Original Article

Nasolabial Anthropometry of Thai Neonates and 4-Month-Old Infants at Srinagarind Hospital, Khon Kaen University

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Background: The ethnic-based nasolabial reference values should be established for evaluations of the patients with dysmorphic faces and assessments of craniofacial surgeries.

Objective: To establish 1) standard nasolabial values for Thai neonates and 4-month-old infants at Srinagarind Hospital, Khon Kaen University, and 2) to compare mean values between sexes.

Materials and Methods: Thirty neonates and thirty 4-months-old infants were enrolled in the study. Direct measurements of the nose and lip were taken by one examiner. Intra-observer variations had been tested. Means, standard deviations (SD) and range were reported. The independent t-test was used to compare all parameters between males and females.

Results: This study established standard values of nasolabial parameters among Thai neonates and 4 -month-old infants. In neonates, the mean values were 11.92±1.18 mm for upper lip height, inter-commissural distance 25.05±1.53 mm, right nostril width 5.55±0.80 mm, left nostril width 6.48±0.86 mm, right nostril height 3.23±0.39 mm and left nostril height 3.25±0.38 mm. There were no statistically significant differences between sexes in this group. In 4-month-old infants, the mean values of the measurements were 14.25±1.06 mm for upper lip height, inter-commissural distance 31.52±2.68 mm, right nostril width 6.79±0.88 mm, left nostril width 6.73±0.87mm, right nostril height 4.79±0.73 mm and left nostril height 4.74±0.77 mm. In addition, there were no statistically significant differences between sexes except for left and right nostril width and inter-commissural distance.

Conclusion: In this study we established nasolabial norm values for Thai neonates and 4-month-old infants which could be used as a guideline to evaluate the efficacy of presurgical alveolar molding and cheiloplasty in cleft lip and palate infants.

Keywords: Facial soft tissue parameters, Craniofacial parameters, Craniofacial measurements, Direct measurement, Direct anthropometry

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Congenital anomalies and inherited birth defects commonly affect the craniofacial structure of the patients[1,2]. The fact that cleft lip and/or cleft palate (CLP) are the most common craniofacial anomalies worldwide[3]. The clinical features of CLP patients also involve facial appearance such as, protrusion of the premaxilla, shortened columella, flared alar cartilage and downward nostril tip on the cleft side[4,5]. Newborns with CLP routinely receive treatment incorporating a pre-surgical nasoalveolar molding (PNAM) device which is a procedure to reshape the alveolar segments and nasal components prior to surgery. PNAM has the ability to diminish the severity of cleft deformities which facilitates cheiloplasty when patients are 3 to 4 months old[6]. In order to evaluate the outcomes of PNAM and cheiloplasty, standard values of the orofacial soft tissue and their relationship in normal children especially in the nose-lip areas are crucial to obtaining optimal facial attractiveness[2,7,8].

The appearance of a human body is affected by several factors such as ecological, biological, geographical, racial, sex and age[9]. Various facial morphologies among infants have previously been studied among different races with varied results. Therefore, ethnicity-based orofacial reference values should be established for each individual race[1,8,10]. Additionally, normative data in Thai ethnic group is still lacking. There are many methodologies used in craniofacial anthropometry such as direct anthropometry with calipers, metric tape or ruler, 2D photogrammetry and computerized 3D photogrammetry. Direct anthropometry was considered as gold standard for facial measurements. Since, it has many advantages, including that simplicity, no limitation presented

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by hair or other defective and reflective area[11,12].

The purpose of this study was to establish standard nasolabial values for Thai neonates and 4-month-old infants which could be utilised as a guideline to evaluate the efficacy of pre-surgical alveolar molding and cheiloplasty in cleft lip and palate infants.

Materials and Methods

Study population

This study was a cross-sectional, preliminary descriptive study. Sixty subjects were divided into 2 groups of 30 neonates (15 males, 15 females) who were born at Srinagarind Hospital between December 2017 and January 2018, in addition to 30 normal infants aged of 4-month-old (15 males, 15 females) who attended the well-baby clinic at Srinagarind Hospital between February 2018 and July 2018. This study was approved by the Ethics Committee on Human Research, Khon Kaen University (HE601415).

Inclusion criteria

1) Full-term neonates (37 to 40 weeks of gestation) and normal infants aged of 4-month-old exhibiting good general health.

2) No history of birth asphyxia or any form of distress or illness.

3) Mother presented no history of diabetes mellitus, hypertension, cardiac, or renal disease during pregnancy.

Exclusion criteria

1) Critically ill condition at birth.

2) Infants with chromosomal abnormalities.

3) Infants born with congenital anomalies.

Data collection and measurements

Informed consent forms were signed by infants' guardians. Direct measurements were taken using a Boley gauge via units of millimeters to 2-digit decimals (Figure 1). All measurements were taken by one examiner whom the intra-examiner reliability was evaluated by intraclass correlation coefficients (ICC). ICCs were greater than 0.8. The measurements were taken during the daytime when the sample cases were sleeping so as to avoid variation of facial expression. Re-measurements were performed 30 minutes after the first examination during the same visit.

The measurements included alar base width (ABW), sub-nasal width (SW), right nostril width (NWRt), left nostril width (NWRt), right nostril height (NHRt), left nostril height (NHRt), columella height (CH), philtrum width (PW), philtrum length (PL), upper lip height (UH), lower lip height (LH), and inter-commissural distance (ID) (Figure 2A-C).

Statistical analysis

The data were analyzed using SPSS version 23® (Statistical Package for Social Sciences for Windows). All variables were presented as range, means and standard

Figure 1. Direct measurements taken with Boley gauge.

deviations. The independent t-test was applied to compare all parameters between males and females. All *p*-values were two-tailed with 95% confidence intervals. Intraclass correlation coefficient (ICC) was calculated to assess the intra-examiner reliability performed for all measurements with a remeasurement at least 30 minutes after the first measurement by same examiner. The intraclass correlation coefficient value via direct measurement must be at least 0.8.

Results

A total of 60 subjects enrolled in the study. In the first group, subjects consisted of 30 normal neonates. The average age of this group was 2.13 days. The average body weight and body length were 3,081.33 grams and 48.90 cm, respectively. Another group is 30 normal 4-month-old infants. The average age of this group was 128.00 days. The average body weight and body length were 6,574.33 grams and 61.50 cm, respectively. Mean values, standard deviations and ranges of nasolabial parameters are presented in Table 1. The comparisons of nasolabial mean values between sexes for neonates and 4-month-old infants are shown in Table 2. Consequently, all nasolabial parameters demonstrated no statistically significant differences between sexes. And the comparison of nasolabial mean values between sexes in 4-month-old infants revealing no statistically significant differences in nostril widths on both sides as well as inter-commissural distance.

Discussion

In this study, we established the nasolabial values of Thai neonates and 4-month-old infants. In neonate group, the results have shown that the craniofacial structures and nasolabial values in infant was differed from adult in both proportions and values, which the appearances of the infant are characterized by flat and wide face with a large eyes and puffy cheeks. Additionally, they have a short nose with board nasal bridge, low ears and tiny mouth[13]. The comparison of nasolabial mean values in our study showed no significant

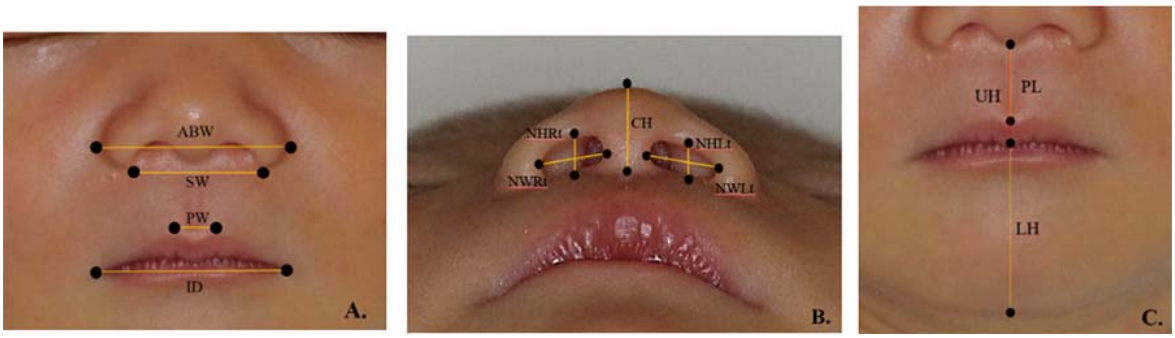

Figure 2. (A) ABW = Alar base width; SW = Sub-nasal width; PW = Philtrum width; ID = Inter-commissural distance. (B) NWRt = Nostril width on right side; NWLt = Nostril width on left side; NHRt = Nostril height on right side; NHLt = Nostril height on left side; CH = Columella height. (C) PL = Philtrum length; UH = Upper lip height; LH = Lower lip height.

Table 1. Measurements of nasolabial parameters

Parameters	Neonates group Mean ± SD (range) in mm (n = 30)	4-month-old infants group Mean ± SD (range) in mm (n = 30)
1) Alar base width (ABW)	22.23±1.09 (19.90 to 24.10)	25.94±1.27 (23.30 to 28.40)
2) Subnasal width (SW)	14.24±1.21 (10.60 to 16.20)	17.39±1.61 (14.30 to 20.70)
3) Nostril width (NWRt)	5.55±0.80 (3.80 to 7.00)	6.79±0.88 (4.20 to 9.10)
4) Nostril width (NWLt)	5.48±0.86 (3.60 to 7.20)	6.73±0.87 (4.10 to 8.70)
5) Nostril height (NHRt)	3.23±0.39 (2.50 to 4.00)	4.79±0.73 (3.20 to 6.60)
6) Nostril height (NHLt)	3.25±0.38 (2.50 to 4.00)	4.74±0.77 (3.20 to 6.60)
7) Columella height (CH)	7.42±1.07 (5.50 to 10.80)	8.01±0.90 (6.30 to 10.00)
8) Philtrum width (PW)	5.32±1.27 (2.90 to 7.80)	7.22±0.99 (5.90 to 9.90)
9) Philtrum length (PL)	9.02±1.43 (5.80 to 12.70)	10.82±1.31 (8.50 to 13.10)
10) Upper lip height (UH)	11.92±1.18 (9.10 to 14.50)	14.25±1.06 (12.00 to 16.20)
11) Lower lip height (LH)	18.93±1.99 (15.10 to 23.60)	25.92±1.75 (22.50 to 29.00)
12) Intercommissural distance (ID)	25.05±1.53 (21.30 to 28.10)	31.52±2.68 (24.50 to 36.40)

SD = Standard deviation; n = Number of subjects

difference between male and female neonates in all measurement parameters. Therefore, this implies that nasolabial mean values for this age group can be employed for both genders.

For 4-month-old infant, the nasolabial values were greater than neonate in entire measurement parameters. However, the proportion still the same. In addition, this study showed a statistically significant larger between sexes in regards nostril width on the right and left sides as well as inter-commissural distance. Although there was no significant difference between the remaining parameters, higher values for males were observed which was similar to those in other studies[2,8,14].

There are many studies regrading to nasolabial parameters of neonates[2,8,15-17]. At present, no publication was found for Thai ethnicity (Table 3). The mean values for alar base width and philtrum length were similar between Chinese and Thai neonates[15]. Whilst, the columella height and inter-commissural distance mean values of Korean neonates were greater than in Thai neonates. On the other

Table 2. Measurement values of neonates and 4-month-old infants (comparing both sexes)

Parameters	Neonate group			4-month-old infant group		
	Males (n = 15)	Females (n = 15)	*p*-value (<0.05)	Males (n = 15)	Females (n = 15)	*p*-value (<0.05)
	Mean ± SD in mm			Mean ± SD in mm		
1) Alar base width (ABW)	22.28±0.97	22.17±1.23	0.793	25.97±1.44	25.92±1.13	0.922
2) Subnasal width (SW)	14.17±1.01	14.31±1.42	0.758	17.31±1.66	17.48±1.60	0.773
3) Nostril width (NWRt)	5.52±0.85	5.58±0.77	0.841	7.18±0.81	6.41±0.77	0.012*
4) Nostril width (NWLt)	5.45±0.93	5.50±0.82	0.885	7.16±0.75	6.28±0.77	0.005*
5) Nostril height (NHRt)	3.27±0.49	3.22±0.32	0.892	4.95±0.65	4.63±0.81	0.257
6) Nostril height (NHLt)	3.25±0.49	3.27±0.28	0.781	4.88±0.73	4.61±0.80	0.338
7) Columella height (CH)	7.43±1.37	7.41±0.70	0.974	8.16±0.97	7.86±0.82	0.368
8) Philtrum width (PW)	5.29±1.56	5.35±0.94	0.888	7.13±0.67	7.31±1.25	0.639
9) Philtrum length (PL)	9.07±1.26	8.96±1.63	0.833	10.59±1.52	11.05±1.06	0.352
10) Upper lip height (UH)	11.59±1.13	12.26±1.16	0.119	14.14±1.12	14.36±1.03	0.579
11) Lower lip height (LH)	18.41±1.71	19.44±2.18	0.162	26.09±1.19	25.75±2.21	0.604
12) Intercommissural distance (ID)	24.81±1.80	25.28±1.23	0.414	32.51±2.68	30.80±1.80	0.041*

n = Number of subjects; SD = Standard deviation; NS = No statistically significant difference; S = Significant difference
* Indicates a statistically significant difference (p<0.05)

Table 3. Comparison of nasolabial mean values of neonates

Study	Mean ± SD (mm)					
	Ethnicity	Alar base width	Columella height	Philtrum width	Philtrum length	Inter-commissural distance
Present study	Thai n = 30	22.23±1.09	7.42±1.07	5.32±1.27	9.02±1.43	25.05±1.53
Fok et al[15]	Chinese n = 2,371	21.50±2.00	-	-	9.00±1.00	-
Byng chae cho[16]	Korean n = 40	20.70±2.20	8.70±1.10	-	8.30±1.10	26.80±3.2
Agnihotri and Singh[2]	North Indian n = 60	-	-	7.58	8.30	20.01
Khandekar et al.[17]	West Indian n = 25	-	-	5.15	-	22.85
Ghosh A et al.[8]	East Indian n = 1,060	-	-	5.1	7.45	21.45

SD = Standard deviation; n = Number of subjects

Table 4. Comparison of nasolabial mean values of 4-month-old infants

Study	Mean ± SD (mm)					
	Ethnicity	Alar base width	Columella height	Philtrum width	Philtrum length	Inter-commissural distance
Present study	Thai n = 30	25.94±1.27	8.01±0.90	7.22±0.99	10.82±1.31	31.52±2.68
Byng chae cho[16]	Korean n = 40	25.30±2.40	11.70±1.40	-	9.80±1.70	30.80±2.90
Agnihotri and Singh[2]	North Indian n = 60	-	-	8.76	10.15	28.55

SD = Standard deviation; n = Number of subjects

hand, philtrum length and alar base width mean values were lower[16]. Comparing the nasolabial values of Thai and Indian population, the philtrum width of Thai was slightly greater than those in West and East Indian neonates but lower than North Indian neonates. For the philtrum length, the mean value of Thai was greater than those in East Indian neonates. For inter-commissural distance, Thai was greater than all Indians[2,8,17]. This concluded that each ethnicity exhibited unique neonate facial profile.

There are few studies which have recorded data regarding nasolabial norms in 4-month-old infants, but until now no report was done in Thai population (Table 4). The philtrum length and inter-commissural distance in Thais were higher than in Koreans. However, columella height mean value in Thais was lower. For alar base width, the mean values among Thai and Korean infants were quite similar[16]. Comparing between Thai and North Indian infants, the philtrum width mean value of North Indians was higher. On the other hand, the philtrum length and inter-commissural distance in Thais were higher[8].

Cho et al[16] considered that data concerning the craniofacial skeleton and soft tissue, especially in nose-lip areas, is imperative to determining the exact time-frame to correct the facial deformity among CLP. Nasolabial norm-values for Thai neonates and 4-month-old infants are beneficial for orthodontists and plastic and maxillofacial surgeons. For orthodontists, they could use these values as a tool to evaluate PNAM outcomes. For plastic and maxillofacial surgeons, the nasolabial mean values could be used as a reference for evaluating the soft tissue balance between cleft areas prior to and post cheiloplasty. In addition, this normative data may be useful amid future researches to compare soft tissue balance and proportion between normal infants and CLP infants.

Anthropometry of the craniofacial soft tissue is a very useful instrument for medical researches. It plays an important role in the diagnosis and assessment of newborns with dysmorphic features and may be employed as a tool for plastic surgery[7]. The direct anthropometry used in this study, which is commonly utilised for soft tissue facial measurement taking, is found in many studies conducted in different populations for instance, North American, Caucasian, Hong Kong Chinese, Korean and Indian[2,8,10,15,18]. Hence, this would imply that direct anthropometry is a standardized and acceptable technique for facial measurement taking.

Clinical application

This study provides norm values with regards to nasolabial parameters for utilisation as a reference to improve clinical application amid CLP. The nasolabial parameter norm values could be used as a template to manufacture preformed devices, which are valuable amid reducing chair time. The data of nostril width and height, columella height, upper lip length and inter-commissural distance in neonate could help create a proper size PNAM. In regards the mean values relating to nostril width and height in 4-month-old infants can assist orthodontists and dental technicians in the development of a preformed nasal retainer suitable in size for Thai patients. This device is employed to maintain the corrected nasal position, and limit the effects of scar contracture after cheiloplasty[19].

Due to the limited period of collecting data, the present study has the limited the number of participants in the study. In order to get the representative results of this study, we have assessed the intra-examiner reliability of the examiner firstly and strictly selected the sample followed by inclusion criteria. In addition, we have excluded child with dysmorphic feature, preterm birth babies and critically ill condition at birth. So, the result of present should be valid and reliable.

Conclusion

We established the nasolabial norms for Thai neonates and 4-month-old infants in both sexes via direct measurements. The results indicated that the dimensions of the human body are affected by various factors including; geography, race, age and sex factors. For that reason, it is clarified that every racial group should have its own distinct anthropometric data for future reference. Obtaining Thai reference values could help to evaluate, diagnose and treat

neonates with dysmorphic features. They could also be applied as a guideline to develop treatment procedures and to assess pre, during, and postsurgical outcomes. In addition, the nasolabial mean values could be used as a database for further research which is suggested by the authors to include a wider age range and an increased number of participants.

What is already known on this topic?

The present study assumes that the dimensions of the human body are affected by various factors i.e. geography, ecology, biology, race, age and sex. So, this assumption clarifies the fact that every racial group ought to have its own definite anthropometric data.

What this study adds?

This study provides a normative data in terms of nasolabial parameters for Thai neonate and 4-month-old infants. This information could then be used as a guideline to develop an average preformed size for PNAM devices and nasal retainers produced at Khon Kaen University.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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