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Anthropometric Comparative Study of Nasal Morphology between Malaysian and Indonesian Populations

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Abstract

Nasal morphology is one of the most crucial anthropometric characteristics of the human face. Furthermore, the nose is a pivotal feature in constructing a biological profile. In this cross-sectional study, we examined the nasal morphology of 103 Malaysian and 109 Indonesians, totaling 212 individuals from both groups. A comprehensive analysis involved the measurement of 12 nasal morphological features. The statistical tool employed for the analysis was a t-test, which revealed significant differences in various parameters between Malaysians and Indonesians ($p<0.05$). These findings demonstrate the statistical importance of nasal morphology in discerning racial and ethnic differences. This research suggests that nose measurements could be instrumental in resolving identity mysteries, making them valuable for forensic examination.

Keywords:
Race; Nasal morphology; Malay; Indonesia; Human Face; Anthropology

1. INTRODUCTION

In forensic settings, facial features are key in determining the identity of individuals, particularly when faced with unidentified remains or skeletal structures. Among these features, the nose stands out as a significant anatomical marker for age, ethnicity, and sex determination [1]. The nasal index, calculated from the ratio of nose width to height, is a valuable tool in forensic medicine and anthropology, aiding in the identification of an unknown person's sex and ethnicity [2]. Specifically, it allows forensic experts to recognize unique morphological traits associated with different ethnic groups. This helps narrow down potential ethnic backgrounds, increasing the accuracy of the biological profile constructed for the individual.

Meanwhile, the nasal index is significant in both forensic sciences and rhinoplasty surgery, as it serves as a valuable tool for distinguishing traits among individuals [3]. The nose, like many other

parts of the face, varies both within and between human populations [4].

The nose functions as the uppermost part of the respiratory tract and serves as the organ for smell. Its shape, including the nasal bridge, slope of the tip, septum, and nares, varies from one population or ethnic group to another, as well as from one environmental region of the world to another [5]. Yadav et al. (2018) highlighted the nose as one of the best body parts for identifying ethnic group origins [5]. The variation among populations with various ethnic backgrounds can be explained by facial morphology itself [6]. According to Stefano (2022), ancestry encompasses more than the mere accumulation of neutral changes over time that align precisely with geographic origins [7]. Human diversity is influenced by a variety of evolutionary processes occurring in different parts of the world. Therefore, ancestry pertains to an individual's ethnic origin or lineage, encompassing their "roots" and the birthplace of their ancestors.

This study investigated the anthropometric human facial traits of nasal morphology and nose characteristics between Malaysians and Indonesians. This is because Malaysians and Indonesians are part of the Malay Archipelago [8]. It was also discovered that Malaysians and Indonesians have a similar ancestor in their ancestral lines [9]. According to Tirtosudarmo (2005), Indonesia and Malaysia are part of the same fluid ethnic group, especially Javanese [10]. By conducting this research, distinctions in nasal morphology between Malaysian and Indonesian individuals can be identified. This is in accordance with a study by Bulut et al. (2019) that highlights the significance of the nose as a crucial feature in establishing a biological profile, encompassing factors such as ethnicity [11].

2. METHODS

2.1. Study Design

This cross-sectional study investigated the nasal morphology of the participants. The researchers applied an ethics and authorization form with reference number MSU-RMC-02/FR01/05/L1/048 prior to conducting this study. This study was approved by the Ethics Committee of the Management and Science University's Faculty of the Post-Graduate Center.

2.2. Study Selection and Criteria

For this study, convenience sampling and snowball sampling methods were chosen because of their cost-effectiveness, minimal time requirements, and ease of reaching respondents. The research included Malaysian and Indonesian participants, with data collected in the Petaling district and Indonesia Surabaya (Javanese, Medan, Madura, and Padang), respectively. A total of 212 respondents participated in the study, comprising 103

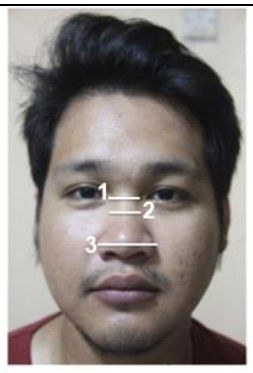
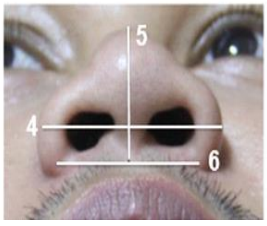
Malaysians (56 Malay men, 47 Malay women) and 109 Indonesians (70 Indo men and 39 Indo women).

The selection of participants adhered to specific inclusion and exclusion criteria. The inclusion criteria were Malay males and females from Malaysia aged 18 to 70, belonging to the same race up to the 3rd generation, as well as Indonesian males and females from Indonesia within the same age range and generational criteria. Exclusion criteria included individuals from families with a history of interracial marriage, those who had undergone cosmetic surgery, recent piercings, nose treatments, children aged 0–17 years, and individuals with nasal trauma.

2.3. Nasal Measurement

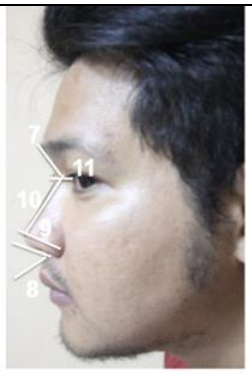
In this study, 12 nasal dimensions were measured using the method described by Pazos et al. (2008) [12]. Before initiating the research, participants were provided with a consent form outlining comprehensive inclusion and exclusion criteria. Both verbal and written explanations were provided, elucidating the research objectives and underscoring the voluntary nature of participation without any financial incentives. The privacy and confidentiality of the participant information were rigorously maintained throughout the study. With consent secured, the researcher collected nasal measurements using the reference provided in **Table 1**.

Table 1. The measurement of nasal morphology along with the abbreviation and the description consists of three measurements from the front view, three measurements from the base view, and five measurements from the side view of the nose.

Parameter – Abbreviation – Description	Figure
Parameter 1 – Endocanthion point (EN-EN) Parameter 2 – Nasal bony width (BB) Parameter 3 – Interalar distance (AL)	 (Front view)
Parameter 4 – Bialar base distance (AL-AL BASE) Parameter 5 – Nasal base to pronasal distance (ACH-PRN) Parameter 6 – Bialar angle (BAA)	

(Base view)

Parameter 7 – Nasofrontal angle (NFR)
Parameter 8 – Nasolabial angle (NLA)
Parameter 9 – Nasal wing to pronasal distance (AL-PRN)
Parameter 10 – Nasal length Nasion pronasal distance (N-PRN)
Parameter 11 – Nasal projection



(Side view)

2.4. Data Analysis

After completing the collection of nasal morphology measurements, data were entered into Microsoft Excel 2019. Statistical analyses were conducted using the IBM SPSS Statistics 27. T-test analysis was used to differentiate between the Malaysian and Indonesian populations. In hypothesis testing, this statistical test assesses whether the means of two groups differ, providing insight into the distinctiveness of the groups or the genuine impact of a procedure or treatment on the population of interest.

3. RESULTS AND DISCUSSION

3.1 Nasal Measurements

Table 2 shows the nasal morphology in Malaysia and Indonesia. Overall, Malaysians exhibited a higher mean nasal morphology in Parameters 1, 5, 6, 8, and 10, while Indonesians demonstrated a higher mean nasal morphology in Parameters 2, 3, 4, 7, and 11. Additionally, Malaysians and Indonesians shared a similar mean value for Parameter 9. The t-test was used for the 11 parameters of nasal morphology. Statistically, the p-value shows a significant value for parameter 4, parameter 5, parameter 7, parameter 8 and parameter 10. This demonstrated that nasal anthropometry could be used to determine the race of people with unknown identities. An examination of Iraqi Arabic and Kurdish individuals revealed that nasal morphometric characteristics were distinct for each individual and exhibited variance between various racial groups (Arabic and Kurdish). Notably, there were significant disparities in nose height and length between the two populations [13].

The findings from this study can be correlated with those of the study conducted by Akbar et al. (2013) on the indigenous population of Toraja. Their research identified anthropological differences in the nasal index morphology based on the race, age, and sex of the Toraja indigenous population [14]. Previous research that was undertaken to assess the mechanisms of human nasal airflow across diverse ethnic

groups revealed significant differences in external nose morphologies and anterior nasal airways among people from Caucasian, Chinese, and Indian backgrounds [15]. A study by Aung et al. (2022), which focused on nasal morphologies of different races, utilized an independent t-test to assess significant differences in the means of two unrelated racial groups. The results of the independent t-test indicated statistically significant differences among the racial groups [16].

Table 2. Nasal morphology results according to parameter 1 until 11

Parameter	Race	Mean ± SD, mm	p-value
1	M	30.35±3.2	0.239
	I	29.68±4.8	
2	M	14.79±2.7	0.790
	I	14.88±1.8	
3	M	39.47±4.5	0.710
	I	39.68±3.5	
4	M	40.20±4.9	0.015
	I	41.67±3.7	
5	M	18.31±5.8	0.000
	I	15.18±2.2	
6	M	36.27±5.7	0.232
	I	35.49±3.4	
7	M	17.10±4.9	0.036
	I	18.33±3.4	
8	M	26.07±6.7	0.047
	I	24.57±3.9	
9	M	32.03±4.4	0.859
	I	32.03±3.2	
10	M	40.88±4.6	0.022
	I	39.49±4.1	
11	M	13.86±2.6	0.515
	I	14.16±3.7	

Note: M = Malaysian, I = Indonesian

3.2. Nasal Basal Index of Malaysian and Indonesian Populations

This study also specifically examined the Nasal Basal Index, designated as the 12th parameter of nasal morphology, representing the relationship between basal height (Parameter 5) and basal width (Parameter 4) [12]. The Nasal Basal Index was calculated using the formula:

$$Nasal\ Basal\ Index\ = \frac{Parameter\ 5}{Parameter\ 4\ \times\ 100}$$

The parameters of the Nasal Basal Index for Malaysians and Indonesians revealed that Malaysians had a value of 0.004684 ± 0.002277, while Indonesians had a value of 0.003656 ± 0.0005172. The results suggested that Malaysians exhibited a higher score than Indonesians with statistical significance indicated a significant difference ($p<0.05$). This suggests that, on average, Malaysians exhibit distinct nasal features compared to Indonesians, highlighting notable variations in nasal morphology between the two populations. A previous Indian study aimed to delineate variations in nasal anthropometric measurements between North Indian and South Indian populations. The findings revealed that the mean nasal breadth among North Indians was 2.8±0.39 cm, surpassing that of South Indians (2.7±0.37 cm). Similarly, the mean nasal

height for North Indians measured 5.2±0.89 cm, indicating a higher value compared to South Indians (4.9±0.33 cm) [17].

The findings of this study demonstrated that nasal morphology measurements can be used to discriminate between Malaysian and Indonesian populations. The nose is one of the finest body parts for identifying ethnic group origins [5]. According to Shah and Frank-Ito (2022), variations in nasal morphology are also thought to be due to human adaptation to diverse climatic environments, and these differences in the human nose due to geographic adaptations are often characterized by the nasal index [18]. Zaidi et al. (2017) used Qst–Fst comparisons to show that nares width and alar base width are more differentiated across populations than expected under genetic drift alone, this conclude that some aspects of nose shape may indeed have been driven by local adaptation to climate [4]. In addition, Multiple studies indicate a correlation between the shapes of the nasal aperture and nasal cavity and climate variables associated with temperature and humidity. In cold-dry climates, individuals tend to have narrower nasal cavities, contrasting with those from warm-humid climates. However, it's important to note that climate might not be the sole contributing factor to differences in nose shape across populations [4].

According to Maréchal et al. (2023), the configuration of the nasal shape is an outcome of various interconnected factors, encompassing genetic drift and climatic adaptation [19]. It manifests intricate patterns of variation in nasal airway morphology. Notably, nasal features like width, height, and prominence are strongly influenced by genetic factors [20]. This aligns with research on facial morphology conducted with 3D facial images of 1380 female twins from the TwinsUK Registry database. The findings revealed that over 70% of the phenotypic facial variation, including facial size, nose dimensions (width, prominence, and height), lip prominence, and interocular distance, is influenced by genetic factors. Consequently, certain traits, such as nose prominence and height, exhibit potential dominant genetic influence [21].

4. CONCLUSIONS

In summary, this study examined differences in nasal morphology between Malaysians and Indonesians, focusing on 12 nasal parameters. Significant differences in nasal characteristics were revealed by significant differences in metrics such as endocanthion point, bialar base distance, and nasolabial angle, among others, with Malaysians exhibiting higher means for certain parameters and Indonesians for others. Malaysian scores were higher on the Nasal Basal Index, indicating a statistically significant difference.

Overall, the study suggests that nasal anthropometry, namely the Nasal Basal Index, is a distinguishing factor between Malaysian and Indonesian populations.

5. ACKNOWLEDGEMENT

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