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Anthropometric Insights: Unravelling the Nexus between Thumb Length and OVD – A Comparative Perspective

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ABSTRACT

Background: Anthropometric proposals of various identification indicators, like limb lengths, skull dimensions, craniofacial measurements, and other body measurements for estimating age, sex, and stature. Thumb length is very less commonly used as an anthropometric indicator, which could be a valuable marker for stature due to its ease of measurement and preservation. **Objective:** A Novel Approach in the Sargodha region to investigate the correlation of OVD with thumb length measurement, connections, and association among male and female participants. **Study Design:** An observational cross-sectional study. **Settings:** Rai Medical College, Sargodha Pakistan. **Duration:** September to October 2023. **Methods:** 405 medical students from Rai Medical College, Sargodha, comprising 209 males and 196 females. The institutional review board obtained ethical approval before the commencement of the study. The occlusion's vertical dimension was gauged from the tip of the nose to the base of the chin with the help of a modified Vernier caliper. Sample t-tests and Pearson's correlation analysis tests performed on SPSS version 27 were performed to examine associations and correlations. **Results:** The correlation between the nasal septum base till the chin's lower border and the thumb measurements is significant in females, suggesting a stronger association between facial and thumb measurements in this group. The significant correlations in females might indicate that thumb measurements are more closely related to facial measurements in this subgroup than in males. **Conclusion:** Our study concluded that there is a strong relationship between anthropometric measurements and demographic factors. VDO is strongly correlated with thumbs in both genders, especially in females.

Keywords: *Anthropometric, Craniofacial measurements, Dermatoglyphics, Demographic, Occlusal vertical dimension, Stature.*

INTRODUCTION

In the Quran, Allah, Subhanutalla, says to man, "Who creates and fashioned you perfectly in whatever form He willed and put you together." Beautiful creation of human beings and anthropometric measurements research is essential to focus on comprehensive biological variations according to human variations in different populations. Its essential knowledge about genetic makeup, nutritional habits, and growth trends can be achieved through information and measurement of the human body with the help of anthropometry.[1] Allah Subhanutalla created every human as unique, and their identity is essential for recognizing the important task in forensic sciences; one of the common and authenticated tools is the DNA technique, and the surest method of identification is fingerprinting for their rapid and secure authenticated identification of a person. It further included prime importance at the crime scenes with their physiological parameters and auxiliary aids in palatal rugae pattern, lip printing, bite marks, and different dermatoglyphics patterns, which are also paramount for individualizing human identification.[2-4] Physiologically,

the facial features and thumb lengths have particular significance for their applicability in various fields, like identification purposes, clinical, ergonomic designs, and forensic sciences.[5] For forensic identification and orthodontics, measurements significantly considered as facial measurements were taken from the base of the nasal septum to the chin's lower border.[6,7] Along with facial measurements, thumb lengths can also help in sexual dimorphism, which is characteristically routinely used in forensic anthropology to differentiate between male and female skeletons.[7,8]

Different studies have already highlighted the importance of these measurements, but still, there is a gap in different regions on these anthropometric markers, which are correlated with each other in gender. There are limited studies that explored the correlation and association of facial dimensions and thumb lengths among the genders. Existing literature highlighted individual measurements without examining their interrelationship.[9,10] To understand or address this gap, it is important to understand that these correlations could be helpful for accurate facial reconstruction and enhance ergonomic designs tailored to specific gender groups. There is no such research activity in this region, and to fill the gap, this study was designed.

Our study intends to assess the connection and association among students of a private medical college, Sargodha, in which male and female students have the measurements taken from the thumb length (both right and left) and base of the nasal septum distance till the chin lower border. Assessing these relationships can provide a comprehensive understanding of anthropometric gender-based differences, which can help contribute to forensic and clinical anthropology.

METHODS

An observational cross-sectional study was piloted after receiving approval from the institutional review board via letter no. RMCS/ERC/ 24/23 dated 2 August, 2023. Data was collected during the months of September-October 2023 after getting written informed consent from medical students. Sampling was collected with the non-probability convenience sampling method. The study comprised 405 medical students of Rai Medical College, Sargodha, which includes 196 females and 209 males. It is pertinent to mention here that various anthropometry techniques or methodologies were used to record measurements of vertical occlusion of dimensions. Vertically occlusion of dimensions was measured from the nose base to the base of the chin; thumb length served as a reference point on the radial side of the first metacarpophalangeal joint, with the distant point at the dactylic (the thumb's distal end), which was measured by using a modified digital Vernier caliper. All data was meticulously recorded and analyzed on SPSS version 27 while performing the one-sample t-test and correlation analysis for their association with a confidence interval of 95% and P value taken as $P < 0.05$ considered as significant. The inclusion criteria for our study included first individuals with a complete set of natural permanent teeth, comprising at least 28 teeth. Second individuals exhibited a Class-I molar relationship, and third individuals demonstrated facial symmetry and a straight profile. Fourth, individuals who have no prior history of facial injury. Our study's exclusion criteria were individuals with a history of orthodontic treatment and individuals with any neurological conditions affecting the eye, orbit, or any craniofacial deformity or who refused to participate in the study.

RESULTS

One sample t-test performed for male and female students in table 1 indicated that the mean distance of (VDO) from the base of the nasal septum to the lower border of the chin was 7.6014 and raised levels of t-value ($t(208) = 133.458$ p-value < .001 with 95% confidence interval vary from 7.489 to 7.714 which indicated the consistent and reliable estimation of VDO among this population. The length of the right thumb mean was 6.408 with raised levels of t-value ($t(208) = 94.965$, $p < .001$) with a 95% CI varying from 6.270 to 6.540. Likewise, the left thumb length mean was found to be 6.408 units, which was also significantly different from zero ($t(208) = 94.965$, $p < .001$), with a 95% confidence interval ranging from 6.270 to 6.540. Similarly, the mean length of the left thumb was 6.408 units, significantly greater than zero ($t(208) = 105.733$, $p < .001$), with a 95% confidence interval from 6.290 to 6.530. Female measurements demonstrated the mean VDO was 7.4663, which showed raised t-value ($t(195) = 134.283$, and p-value < .001) with a 95% confidence interval varying from 7.357 to 7.576 which indicates that VDO is a reliable parameter amongst females. In females, the mean length of the right thumb was 6.767 with raised levels of t-values ($t(195) = 168.028$, $p < .001$) with a 95% confidence interval ranging from 6.690 to 6.850. The left thumb mean length was 6.742 with raised t –levels ($t(195) = 155.734$, $p < .001$), with a 95% confidence interval from 6.660 to 6.830.

Pearson's correlation in the table 2 demonstrated male and female participants' relationship amongst the measurement of vertical occlusion of dimension (from the Nasal septum base till the chin's lower border) with the right and left thumb. In males, Pearson's correlation demonstrated a positive but non-significant correlation between the Nasal septum base till the chin's lower border and Right thumb measurements, r=0.081r = 0.081r=0.081, p-value =0.241 p-value = 0.241, p-value =0.241. In females, the Nasal septum base till the chin's lower border and Right thumb demonstrated a stronger

significant positive correlation than males r=0.261, r = 0.261, r=0.261, P-value < 0.001, p < 0.001, p<0.001. Males, when comparing the base of the nasal septum to the lower border of the chin with the left thumb, demonstrated a significant positive correlation r=0.140r = 0.140r=0.140, p=0.044p = 0.044p=0.044 which indicated a moderate association between these variables. Similarly, in females, a significant positive correlation was observed r=0.232r = 0.232r=0.232, p=0.001p = 0.001p=0.001which indicated that association is also stronger in females than males. In Males, when we correlated both thumbs, right and left, these results demonstrated strong and highly significant positive r=0.835r = 0.835r=0.835, p<0.001p < 0.001p<0.001which indicated that strong symmetry in male both thumbs. In females, extremely strong and highly significant positive correlation between right and left thumb measurements r=0.935r = 0.935r=0.935, p<0.001p < 0.001p<0.001which demonstrated a very high degree of symmetry even higher than males measurements.

Table 1: Student t-test gender variation of VDO and thumb length

Gender		Test Value = 0					
		T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Male	Nasal septum base till chin's lower border	133.458	208	.000	7.6014	7.489	7.714
	Right thumb	94.965	208	.000	6.408	6.27	6.54
	Left thumb	105.733	208	.000	6.408	6.29	6.53
Female	Nasal septum base till chin's lower border	134.283	195	.000	7.4663	7.357	7.576
	Right thumb	168.028	195	.000	6.767	6.69	6.85
	Left thumb	155.734	195	.000	6.742	6.66	6.83

Table 2: Gender-based Pearson's correlations analysis

Gender			Nasal septum base till chin's lower border	Right Thumb	Left Thumb
Male	Nasal septum base till chin's lower border	Pearson Correlation	1	.081	.140*
		Sig. (2-tailed)		.241	.044
		Sum of Squares and Cross-products	141.030	13.599	20.935
		Covariance	.678	.065	.101
		N	209	209	209
	Right Thumb	Pearson Correlation	.081	1	.835**
		Sig. (2-tailed)	.241		.000
		Sum of Squares and Cross-products	13.599	197.928	148.486
		Covariance	.065	.952	.714
		N	209	209	209
	Left Thumb	Pearson Correlation	.140*	.835**	1
		Sig. (2-tailed)	.044	.000	
		Sum of Squares and Cross-products	20.935	148.486	159.693
		Covariance	.101	.714	.768
		N	209	209	209
Female	Nasal septum base till chin's lower border	Pearson Correlation	1	.261**	.232**
		Sig. (2-tailed)		.000	.001
		Sum of Squares and Cross-products	118.158	22.320	21.373
		Covariance	.606	.114	.110
		N	196	196	196
	Right Thumb	Pearson Correlation	.261**	1	.935**
		Sig. (2-tailed)	.000		.000
		Sum of Squares and Cross-products	22.320	61.993	62.332
		Covariance	.114	.318	.320
		N	196	196	196
	Left Thumb	Pearson Correlation	.232**	.935**	1
		Sig. (2-tailed)	.001	.000	
		Sum of Squares and Cross-products	21.373	62.332	71.626
		Covariance	.110	.320	.367
		N	196	196	196

** Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed)*

DISCUSSION

Previously, it was already documented in literature, especially by Leonardo de Vinci, who observed many observations and facial portion drawings and the inferior one-third of the face. Several facial dimensions and anthropometric calculations help resolve the vertical occlusion of dimension. Many body measurements and facial are needed to determine the vertical occlusion of dimension. In complete dentition of patients, these facial measurements can be applied.[11,12,13] Our study highlights the fascinating, crucial relationship between demographic and anthropometric factors and dental clinical settings.[14-16]

One sample t-test highlighted these results were significantly different from zero for males and females in the mean variation of VDO with thumb length measurements, which are consistent and reliable. Pearson's correlation analysis highlighted male and female measurements. It indicated that there was a positive but non-significant correlation. The correlation was strong and significant in females, which highlighted that VDO and the thumb length were more prominent in females than males. Interestingly, the left thumb length correlation with VDO indicated a positive correlation among them, but it was more prominent in females. A study in India showed the same results.[15-17]

A significant correlation was found in the right and left thumbs, with a remarkable symmetry in both males and females. It is worth mentioning here that females have greater symmetry due to their gender-specific or developmental parameters, which may be aligned with each other. A study in Nepal by Bajracharya *et al*. highlighted that the highest correlation of VDO in Aryans and Mongolians was seen with the length of the thumb.[14,15] In another study pointed out by Bishal Babu Basnet *et al*. in Aryans and Mongoloids, thumb length is significantly associated and correlated with OVD, which further pointed out that longer thumbs have a raised occlusal vertical dimension, which may help prosthetic rehabilitation, which helps to improve the precision of dental procedures with better outcomes.[16-21] Another study in India and Pakistan supports the same results.[16,17]

Beyond theoretical interest, understanding the interrelationships between facial and hand measurements carries practical implications. Knowing these associations in product design can inform the creation of user-friendly tools, gadgets, and wearables. Designers can enhance comfort and usability by considering individual hand and facial dimensions.[20,21] Awareness of these connections becomes invaluable in medical disciplines, such as plastic and reconstructive surgery. This understanding can benefit surgical planning, especially for facial reconstruction or orthopedic surgery.

CONCLUSION

Our study concluded occlusion of vertical dimension in both male and female genders, especially in females, strongly correlated with the thumb, which highlighted future perspectives with the complex interplay of human anatomy in anthropometric as well as demographic parameters.

LIMITATIONS

Our study concluded that occlusion of vertical dimension in both male and female genders, especially in females, strongly correlated with the thumb, which highlighted future perspectives with complex interplay of human anatomy in anthropometric as well as demographic parameters. Generalizability in the community could be restricted due to its small sample size with a cross-sectional design, which restricts establishing causal relationships, advocating for longitudinal studies. Relying on self-reported demographic data introduces potential biases, suggesting objective measurements are needed.

SUGGESTIONS / RECOMMENDATIONS

It is pertinent to recommend that similar studies be conducted on larger and more diverse scale populations as a corroborative for correlations amongst the thumb length with occlusion of vertical dimension across the country's different ethnicities. Tracking for age variation changes in longitudinal studies is required for further exploration, and deeper insights may be thoroughly inquired into additional anthropometric measurements with asymmetry and gender-based factors. This was further investigated by using digital tools for better prediction, which could be helpful for greater precision.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare no conflict of interest.

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