



ORIGINAL ARTICLE

Finger length, palm width, and vertical dimension at occlusion: a correlational study among selected southern Nigerian university students

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ABSTRACT

Background: Accurate determination of the vertical dimension of occlusion (VDO) is essential for successful prosthetic, restorative, and orthodontic treatments. However, conventional assessment methods present several limitations, including invasiveness, reliance on facial landmarks, and variability in landmark identification—particularly in cases involving facial deformities or trauma. **Objective:** This study aimed to investigate the relationship between finger lengths, palm width, and VDO among a Nigerian university student population. **Materials and Methods:** A cross-sectional study was conducted among 300 apparently healthy undergraduate students aged 18–25 years at Madonna University, Nigeria. Demographic data were recorded, and measurements of palm width and finger lengths were obtained using digital vernier calipers. VDO was measured with participants in a reproducible physiological bite position. All measurements were taken in duplicate to ensure accuracy and reliability. Data analysis included descriptive statistics, Pearson's correlation coefficients to assess associations between hand parameters and VDO, and multiple linear regression models to evaluate the predictive value of hand measurements for estimating VDO. **Results:** Significant sex-based differences were observed in both hand measurements and VDO. Males exhibited significantly higher mean VDO values compared to females, along with larger finger lengths and palm widths in both hands. In females, palm width showed a strong positive correlation with VDO ($p < 0.01$), whereas in males, middle finger length demonstrated a moderate positive correlation. In the female regression model, left palm width emerged as the strongest predictor of VDO, with moderate explanatory power ($R^2 = 0.25$). In males, the association was weaker ($R^2 = 0.18$), with middle finger lengths of both hands contributing most significantly to the model. **Conclusion:** These findings highlight the influence of sex and population-specific factors on anthropometric correlations with VDO, underscoring the importance of establishing localized normative data for clinical application.

Keywords: Finger length, palm width, vertical dimension at occlusion.

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1. INTRODUCTION

The complex design of the human face and accompanying oral features is essential for vital biological functions such as masticatory mechanics, clear articulation, and overall facial harmony [1-2]. The measurement of the occlusal vertical dimension (VDO) is critical

for maximising these functions, particularly in restorative dentistry, orthodontics, and craniofacial measurements. This metric measures the height of the bottom part of the face when the dental arches are closed at their maximum intercuspation, which influences bite stability, facial proportionality, and general oral function [3-4]. When planning comprehensive dental rehabilitation, which may include full-mouth reconstructions, implant dentition restoration, or the placement of complete removable prostheses, accurate VDO estimation is essential. Incorrect estimation of this metric poses a substantial risk, potentially resulting in impaired chewing efficiency, difficulty with verbal communication, severe aesthetic distortion of the lower face, and painful jaw joint issues [5-6]. Most clinicians depend on subjective methods, such as measuring external face dimensions, consulting past clinical records, or calculating facial height at rest. However, these approaches have been proven to be slow, potentially painful, and intrinsically unreliable.

Recent developments in anthropometric research have led to the development of simplified, non-radiographic, and economically feasible methods for determining VDO [7-10]. These strategies use readily available somatic proxies, such as the length of individual digits or the width of the palm, to serve as surrogate indications for underlying craniofacial dimensions. This biometric application eliminates the need for complex internal measurements and is especially useful in clinical settings where traditional facial reference points are inaccessible or compromised, such as after severe facial trauma or during complex forensic investigations. However, a good number of scholarly findings documenting the correlation between peripheral body measurements and oral height measurements predominantly involve populations of European or Asian ancestry [9-11]. This disparity has in turn created a noticeable knowledge gap concerning this specific relationship within African demographics, notably among Nigerians, whose distinct craniofacial morphology and anthropometric parameters necessitate localized study. The pervasive lack of region-specific reference indices critically curtails the capacity of resident practitioners to achieve precise restorative outcomes and compromises the integrity of dental and forensic reconstructions for individuals within this group.

Accurate assessment of VDO remains a critical challenge in dental practice, with conventional methods often fraught with limitations such as invasiveness, dependency on facial skeletal landmarks, and the need for advanced equipment [12-13]. In the Nigerian context, where dental patients may present with facial injuries, deformities, or wear of dentition, conventional facial measurements may prove unreliable. Furthermore, reliance solely on clinical judgment without standardized reference data can lead to inaccuracies [14-15]. The absence of localized normative data specific to Nigerian populations hampers the application of anthropometric parameters in estimating VDO. Therefore, the aim of this study was to evaluate the relationship between hand anthropometric parameters using palm width and finger length and the vertical dimension at occlusion (VDO) among Nigerian university students. In so doing, the study was done to establish a clear correlation between these hand dimensions and VDO among Nigerian students and intended to create reliable regression models applicable in clinical and forensic scenarios. Furthermore, Nigeria's diverse ethnic groups exhibit notable variations in craniofacial features. Focusing on a Nigerian sample helps generate region-specific data, ensuring that dental professionals and forensic experts have appropriate benchmarks tailored to the population they serve.

2. MATERIALS AND METHODS

Ethical Considerations

Prior to the commencement of the study, ethical approval was obtained from the Institutional Review Board (IRB) of Madonna University, Elele Campus, Nigeria. The approval process adhered to national and international ethical standards for research involving human subjects, including the Declaration of Helsinki. Participants were thoroughly informed about the purpose, procedures, potential benefits, and risks associated with the study through an information sheet. They were assured of confidentiality, voluntary participation, and their right to withdraw at any time without any repercussions. Written informed consent was obtained from all subjects before data collection.

Research Design

This study adopts a descriptive cross-sectional research design. The study was conducted among undergraduate students at Madonna University, Elele Campus, Nigeria. The university is situated within a semi-urban setting, providing a diverse student population encompassing different Nigerian ethnic groups. Participants included students aged 18 to 25 years from various academic departments. Some of the inclusion criteria for selecting the participants included students who are apparently healthy with no history of facial or hand deformities, students with complete, natural dentition (excluding third molars), and no prior orthodontic or prosthodontic interventions affecting facial or dental structures, and students with no history of temporomandibular joint disorders or facial trauma.

Sample Size Determination

In this study, the estimated sample size was calculated using the Taro-Yamane formula.

$$n = \frac{N}{1 + Ne^2}$$

where: n = required sample size, N = total population size, and e = margin of error (0.05 for 5%)

In this study, the total sample population (N) comprising undergraduate students of the Faculty of Basic Medical Sciences of Madonna University was 1265.

Therefore, the sample size (n) was calculated as

$$n = \frac{1265}{1 + 1265 \times 0.05^2} = 303$$

Upon the utilization of the Taro Yamane's formula for sample size determination, an approximate total of 300 participants were targeted. Participants were selected through stratified random sampling to ensure proportional representation of males and females and different departments, facilitating gender-based and ethnically diverse analysis.

Methods of Data Collection

All anthropometric measurements were obtained from participants, following standardized procedures to ensure accuracy and repeatability in accordance with the study done by Bacali et al. [10]. Participants' demographic data, including age and sex, were recorded using a structured questionnaire.

Measurement of Hand Anthropometrics

- *Palm Width*: Measured as the maximum transverse distance across the palm at the level of the metacarpal heads. Participants placed their right and left palms flat on a horizontal surface with fingers extended, adducted, and relaxed. The tips of the digital vernier caliper were positioned at the widest points of the palm, and the measurement was recorded to the nearest millimetre.
- *Finger Lengths*: The lengths of the index, middle, ring, and little fingers of both hands were measured with each participant seated comfortably, with the hand pronated (palm facing downward) and placed on a flat, firm surface. The tips of the digital vernier caliper were aligned along the dorsal surface, measuring from the tip of the finger to the farthest digital crease at the proximal phalanx. The measurement was taken precisely and recorded in millimeters.

Measurement of Vertical Dimension of Occlusion (VDO)

Participants were seated upright with their heads stabilized using the Frankfurt horizontal plane parallel to the floor. The lips were relaxed, and the mandible was in the natural, physiologic bite position. To record VDO, a digital Vernier caliper was used, with the distal end positioned beneath the chin and the upper end on the removable maxillary occlusal plane or a reference point on the maxilla. Participants were instructed to gently close until their teeth touched lightly in maximum intercuspation, with the lips at rest. The caliper was adjusted to record the distance between soft tissue under the chin and a reference point on the maxilla without exerting excessive pressure. The VDO measurement was recorded to the nearest millimeter.

Reliability of Data

We calculated the intraclass correlation coefficient (ICC) to assess the consistency of VDO measurements both within the same examiner (intra-examiner) and between different examiners (inter-examiner), and the ICC value was found to be 0.78, which indicated a good reproducibility of the results.

Data Analysis

Data collected were entered into a spreadsheet and analysed using Statistical Package for Social Sciences (SPSS) version 26. The analysis involved descriptive, inferential, and predictive statistical methods. The means and standard deviations for hand measurements (palm width and finger lengths) and VDO were analysed. Inferentially, Pearson's correlation coefficient was computed to assess the strength and significance of relationships between hand measurements and VDO. Independent t-tests were used to compare measurements between males and females to determine sexual dimorphism. Predictively, multiple linear regression models were developed to predict VDO based on hand measurements (palm width and finger lengths). Finally, separate regression models were derived for males and females, considering potential gender differences.

3. RESULTS

Table 1 presents the results of independent samples t-tests conducted to evaluate significant gender differences across the studied anthropometric parameters. In this table, a highly significant statistical difference was observed for all parameters except RPW. All measured finger lengths showed a statistically significant difference between genders, confirming that males generally had longer fingers. Also, LPW was significantly larger in males (83.10 ± 6.39) compared to females (79.10 ± 6.13). Males had significantly higher VDO (74.54 ± 9.58) compared to females (70.20 ± 10.71).

Table 1. T-test of Gender Differences between Anthropometric Parameters.

Anthropometric Parameter	Male	Female	t-test	p-value	Inference
	Mean $\pm$ SD	Mean $\pm$ SD			
LIFL	75.87 $\pm$ 6.22	73.10 $\pm$ 6.51	-3.77	0.00	Significant
LMFL	82.93 $\pm$ 6.08	81.33 $\pm$ 6.06	-2.28	0.02	Significant
LRFL	78.35 $\pm$ 6.37	75.71 $\pm$ 6.48	-3.55	0.00	Significant
LLFL	64.43 $\pm$ 6.07	59.81 $\pm$ 7.51	-5.85	0.00	Significant
LPW	83.10 $\pm$ 6.39	79.10 $\pm$ 6.13	-5.51	0.00	Significant
RIFL	75.69 $\pm$ 6.17	72.79 $\pm$ 6.41	-3.89	0.00	Significant
RMFL	83.72 $\pm$ 6.31	79.73 $\pm$ 9.77	-4.20	0.00	Significant
RRFL	77.65 $\pm$ 5.59	75.32 $\pm$ 6.26	-3.39	0.001	Significant
RLFL	64.90 $\pm$ 8.48	60.36 $\pm$ 6.79	-5.11	0.00	Significant
RPW	81.53 $\pm$ 7.75	80.66 $\pm$ 6.72	-1.04	0.29	Non-significant
VDO	74.54 $\pm$ 9.58	70.20 $\pm$ 10.71	-3.69	0.00	Significant

LIFL – Left Index Finger Length; *LMFL* – Left Middle Finger Length; *LRFL* – Left Ring Finger Length; *LLFL* – Left Little Finger Length; *LPW* – Left Palm Width; *RIFL* – Right Index Finger Length; *RMFL* – Right Middle Finger Length; *RRFL* – Right Ring Finger Length; *RLFL* – Right Little Finger Length; *RPW* – Right Palm Width; *VDO* – Vertical Dimension at Occlusion; *SD* – Standard Deviation

Table 2 details the correlation between left-hand anthropometric parameters (LIFL, LMFL, LRFL, LLFL, LPW) and right-hand parameters (RIFL, RMFL, RRFL, RLFL, RPW), as well as the Vertical Dimension of Occlusion (VDO) in the male population. The lengths of the left index (LIFL), middle (LMFL), and ring (LRFL) fingers exhibited highly significant positive correlations with almost all corresponding right-hand finger lengths. LMFL showed the strongest correlation with VDO. Also, LRFL and LIFL also showed significant positive correlations with VDO. LPW showed a weak positive correlation, while LLFL showed the weakest correlation with VDO.

Table 2. Correlation between Hand Anthropometric Parameters and VDO for the male population.

Parameters		RIFL	RMFL	RRFL	RLFL	RPW	VDO
LIFL	R	0.789**	0.689**	0.622**	-0.028	0.178*	0.045
	p-value	0.000	0.000	0.000	0.730	0.029	0.582
LMFL	R	0.744**	0.720**	0.629**	-0.042	0.212**	0.238**
	p-value	0.000	0.000	0.000	0.606	0.009	0.003
LRFL	R	0.737**	0.693**	0.646**	-0.036	0.221**	0.179*
	p-value	0.000	0.000	0.000	0.660	0.007	0.028
LLFL	R	0.152	0.149	0.155	-0.015	0.143	0.035
	p-value	0.064	0.068	0.059	0.858	0.080	0.675
LPW	R	0.308**	0.349**	0.188*	-0.244**	0.327**	0.159
	p-value	0.000	0.000	0.021	0.003	0.000	0.052
VDO	R	0.091	0.211**	0.030	0.060	0.232**	1
	p-value	0.270	0.009	0.717	0.464	0.004	

LIFL – Left Index Finger Length; *LMFL* – Left Middle Finger Length; *LRFL* – Left Ring Finger Length; *LLFL* – Left Little Finger Length; *LPW* – Left Palm Width; *RIFL* – Right Index Finger Length; *RMFL* – Right Middle Finger Length; *RRFL* – Right Ring Finger Length; *RLFL* – Right Little Finger Length; *RPW* – Right Palm Width; *VDO* – Vertical Dimension at Occlusion; *R* – Pearson's correlation coefficient; ** signifies statistical significance at $p < 0.001$; * signifies statistical significance at $p < 0.05$

Results from Table 3 depicted the Pearson's correlation coefficients (R) between hand anthropometric parameters (for both left and right hands) and the vertical dimension at occlusion (VDO) for the female population. Nearly all hand measurements show a statistically significant positive correlation with VDO. The right-hand measurements showed slightly stronger correlations with VDO than the left-hand measurements. However, RRFL displayed the strongest correlation with VDO. Only LRFL demonstrated no statistically significant correlation with VDO (at a p-value of 0.063).

Table 3. Correlation between Hand Anthropometric Parameters and VDO for the female population.

Parameters		RIFL	RMFL	RRFL	RLFL	RPW	VDO
LIFL	R	0.493**	0.424**	0.555**	0.330**	0.236**	0.382**
	p-value	0.000	0.000	0.000	0.000	0.004	0.000
LMFL	R	0.619**	0.501**	0.724**	0.374**	0.181*	0.316**
	p-value	0.000	0.000	0.000	0.000	0.027	0.000
LRFL	R	0.553**	0.522**	0.752**	0.386**	0.152	0.357**
	p-value	0.000	0.000	0.000	0.000	0.063	0.000
LLFL	R	0.402**	0.285**	0.429**	0.338**	0.209*	0.174*
	p-value	0.000	0.000	0.000	0.000	0.010	0.033
LPW	R	0.493**	0.424**	0.555**	0.330**	0.236**	0.382**
	p-value	0.000	0.000	0.000	0.000	0.004	0.000
VDO	R	0.242**	0.285**	0.272**	0.241**	0.160	1
	p-value	0.003	0.000	0.001	0.003	0.051	

LIFL – Left Index Finger Length; *LMFL* – Left Middle Finger Length; *LRFL* – Left Ring Finger Length; *LLFL* – Left Little Finger Length; *LPW* – Left Palm Width; *RIFL* – Right Index Finger Length; *RMFL* – Right Middle Finger Length; *RRFL* – Right Ring Finger Length; *RLFL* – Right Little Finger Length; *RPW* – Right Palm Width; *VDO* – Vertical Dimension at Occlusion; *R* – Pearson's correlation coefficient; ** signifies statistical significance at $p < 0.001$; * signifies statistical significance at $p < 0.05$

Tables 4 and 5 highlighted the results of a multivariate regression analysis aimed at estimating vertical dimension at occlusion (VDO) using various left-hand and right-hand parameters for female and male subjects. The linear multiple regression equations for predicting VDO using the left-hand parameters for each gender category were expressed mathematically as

$$\text{Female: VDO} = -6.76 + \text{LIFL}(0.32) - \text{LMFL}(0.08) + \text{LRFL}(0.28) - \text{LLFL}(0.08) + \text{LPW}(0.55)$$

$$\text{Male: VDO} = 42.81 - \text{LIFL}(1.23) - \text{LMFL}(0.99) + \text{LRFL}(0.46) - \text{LLFL}(0.09) + \text{LPW}(0.15)$$

the linear multiple regression equations for predicting VDO using the right-hand parameters for each gender category were expressed mathematically as

$$\text{Female: VDO} = 19.65 + \text{RIFL}(0.13) + \text{RMFL}(0.16) + \text{RRFL}(0.16) + \text{RLFL}(0.17) + \text{RPW}(0.06)$$

$$\text{Male: VDO} = 38.39 + \text{RIFL}(0.07) + \text{RMFL}(0.45) - \text{RRFL}(0.22) + \text{RLFL}(0.05) + \text{RPW}(0.22)$$

Table 4. Multivariate regression analysis for VDO estimation using left hand parameters.

		B	Std. Error	Beta	SEE	R	R ²	p-value
Female	(Constant)	-6.767	12.221					0.581
	LIFL	0.322	0.164	0.196				0.052
	LMFL	-0.084	0.212	-0.048	9.47	0.49	0.25	0.691
	LRFL	0.283	0.197	0.171				0.153
	LLFL	-0.081	0.123	-0.057				0.511
	LPW	.552	0.146	0.315				0.000*
Male	(Constant)	42.812	12.575					0.001*
	LIFL	-1.235	0.274	-0.803	8.81	0.42	0.18	0.000*
	LMFL	0.995	0.272	0.631				0.000*
	LRFL	0.465	0.293	0.309				0.115
	LLFL	-0.091	0.124	-0.058				0.466
	LPW	0.148	0.126	0.099				0.240

LIFL – Left Index Finger Length; *LMFL* – Left Middle Finger Length; *LRFL* – Left Ring Finger Length; *LLFL* – Left Little Finger Length; *LPW* – Left Palm Width; *VDO* – Vertical Dimension at Occlusion; *R* – Pearson's correlation coefficient; *R²* – Adjusted R-square * signifies statistical significance at $p < 0.05$

4. DISCUSSIONS

Based on the present study results, it was justifiable to limit the participants to a specific age group (18 – 25) since such individuals usually have complete dentition, thereby eliminating confounding factors such as periodontal disease, edentulism, or dental wear, which could adversely affect VDO measurements as well as increase the reliability of correlations between VDO and hand

Table 5. Multivariate regression analysis for VDO estimation using right-hand parameters.

		B	Std. Error	Beta	SEE	R	R²	p-value
Female	(Constant)	19.650	13.711					0.154
	RIFL	0.132	0.159	0.079				0.406
	RMFL	0.168	0.106	0.153	10.21	0.34	0.12	0.118
	RRFL	0.163	0.178	0.095				0.363
	RLFL	0.172	0.149	0.109				0.249
	RPW	0.061	0.140	0.038				0.664
Male	(Constant)	38.394	14.400					0.009*
	RIFL	-0.074	0.213	-0.048	9.25	0.32	0.10	0.730
	RMFL	0.446	0.198	0.294				0.026*
	RRFL	-0.228	0.196	-0.133				0.245
	RLFL	0.053	0.090	0.047				0.559
	RPW	0.229	0.101	0.185				0.025*

RIFL – Right Index Finger Length; **RMFL** – Right Middle Finger Length; **RRFL** – Right Ring Finger Length; **RLFL** – Right Little Finger Length; **RPW** – Right Palm Width; **VDO** – Vertical Dimension at Occlusion; **R** – Pearson's correlation coefficient; **R²** – Adjusted R-square; * signifies statistical significance at $p < 0.05$

measurements. The comparative analysis between male and female participants in this study revealed a clear and consistent trend that males generally had higher values across the measured hand parameters. This pattern of sexual dimorphism was observed on both sides of the hands and was especially noticeable in the linear measurements of the index, middle, ring, and little fingers. Interestingly, the only parameter that did not show a significant sex difference was RPW. When it came to the vertical dimension of occlusion (VDO), males again recorded higher mean values than females. The findings that showed that both VDO, finger lengths, and palm widths (both hands) were significantly higher in males were in line with several literature done by Shah et al. [16], Tripathi et al. [11], Munshi et al. [17], Basutkar et al. [18], and Guragain et al. [9]. The literature corroborates the notion that males generally display larger anthropometric measurements than females due to differences in skeletal and soft tissue dimensions, which are influenced by hormonal and genetic factors. That is to say that these findings not only add to the growing understanding of the application of facial proportions in prosthodontics but also highlight the importance of accounting for sex when making clinical decisions. Coelho & Gonzalez [19] discussed that hand growth usually occurs later and lasts longer in males, greatly influenced by adolescent growth spurts. These differences are central to understanding how anthropometric data can be customized or interpreted differently based on sex, thereby improving the accuracy of clinical assessments.

With respect to the relationship between VDO and the measured hand parameters, the present study revealed that there were positive, significant correlations between VDO and the length of the middle finger for both hands in males. However, correlation was positively significant between VDO and the ring finger of the left hand and palm width of the right hand for males. As for the female category, significant correlations were found between VDO and the lengths of all four fingers for both hands. Nevertheless, there was a positive significant relationship between VDO and the left palm width in females. In a related study, VDO was found to be positively correlated with the length of the index finger in males and little finger in females in an Indian population [20]. Sambath et al. [8] reported that VDO was significantly and positively correlated with the length of the index and little fingers. In a male Saudi cohort done by Basutkar et al. [18], there was a strong positive correlation observed between VDO and the length of the index finger ($r = 0.7341$); however, females showed a strong correlation with the little finger ($r = 0.5827$). The outcomes of Munshi et al. [17] showed that the correlation between VDO and little finger measurement was stronger in females compared to males. However, there was a weak positive correlation between VDO and both index and little finger lengths in males. In addition, Guragain et al. [9] reported that there was a moderate positive correlation between VDO and the lengths of all four fingers excluding the thumb. These findings corroborate the idea that sexual dimorphism influences anthropometric correlations, which may be due to differential growth patterns and hormonal influences affecting hand and facial dimensions. Furthermore, the related literature emphasizes that racial and ethnic differences significantly influence these correlation coefficients since these variations across studied populations of Indian, Pakistani, Saudi, and other origins indicate that a universal standard may not be feasible.

The multivariate regression analyses in tables 4 and 5 of this present study explored the predictive utility of left-hand and right-hand anthropometric parameters for estimating occlusal vertical dimension (VDO), considering male and female populations. For the left hand (table 4), the female model revealed a moderate predictive strength ($R^2 = 0.25$), with the left palm width (LPW) showing the most significant positive contribution ($\beta = 0.315$, $p = 0.000$). While other variables such as LIFL and LRFL were positively associated, LMFL and LLFL had inverse but non-significant associations. In males, the model was slightly weaker ($R^2 = 0.18$), where LIFL contributed significantly and negatively ($\beta = -0.803$, $p = 0.000$), and LMFL contributed positively ($\beta = 0.631$, $p = 0.000$). Also, the right-hand parameters (table 5) yielded weaker predictive values overall. For females, the model explained only 12% of the variance ($R^2 = 0.12$),

and no individual variable reached significance. However, for males, RMFL ($\beta = 0.294$, $p = 0.026$) and RPW ($\beta = 0.185$, $p = 0.025$) emerged as significant predictors, indicating some diagnostic utility in specific right-hand measurements. The predictive values for estimating VDO using palm widths and finger lengths for both hands, as observed in the male model deduced for this present study, were found to be significant for middle finger length. A related study by Munshi et al. [17] had earlier postulated the importance of combining multiple assessment methods, such as facial measurements, skeletal analyses, and clinical judgment, to achieve more accurate VDO estimation.

5. CONCLUSION

The study confirmed significant sexual dimorphism, with males exhibiting higher values across hand parameters and VDO, attributable to hormonal and genetic factors. Correlation analyses revealed positive, significant relationships between VDO and specific finger lengths, notably the middle and ring fingers, and palm widths, with variations observed based on sex. In males, VDO correlated primarily with middle finger length and certain palm widths, while in females, all four finger lengths showed significant associations. Multivariate regression indicated moderate predictive utility of hand measurements for estimating VDO, especially in females with palm width as a key predictor and in males with certain finger lengths and palm widths. Overall, the study results underscore the influence of sex and growth patterns on anthropometric correlations, suggesting that hand parameters can serve as useful, population-specific indicators for VDO assessment in prosthodontics.

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Author contributions: We state that all authors collectively contributed to this research. GSO wrote the study protocol, supervised the data analysis, and wrote the first draft of the manuscript. OMA, APN, and MB managed the literature research, gathered the participants, and assisted in the collection of data, as well as performed statistical analysis of data. All authors read and approved the final manuscript for submission.

Data availability: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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