalies: the effects on speech and resonance. 3. ed. New Albany: Delmar Cengage Learning; 2013. Chapter 1; p. 2-38.

29. Awan SN, Virani A. Nasometer 6200 versus Nasometer II 6400: effect on measures of nasalance. Cleft Palate Craniofac J. 2013;50(3):268-74. PMid:22906390. http://dx.doi.org/10.1597/11-219.

Author contributions

DSM was responsible for the collection, classification and analysis of data and writing of the manuscript; MNCPP and LNAR collaborated with the interpretation of data and writing of the manuscript; LVVT was the study adviser and collaborated with the interpretation of data and writing of the manuscript.