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Anthropometric Study of Nasal Indices in Undergraduate Omani Medical Students

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Abstract

Background: The nasal index (NI) varies across populations. Nasal indices (NIs) characterize the human face. This study examined the NIs in the Omani population. The NI provides objective measures of facial morphology, contributing to population differentiation and anthropological research while also supporting forensic biological profiling and human identification. **Methods:** This cross-sectional study included 149 Omanis aged 18–24 years. We initially collected demographic data using a questionnaire and screened the participants for eligibility. A Housolution 0–300 mm digital sliding caliper (Shenzhen, China) was used to obtain the NI measurements. Two trained researchers independently performed the measurements. Continuous variables were summarized using mean ± standard deviation (SD), and associations between nasal measurements were evaluated using Spearman's rank correlation coefficients. **Results:** The NI was significantly higher in males than in females (68.4 ± 7.1 vs. 56.1 ± 6.8, respectively; $p < 0.001$). The most prevalent nasal type was leptorrhine (50.3%). **Conclusions:** This study provides descriptive data on the distribution of the NI in young Omani adults. These findings may support future comparative anthropometric studies but should not be interpreted as validated measures for forensic identification.

Keywords: nasal index; anthropometry; anatomy; nose; forensic

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1. Introduction

Anthropometry, derived from the Greek words anthropos (human) and metron (measure), refers to the systematic measurement of human body dimensions and composition. It provides a range of simple, portable, non-invasive, and inexpensive techniques for assessing body weight, size, shape, and composition [1]. Anthropometric measurements play a vital role in evaluating physical fitness, nutritional status, and general health across different populations [2]. In forensic investigations, anthropometric measurements support the human identification of unknown individuals. Measurements obtained from the skull, facial structures, and other anatomical features can be used to estimate sex, age, and stature [3]. Population-based variation regarding anthropometric measurements was observed, with differences reported in several facial characteristics, including nasal and facial dimensions, as demonstrated across European, Middle Eastern, Asian, and African population studies. Farkas et al. reported that 1470 individuals from different ethnic backgrounds demonstrated significant variation in facial morphology, especially in the nasal and orbital regions [4]. Likewise, a comparison between Kenyan and Chinese populations revealed significant

differences in both vertical and horizontal facial measurements, with differences also observed in overall facial proportions [5]. Furthermore, a study conducted in the United States highlighted the differences in facial anthropometry across sex, race, ethnicity, and age group, emphasizing the significance of population-specific anthropometric data. Collectively, these findings highlight the presence of inter-population variation in anthropometric characteristics and support the importance of establishing population-specific reference data, particularly in clinical and forensic applications [6].

The human nose is a facial feature marked by substantial morphological diversity. The NI is defined as the ratio of nasal width to nasal height, multiplied by 100 [7]. It is commonly used to classify nasal morphology into five types: hyperleptorrhine, leptorrhine, mesorrhine, platyrrhine, and hyperplatyrrhine, providing a basis for population-level comparisons of anthropometric measurements [8]. Crucially, the human nose represents more than a primary feature of facial esthetics; it serves as a key anatomical structure influenced by environmental conditions, such as temperature and humidity. As a result, nasal dimensions show a marked diversity among different populations. Highlighting the need of population-specific reference value is important. Detailed assessment of nasal index offers a clinical foundation for reconstructive maxillofacial procedures and rhinoplasty while respecting ethnically distinct features [9,10].

However, despite extensive global research, evidence on NI patterns within the Omani population is lacking. Population-specific values may support comparative anthropometric and clinical research. The primary aim of this study was to evaluate the nasal indices, determine the different nasal types, identify the dominant type, and assess sex differences among undergraduate medical students at Sultan Qaboos University. The secondary aim was to provide descriptive population-specific anthropometric data for young Omani adults.

2. Materials and Methods

2.1. Study Design

This prospective cross-sectional study was conducted at the College of Medicine and Health Sciences at Sultan Qaboos University, Oman, from 1 June 2025 to 26 April 2026. This study protocol was approved by the Institutional Medical Research Ethics Committee (MREC#3566—1 June 2025). All participants provided verbal informed consent after receiving a detailed explanation of the study procedures and measurements. This study was reported in accordance with the STROBE guidelines for cross-sectional studies.

2.2. Participant Selection and Sample Size

Participants were undergraduate medical students aged 18–24 years who met the eligibility criteria. Participants with a history of head trauma or previous head surgery were excluded. Sultan Qaboos University is Oman's largest university, with approximately 820 medical students enrolled in 2025. Based on this population size, we calculated a required sample size of 262 participants using the population mean sample size formula, with a 95% confidence level and a 5% margin of error. Due to limited subject availability during the study period, failure to obtain consent, and strict inclusion criteria, we completed the study with a total sample size of 149 participants. These exclusion criteria were determined based on self-reports of the participants on the screening questionnaire.

2.3. Data Collection

Data collection comprised two components. First, the participants completed a questionnaire designed by the research team. The questionnaire aimed to collect demographic information, including age, sex, cohort, and residence (Wilayat/Governorate) of the participants. Additionally, individuals with a history of head trauma, cranial injury, or pre-

vious head surgery were excluded from this study. Measurements were obtained using a Housolution 0–300 mm digital sliding caliper (Shenzhen, China). To reduce observer bias, two trained members of the research team performed the measurements independently. Both observers used the same predefined landmark definitions and standardized participant positions. Nasal height, defined as the distance from the nasion to the subnasale, and nasal width, measured as the maximum distance between the two alar points, were recorded. Figure 1 shows the measurement of nasal height, and Figure 2 shows the measurement of nasal width. These measurements were subsequently used to calculate the NI according to the internationally established anthropometric standards [11]. Furthermore, the research team standardized the measurement protocol to reduce potential measurement errors and ensure consistency in all assessments. The use of a digital caliper with blunt, rounded edges posed no risk of injury or harm to the participants.

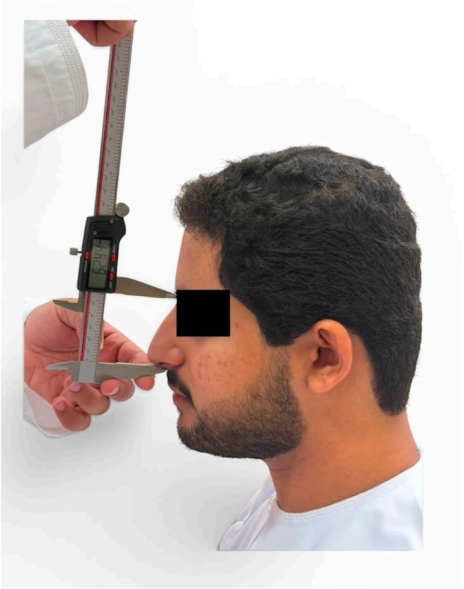


Figure 1. Measurement of nasal height using a digital sliding caliper, defined as the distance from the nasion superiorly to the subnasale inferiorly.



Figure 2. Measurement of nasal width using a digital sliding caliper, defined as the maximum distance between the two alar points.

2.4. Outcome

The primary outcome was to determine the type of NI. The secondary outcome was to evaluate the correlation between anatomical parameters (nasal height, nasal width). Table 1 shows the classifications of the nose, based on Martin and Saller.

Table 1. Classification of NI according to Martin and Saller standards, as cited by Kopecký et al. (2019) [12].

	Category	Reference Range	Description	Reference
NI	Hyperleptorrhine	<55.0	Long narrow nose	Martin & Saller
	Leptorrhine	55.0–69.9	Moderately narrow nose	
	Mesorrhine	70.0–84.9	Medium nose	
	Platyrrhine	85.0–99.9	Moderately wide nose	
	Hyperplatyrrhine	≥100	Very wide nose	

Abbreviations: NI = (Nasal width/Nasal height) × 100.

2.5. Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 26 (IBM Corp., Armonk, NY, USA). Continuous variables, including all craniofacial measurements, were summarized as mean ± standard deviation (SD), while categorical variables, including nasal type, were expressed as frequencies and percentages. The inter-rater reliability between the two researchers was assessed using the intraclass correlation coefficient (ICC), based on a two-way mixed-effects model with absolute agreement. Normality of continuous variables was assessed using the Shapiro–Wilk test. Accordingly, the independent-samples *t*-test was used to compare the mean NIs between males and females when normality was met; otherwise, the Mann–Whitney U test was used. Spearman's correlation coefficient was used to examine the associations among the craniofacial measurements, namely the nasal height and nasal width. A two-tailed p-value ≤ 0.05 was considered statistically significant.

3. Results

3.1. Demographic Data

A total of 149 students from the College of Medicine and Health Sciences (COMHS) at Sultan Qaboos University were included in the study. The mean age of the participants was 20.7 ± 1.3 years. More than half of the students (56.4%) were enrolled in the preclinical phase of medical education. The participants were predominantly from the Al Dakhiliyah Governorate (30.2%), whereas the lowest representation was observed in the Al Buraimi Governorate (1.3%). None of the participants had a history of major head trauma. The baseline demographic characteristics of the study population are presented in Table 2.

3.2. Anthropometric Measures

The intraclass correlation coefficient (ICC) showed excellent inter-rater reliability for the nasal index measurement with a two-way mixed-effects model, the absolute agreement model, showing an ICC of 0.922; 95% CI: 0.89–0.94. As the reliability was high, the mean of the two measurements was used for further analyses.

The mean NI in the study population was 60.2 ± 9.0. In males, the mean NI was 68.4 ± 7.1, whereas females demonstrated a mean value of 56.1 ± 6.8. The NI was significantly higher in males compared with females ($p < 0.001$). Table 3 compares the NI across Governorates.

Table 2. Baseline demographic data for the study population.

Variable		*n* (149)	%
Sex	Male	50	33.6
	Female	99	66.4
Phase of study	Preclinical	84	56.4
	Clinical	65	43.6
Governorate	Muscat	11	7.4
	Musandam	3	2.0
	Al Buraimi	2	1.3
	Al Dakhiliyah	45	30.2
	Al Dhahirah	10	6.7
	North Al Batinah	26	17.4
	South Al Batinah	27	18.1
	North Ash Sharqiyah	16	10.7
	South Ash Sharqiyah	9	6.0

Table 3. Nasal index by governorate of residence.

Governorate	*n*	NI (Mean ± SD)
Muscat	11	61.1 ± 11.6
Musandam	3	58.2 ± 8.5
Al Buraimi	2	55.0 ± 5.9
Al Dakhiliyah	45	61.4 ± 9.1
Al Dhahirah	10	57.3 ± 7.1
North Al Batinah	26	60.7 ± 9.7
South Al Batinah	27	61.5 ± 9.6
North Ash Sharqiyah	16	57.1 ± 7.7
South Ash Sharqiyah	9	58.9 ± 5.4

Regarding the nasal type, half of the participants (50.3%) exhibited a leptorrhine nose, whereas a mesorrhine nose was observed in 25 individuals (16.8%). The distributions of the nasal anthropometric types are presented in Table 4.

Table 4. Distribution of nasal anthropometric types among the study population.

Classification Category	Subtype	Total *n* (%)	Male *n* (%)	Female *n* (%)
Nasal type	Hyperleptorrhine	49 (32.9)	2 (4)	47 (47.5)
	Leptorrhine	75 (50.3)	26 (52)	49 (49.5)
	Mesorrhine	25 (16.8)	22 (44)	3 (3)

Regarding the distribution among governorates, hyperleptorrhine was the predominant phenotype in Muscat (45.5%), Al Dhahirah (50.0%), and North Ash Sharqiyah (50.0%), while leptorrhine predominated in Al Dakhiliyah (53.3%), North Al Batinah (50.0%), South Al Batinah (59.3%), and South Ash Sharqiyah (66.7%).

Spearman's correlation analysis was performed among the two raw nasal measurements. The nasal width and nasal height showed a negative correlation that did not reach statistical significance ($\rho = -0.143$, $p = 0.082$).

4. Discussion

This study provides descriptive anthropometric data for young Omani adults, as all 149 participants were medical students from Sultan Qaboos University with a mean age

of 20.7 ± 1.3 years, which may prove valuable for anthropological, forensic, and clinical research. The mean NI was 60.2 ± 9.0. The leptorrhine nasal type was most frequently observed (50.3%).

The NI showed a highly significant sex difference, with males showing a higher mean NI (68.4 ± 7.1) compared to females (56.1 ± 6.8) ($p < 0.001$). Morphologically, males were predominantly leptorrhine (52%) and mesorrhine (44%), indicating relatively wider nasal dimensions, whereas females showed a predominance of leptorrhine patterns (49.5%) and hyperleptorrhine (47.5%), which were nearly equally distributed, reflecting narrower nasal morphology.

This difference is substantially greater than those reported in previous studies. According to Premraj et al. (2025), the mean NI was slightly higher in males (71.29) compared to females (71.05), with the leptorrhine nasal type being the most prevalent in both males (47.08%) and females (52.30%) [13]. In contrast, Rishu et al. reported a mean NI of 67.32 ± 6.21 in males and 65.40 ± 6.07 in females, demonstrating a statistically significant difference in nasal length, nasal width, and NIs between sexes ($p < 0.05$) [14]. Despite this sexual dimorphism, the mean NI values in both males and females fell within the leptorrhine category, which was identified as the predominant nasal type in the studied population. As a possible explanation, androgen-mediated growth, particularly testosterone-driven periosteal bone expansion, may contribute to the increased nasal width in males during puberty [15]. In addition, differences between studies may be explained by variations in population characteristics, sample composition, measurement techniques, and anthropometric landmarks.

From a forensic perspective, the NIs provide quantitative measures of nasal proportions that can contribute to population-specific anthropometric standards. The present study adds to the limited regional data on nasal morphology among young Omani adults by providing reference values for nasal proportions. The use of the NI with other craniofacial parameters may provide a more comprehensive anthropometric profile, facilitate comparative assessment, and support forensic facial reconstruction of unidentified human remains within a population-specific context [16–20].

To the best of our knowledge, this study is the first prospective cross-sectional investigation to evaluate the NIs among medical students in the Sultanate of Oman. The anthropometric measurements were standardized to ensure consistency and reproducibility. Nasal dimensions were obtained using a digital caliper based on internationally accepted anthropometric landmarks. The measurements were independently performed by two researchers, demonstrating excellent inter-rater reliability, with intraclass correlation coefficient of 0.92.

Furthermore, given the limited anthropometric data available for young adults, this study provides descriptive population-specific data that may inform future anthropometric and craniofacial studies. In addition, none of the participants had a history of major head trauma, which minimizes the potential influence of trauma-related structural alterations on the anthropometric measurements and indices. By excluding this potential source of variation, the study was better able to characterize the underlying nasal morphology of the study population and enhance the internal validity of the findings.

This study has several limitations. First, the sample size was smaller than initially planned because of limited participant availability and a low participation rate. Second, this was a single-center study that included only medical students from Sultan Qaboos University, which may limit the generalizability of the findings to the wider Omani population. In addition, females comprised approximately two-thirds of the study sample, resulting in an unequal sex distribution. Finally, several governorates were represented by only a small number of participants, which reduced the statistical power of the regional comparisons.

5. Conclusions

The present study provides data on the NI among young Omani males and females. These findings provide descriptive anthropometric data for young Omani adults and may support future comparative studies involving more representative samples and validated measurement techniques. Despite its strengths, the present study should be interpreted cautiously. Future multicenter studies involving different regions of Oman, including a wider age group, consideration of genetic and environmental factors, and advanced three-dimensional imaging techniques, would be beneficial. The results of the study in a larger population may also help in creating a local data bank.

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