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Original Article

Nasalance scores of Malay (Kelantan dialect) in children with and without palatal cleft

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Abstract This study was designed to obtain and compare the nasalance scores produced by normal Malay children and those with repaired palatal cleft. Data from 103 noncleft children and 27 children with repaired clefts were included. All children were of Malay origin with the Malay language (Kelantan dialect) as their first language. Two short and simple test stimuli were constructed in the Malay language; one resembled the Nasal Sentences and the other resembled the Zoo Passage (oral passage) used in nasometer testing. Nasalance scores were obtained with the Nasometer II model 6400 by Kay Elemetrics. Calibration of the nasometer and collection of data followed the recommended protocol outlined in the manual. Nasalance scores for the Oral Passage was significantly higher ($p < 0.001$) for the children with repaired palatal clefts when compared to scores for children without clefts. However, no differences in nasalance scores were detected between both groups for the Nasal Passage. The normative nasalance scores for Malay children with Kelantan dialect was established, which can be used as an objective reference in the management of Malay patients with resonance disorders.

Keywords: Cleft palate, hypernasality, nasalance, nasometer, Malay.

Introduction

Cleft lip with or without cleft palate (CLP) is a common facial birth defect (Kummer, 2001; Watson, 2001). Corrective surgery to repair the cleft is often done early in infancy, before the child starts speaking. Speech is one of the main outcomes measured in the multidisciplinary management of CLP patients (Enderby and Emerson, 1996; Lohmander and Olsson, 2004; Witt and Marsh, 1997). Nasality judgments are one of the primary aspects of the speech pathologists' evaluation in the management of CLP patients. The nasometer has been used to provide an objective measure of oral and nasal sounds energy during speech (nasalance score), which has been associated with perception of oral-nasal resonance balance.

Previous studies have shown that language and dialect can influence nasalance scores (Anderson, 1996; Seaver *et al.*, 1991; van Doorn and Purcell, 1998). As such, the norms for a specific language should be obtained before nasalance scores can be used clinically in evaluating palatal function for speakers of that language (Sweeney *et al.*, 2004; Whitehill, 2001). A set of published data for the normative nasalance scores for Malay children aged 6 to 12 years old was reported by Mohd Ibrahim *et al.* (2011) as 13.86% (SD 5.11) and 60.28% (SD 6.99) for oral and nasal stimuli, respectively. However, these data were obtained from children speaking the standard Malay language, not the Kelantan dialect.

Teoh (1994) claimed that the Malay language is a western Austronesian language. It is a Type III language, namely of consonant, vocal (consonant) [(CVC)] type "in which every syllable must have an onset" (Teoh, 1994; p. 26). Standard Malay language is based on the Johor-Riau Malay dialect spoken mainly in the south of Peninsular Malaysia. Kelantan is situated in the north-east of Peninsular Malaysia and hence has some dissimilarity features. For instance, standard Malay is characterized by a schwa (/ə/) in word final positions, which in other dialects (for example the Kelantan dialect used by the subjects in this study) is normally produced as an [a]. For both Kelantan dialect and standard Malay, vowel nasalization "operates across morpheme boundary and penetrates the glides [w], [y], and [h] and glottal stop" (Teoh, 1994, pp. 37-38). For example, /mahal/ (expensive) is realized as [mãhãl].

Different languages may have the same phonetic content but the co-articulation and assimilation characteristics of the phonemes may not be identical (vowel nasalization in Malay language is an example). Standard passages used in nasometric assessment are constructed in English. Therefore, two passages resembling these standard passages were first constructed for the purpose of this study. The same method was also adopted in previous research (Anderson, 1996; Tachimura *et al.*, 2000; Watterson *et al.*, 1996).

Speech may also be influenced by age and sex. The effect of age on nasalance scores reflects the immature velar movements of young children (Haapanen, 1991). This could be explained by presence of some leakage from the oral to the nasal cavity during production of sentences with pressure consonants. This occurred because the oral air pressure was higher during articulation of pressure consonants and more acoustic energies were pushed to the nasal cavity. These were registered by the nasometer, giving a higher nasalance scores in the younger children.

There were some controversies regarding the effect of sex on nasalance scores (Sweeney *et al.*, 2004), which may be due to physiological differences, equipment factors, or statistical errors (Seaver *et al.*, 1991; Whitehill, 2001). However, most studies on nasalance scores reported no differences between male and female scores (Sweeney *et al.*, 2004; Tachimura *et al.*, 2000).

The aims of this study were to determine the nasalance scores in Malay-speaking noncleft children and children with repaired cleft palate (± lip) and to compare the nasalance scores between these groups. This study also examined whether there were age and/or sex differences in the nasalance scores in both groups.

Materials and methods

One hundred and three noncleft Malay children were randomly chosen from two randomly selected schools in Kota Bharu, Kelantan, Malaysia. To minimize the effects of language and dialect, only children using the Malay language (Bahasa Melayu) with Kelantan dialect as their first language were selected. The children were divided into three groups: 6-9 years old (Group 1), 10-13 years old (Group 2), and 14-17 years old (Group 3) following results of Smith *et al*. (2003) who found that pressure flow characteristics for nasal speech sounds were similar for ages 5-9, 10-13, and 14-18 years old. The authors used this as a guideline given that Dalston and Seaver (1992) had found that the scores on the Zoo Passage were significantly related to velopharyngeal area. The noncleft or normal children would act as the control group.

Twenty-seven children with repaired cleft palate (± lip) participated as the subjects for the experimental group. They were randomly selected from a cleft database of repaired CLP patients seen at the Universiti Sains Malaysia hospital.

Both cleft and noncleft subjects had no medical illnesses or conditions that could affect their speech (other than the cleft). Specifically, they were nonsyndromic and had no neurologic conditions or upper respiratory tract infection at the time of testing. The noncleft subjects had no family history of CLP or other palatal dysfunction. All the subjects were able to read the passages presented or repeat the sentences after the examiner.

Informed consent was obtained from parents/guardians of those who had agreed to participate in the study. This study was approved by the Research and Ethics Committee of School of Medical Sciences, Universiti Sains Malaysia

(Reference number: USM/PPSP®/Ethics Com./2003(116.4[2).

Two short and simple test stimuli in the Malay language were constructed to resemble the passages often used with nasometry in English-speaking subjects (in terms of the percentage of nasal phonemes). They were called the Oral and Nasal Passages (Fig. 1). The Oral Passage is devoid of nasal consonants and the Nasal Passage has 34.7% of nasal consonants (Anderson, 1996).

Fig. 1 Reading stimuli

Nasal Passage
Mimi mahu makan nasi
Mama Mimi masak nasi ayam
Nenek Mimi datang
Mimi jemput Nenek makan

Oral Passage
Perut Ali sakit
Ali pergi ke hospital
Doktor beri Ali ubat
Perut Ali tak sakit lagi

The Nasometer II model 6400 (Kay Elemetrics Corp., USA) connected to a tabletop computer was used in this study. Prior to initiating data collection, the nasometer was calibrated following procedures outlined in the manufacturer's instruction manual. To ensure that the headgear was worn correctly, its placement and necessary adjustments were done according to the manufacturer's specification (Kay Elemetrics Corporation, 2003). Subjects were then instructed to read or repeat the stimuli with the nasometer software running to capture the speech signals. Twelve subjects from the control group first read the test stimuli and then repeated them after the examiner. This was done to evaluate if there were any differences in the nasalance scores computed for the read versus repeated stimuli. All speech inputs were saved in the computer hard disc for later analyses.

The data were entered into an SPSS 11.0 for statistical analyses. Descriptive statistics were used to find the means for each passage for the control and experimental groups. Independent *t*-tests were utilized to determine differences in the nasalance scores of both passages between the two groups. Additionally, the effects of sex and age in both groups were also analysed using *t*-test and repeated-measures ANOVA, respectively. Data from the 12 participants who read and repeated the stimuli were analysed using paired *t*-test. For all analyses, a p value of < 0.05 was accepted as significant.

Results

The nasalance scores obtained from the two groups are summarized in Table 1. The independent *t*-tests showed significant differences in the mean nasalance scores for the Oral Passage between the control and experimental groups with $p < 0.001$. No differences between the groups were found for the Nasal Passage ($p = 0.79$). There were also no differences observed in the nasalance scores of the 12 children who read and repeated the stimuli ($p = .08$ and $p = .07$ for the Nasal and Oral Passages, respectively).

The mean nasalance scores for the control and experimental groups by their sex and age were presented in Table 2 and Table 3, respectively. The differences between sexes were not significant for either the control group or the experimental group. Using ANOVA with Scheffe's posthoc test, a significant difference was found for age only in the control sample between age groups 10-13 and 14-17 years. The differences were significant for both Nasal and Oral Passages.

Table 1 Mean nasalance scores for the normal (control) and cleft (experimental) groups

Stimulus	Normal group (n = 103) Mean NS (%) (SD)	Cleft group (n = 27) Mean NS (%)(SD)	*t* statistics (df)	*p* value
Nasal Passage	59.3 (5.65)	59.6 (6.23)	-0.3 (128)	.791
Oral Passage	17.7 (6.31)	42.9 (14.43)	-8.9 (28.7)	< .0001

NS = nasalance scores; SD = standard deviation; n = sample size; df = degree of freedom.

Table 2 Mean nasalance scores for the normal and cleft groups by sex (n = 52, 51, 12, and 15 in normal males, normal females, cleft males, and cleft females, respectively)

	Mean nasalance scores (%) (SD)			
	Male	**Female**	***t* statistics (df)**	***p* value**
Nasal Passage				
Normal group (n = 103)	58.8 (6.05)	59.7 (5.22)	-0.8 (101)	.43
Cleft Group (n = 27)	58.2 (7.87)	60.7 (4.50)	-1.1 (25)	.30
Oral Passage				
Normal group (n = 103)	16.7 (5.83)	18.6 (6.69)	-1.5 (101)	.13
Cleft Group (n = 27)	41.4 (15.93)	44.1 (13.55)	-0.5 (25)	.64

SD = standard deviation; df = degree of freedom.

Table 3 Mean nasalance scores for the normal and cleft groups by age (n = 30, 37, and 36, for normal children 6-9 years, 10-13 years, 14-17 years, respectively; n = 11, 8, and 8, for cleft children 6-9 years, 10-13 years, and 14-17 years, respectively

	Mean nasalance scores (%) (SD)		
	6-9 years	**10-13 years**	**14-17 years**
Nasal Passage			
Normal group (n = 103)	58.4 (4.71)	58.0 (5.94)*	61.3 (5.62)*
Cleft Group (n = 27)	60.4 (6.05)	59.8 (8.14)	58.4 (4.78)
Oral Passage			
Normal group (n = 103)	16.7 (6.61)	16.0 (4.95)*	20.1 (6.72)*
Cleft Group (n = 27)	44.1 (14.56)	43.5 (11.69)	40.8 (18.06)

SD = standard deviation; *$p < .05$ for the normal group between 10-13 and 14-17 years for both passages.

Discussion

The aims of this study included determining and comparing nasalance scores for noncleft children and children with repaired CLP speaking the Malay language, Kelantan dialect. The nasalance scores obtained from this study were lower for the Oral Passage than the Nasal Passage, for both control and experimental groups. These findings were similar with other studies (Chun and Whitehill, 2001; Tachimura *et al.*, 2004) and it confirmed the suitability of the newly constructed passages.

Watterson *et al.* (1996) utilized shorter passages than the standard passages used in nasometry and they reported similar findings with the well-known longer passages. They recommended a simpler stimulus for use with younger subjects for practical purposes. Thus, the two passages constructed for use in this study were short and contained simple words so that they could be easily read or repeated by young children. Using a standard passage (versus conversation) is useful because it provided a consistent speech sample (Kuehn and Moller, 2000). Furthermore, it can be used to compare the speech characteristics before and after treatment or intervention. Future research in the studies of speech in the Malay language could reliably compare their results with this study if these passages were used as part of the stimuli.

The normative mean nasalance scores reported by Kay Elemetrics Corp. (Kay) (2003) were 59.6% (SD 7.96) and 11.3% (SD 5.63) for nasal and oral stimuli, respectively. However, these data were derived from 40 adults, as compared to this study which evaluated nasalance scores in younger subjects. Age has been identified as an influencing factor in nasalance scores, with younger subjects reportedly having higher nasalance scores due to the high energy which escaped through the nose during speech, particularly for oral speech sounds. However, our data showed that in the normal subject, the 14-17 years old children had higher nasalance scores compared to the 10-13 age group. This could be due to changes in the laryngopharynx in some of the participants due to puberty, which could affect the velopharynx. Studies have shown that nasalance scores can be affected when there is growth in the nasopharyngeal area (Pulkkinen *et al.*, 2001). Nevertheless, the mean nasalance scores obtained from this study are comparable to Kay's data, as well as data from other studies (Table 4) (Mohd Ibrahim *et al.*, 2011; Nichols, 1999; Prathanee *et al.*, 2003; Whitehill, 2001). There were also no differences in nasalance scores between males and females, similar to other studies in other languages (Sweeney *et al.*, 2004; Tachimura *et al.*, 2000).

Table 4 Mean nasalance scores for nasal and oral stimuli in other research

Research	Language	Nasal stimulus NS (%) (SD)	Oral stimulus NS (%) (SD)
Kay Elemetrics Corp. (2003)	English	59.6 (7.96)	11.3 (5.63)
Nichols (1999)	Spanish	55.3 (6.00)	17.0 (6.72)
Prathanee *et al.* (2003)	Thai	51.1 (6.40)	14.3 (5.80)
Whitehill (2001)	Cantonese	55.7 (7.38)	13.7 (7.16)
Mohd Ibrahim *et al.* (2011)	Malay (West Peninsular)	60.28 (6.99)	13.86 (5.11)
Present study	Malay (Kelantan dialect)	59.3 (5.65)	17.7 (6.31)

NS = nasalance scores; SD = standard deviation.

Findings from the current study were consistent with other research that evaluated the differences in nasalance scores between noncleft and cleft patients (van Lierde *et al*., 2002; Nandurkar, 2002; Pinborough-Zimmerman *et al*., 1998; Tachimura *et al*., 2004; Watterson *et al*., 1998). Nevertheless, the nasalance scores for the repaired CLP group in this study are higher than those reported in other studies (Table 5).

Chun and Whitehill (2001) suggested that "the nasometer can be used with some confidence in corroborating clinical impressions of hypernasality…". Therefore, we assumed that the higher nasalance measures in the children with repaired CLP may be correlated with increased hypernasality. This would suggest that our repaired CLP patients' speech were less acceptable than those patients reported in other studies. The explanation for this problem could be a combination of factors including late surgery, lack of speech therapy services and late intervention for children with CLP. Further investigations regarding these factors are warranted. As language and dialect have been shown to influence nasalance score, results from this study can only be used with persons in this region.

Table 5 Mean nasalance scores for oral stimulus in repaired cleft patients and patients with other craniofacial anomalies reported in other studies

Studies	Sample size	Age (years in range)	Nasalance score (SD)
Tachimura *et al.* (2004)	43	4-20	33.5 (13.30)
Nandurkar (2002)	10	5-12	34.0 (9.38)
Watterson *et al.* (1998)	25	5;4-13;3	30.28 (15.35)
Pinborough-Zimmerman *et al.* (1998)	15	4;6-13;1	31.1 (†)
Present study	27	6-17	42.9 (14.43)

SD = standard deviation; 5;4 = 5 years 4 months; † SD was not available.

Conclusion

This study provides the normative nasalance scores for Malay-speaking Kelantanese children which could be utilized as references in the management of Malay patients with resonance disorders. The nasalance scores obtained from the two groups were different for the Oral Passage, with the cleft children having higher scores compared to the normal children. The scores did not differ between the opposite sex; however, age differences were found in this study, with the 14-17 years old of the normal children having higher nasalance scores compared to the 10-13 years old normal children.

The nasalance scores for the cleft group could be used in comparing speech outcomes of our cleft patients with other centres worldwide. Thus, our management protocol in looking after these cleft patients could be improved by taking into account the extra measures taken by other cleft centres in managing their patients; for example, the usage of a standardised speech assessment in measuring outcomes of palatal surgery. It is the author’s hope that a speech assessment in Malay language would be developed for use in this country, which would also consider the different dialects in its application, as Malaysia is a multi-cultural country and has diverse types of languages.

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