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RESEARCH ARTICLE

Sonographic biometry of apparently normal parotid gland among adults in Asaba, South-South Nigeria

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ABSTRACT

Background: Detecting subtle changes in the parotid gland size can be difficult when there are no established reference values in a specific area. This can affect patient management and delay early detection of diseases. Therefore, the objective of this study was to describe the size of the parotid gland of adult Nigerian people.

Methods: This cross-sectional study included apparently healthy adults. The parotid glands were scanned in various sections using a 7.5 MHz probe after applying ultrasound gel. Each dimension was measured twice, and the mean value was calculated. The 95% reference rages (mean ± 1.96 standard deviation) were described for various dimensions of the parotid glands.

Results: Four hundred healthy adults participated in the survey. Their mean (standard deviation) age was 38.6 (14.6) years. The mean (95% reference range) of both parotid lengths was 4.7 (4.1 – 5.3) cm. The right and left parotid transverse sizes were 3.8 (3.4 – 4.2) and 3.7 (2.9 – 4.5) respectively. The right and left parotid depths lateral to the mandible were 0.8 (0.4 – 1.2) and 0.9 (0.3 – 1.5), parotid depths dorsal to the mandible were 2.3 (1.7 – 2.9) and 2.2 (1.8 – 2.6), and parotid volume were 20.3 (13.3 – 27.1) and 19.8 (14.3 – 25.3) cm^3. No significant difference was seen between the right and left parotid glands in men and women.

Conclusion: This study delineates the mean and reference range values of parotid glands among healthy adults of Nigeria which can be used for clinical decision making.

Keywords: *parotid gland, ultrasound, biometry, dimensions, reference range, normal range, Nigeria*

INTRODUCTION

The parotid gland is the largest of the three major salivary glands in humans. It is located in the retromandibular fossa and is bordered by the zygomatic arch superiorly, the masseter muscle anteriorly, and the sternocleidomastoid muscle posteriorly. The superficial lobe of the gland extends forward, covering the mandibular ramus and the posterior region of the masseter muscle.[1,2,3] Positioned anteroposteriorly to the external ear, the parotid glands are located over the mandibular ramus.[4] These glands occupy the parotid fascial spaces, which are situated on each lateral side of the head. The extent of each gland irregularly stretches from the zygomatic arch to the angle of the mandible, making it palpable in this position. Various neoplastic and non-neoplastic diseases of the salivary glands, including parotid gland swelling, often require accurate imaging for proper evaluation as clinical assessment alone cannot reliably predict the cause.[5]

Ultrasound is a diagnostic technique that allows for a painless and non-invasive examination of the salivary glands. It is an inexpensive method that can be used alongside computed tomography and magnetic resonance imaging to evaluate tumour pathology.[6] Generally, a high-frequency linear array transducer is used for the ultrasound examination of the salivary glands, with frequencies ranging from 7 to 12 MHz or higher. Lower frequencies may be required for assessing

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HIGHLIGHTS

1. The dimensions of the parotid gland in men and women have been determined in South-South Nigeria using ultrasound.
2. Parotid glands length ranges from 4.1 cm to 5.3 cm.
3. No significant difference was seen between the right and left parotid glands between men and women.

large tumours or lesions located deep within the glands.[7, 8, 9] It is recommended to evaluate the salivary glands and any lesions within them in at least two perpendicular planes.[10] In recent years, the use of ultrasound has increased because of its high performance and user-friendly apparatus. It is a valuable tool for exploring the salivary glands, providing rapid visualization that is non-invasive, painless, and relatively inexpensive. Ultrasound can be particularly useful in the context of tumour pathology.

In the past few years, various publications have emphasized the potential benefits of salivary gland sonography as a straightforward and non-invasive supplementary test for evaluating and identifying gland involvement in Sjogren's syndrome.[11] A recently introduced technique called colour Doppler sonography enables the assessment of vascularization within and around lesions, as well as the study of hemodynamics in the specific area under examination. By complementing traditional ultrasound, colour Doppler sonography can enhance diagnostic accuracy in submandibular-parotid masses and facilitate the analysis of physiological changes that occur during salivary stimulation in healthy individuals, as well as the flow abnormalities observed in diseased glands of Sjogren's syndrome patients.[12, 13, 14]

Therefore, a combination of clinical examination and investigative procedures is necessary for a final diagnosis. Unfortunately, in Nigeria, the absence of domestic reference values for parotid gland assessment makes it challenging to detect subtle changes in size, which could hinder early detection and patient management. To address this gap, the researchers aim to establish a nomogram that can serve as a reference for biometric changes in the parotid gland among normal adult Nigerian subjects using ultrasound.

METHODS

Design and population

A cross-sectional study was conducted among healthy individuals aged 18 to 70 years who accompanied patients to the Federal Medical Centre Asaba from January to May 2023 in Asaba, South-South Nigeria. This range was chosen because there is no documented age at which the salivary gland stopped growing and legally adulthood starts from 18 years in this locality. Their ages were stratified into five groups according to 10 decades of life. The total 400 participants [male: 193 (48%) and female: 207 (52%)] were selected purposively. Nigerian black races adults with no known disease of the parotid gland or any critical ailment, and who gave their consent were examined until the desired sampling size was achieved. Pregnant women, individuals with chewing disorders, critically ill individuals, those with maxillofacial disorders, and those with acromegaly were excluded from the study. Before the final selection, the subjects were screened by a physician to rule out the participants who have health conditions that may affect our study parameters.

Equipment

The Sono-Ace X4 ultrasound machine, manufactured by Samsung Medison Company in Korea, was used with a 7.5 MHz transducer. This machine was specifically chosen for its ability to investigate parotid glands using ultrasound technology. Additionally, the TECHMEL ZT-160 weighing scale was used to measure the subjects' weight, while the TECHNEL ZT-160-meter ruler was used to measure their height.

Examination

During the ultrasound examination, the subjects were positioned in a supine position on a couch. To ensure accurate measurements, their heads were turned laterally, aligning the inter-orbital line perpendicular to the couch. A standard ultrasound gel was applied on the side opposite the couch, and a 7.5 MHz probe was used to scan the parotid gland in different sections. Both sides of the parotid gland were measured, with each dimension being measured twice to obtain an average value. The following dimensions were measured.

a. *Length dimension:* Parallel to the mandibular ramus; beginning from the upper border of the gland at the level of the zygomatic arch and external acoustic meatus until the lower border of the gland at the angle of the mandible, depending on the echogenicity of the gland comparing with the surrounding structures.

b. *Transverse dimension:* Extends from the masseter muscle and posterior edge of mandibular ramus anteriorly and extends into the tip of the mastoid process posteriorly (anteroposterior dimension).

c. *Depth lateral to the mandible:* Extending from subcutaneous to the mandible.

d. *Depth dorsal to the mandible:* extending from the subcutaneous region to the retromandibular vein.

Ethical considerations

After getting the ethical approval for this study, the subjects were provided with a comprehensive explanation of the study's purpose, and then written informed consent was obtained. Participation in the study was completely voluntary, and participants had the freedom to withdraw without any negative consequences. All information collected was treated with utmost confidentiality and solely used for this study.

Statistical analysis

The obtained data were analysed using SPSS version 21. The baseline reference values of parotid gland parameters were described using mean and 95% reference range defined by mean ± 1.96 standard deviation.[15]

RESULTS

A total of 400 healthy adults were analysed. The mean (standard deviation) age was 38.6 (14.6) years. The average (standard deviation) height and weight of the patients were recorded as 1.6 (0.1) meters and 60.4 (14.8) kg, respectively.

The mean (95% reference range) of the right and left parotid lengths was 4.7 (4.1 – 5.3) cm. Right and left transverse sizes were 3.8 (3.4 – 4.2) and 3.7 (2.9 – 4.5) respectively. The average (95% reference range) right and left parotid depth lateral to the mandible were 0.8 (0.4 – 1.2) and 0.9 (0.3 – 1.5), parotid depth dorsal to the mandible was 2.3 (1.7 – 2.9) and 2.2 (1.8 – 2.6), and parotid volume was 20.3 (13.3 – 27.1) and 19.8 (14.3 – 25.3) cm3 **(TABLE 1)**. No significant difference was seen between the right and left parotid glands between and women **(TABLE 2).**

TABLE 1 **Measurements of the parotid glands of the study subjects (n=400)**

Parotid measurements	Right parotid		Left parotid	
	Mean	95% reference range[a]	Mean	95% reference range[a]
Parotid length (cm)	4.7	4.1 – 5.3	4.7	4.1 – 5.3
Parotid transverse size (cm)	3.8	3.4 – 4.2	3.7	2.9 – 4.5
Parotid depth lateral to the mandible (cm^3)	0.8	0.4 – 1.2	0.9	0.3 – 1.5
Parotid depth dorsal to the mandible (cm^3)	2.3	1.7 – 2.9	2.2	1.8 – 2.6
Parotid volume (cm^3)	20.2	13.3 – 27.1	19.8	14.3 – 25.3

[a]Mean±1.96 standard deviation

Table 2 **Measurements of the parotid glands of the study subjects (n=400)**

Parotid measurements	Men		Women	
	Mean	95% reference range[a]	Mean	95% reference range[a]
Parotid length (cm)				
Right	4.7	4.1 – 5.3	4.7	4.1 – 5.3
Left	4.7	4.1 – 5.3	4.7	4.1 – 5.3
Parotid transverse size (cm)				
Right	3.8	3.2 – 4.4	3.7	3.3 – 4.1
Left	3.7	2.9 – 4.5	3.8	3.2 – 4.4
Parotid depth lateral to the mandible (cm^3)				
Right	0.8	0.4 – 1.2	0.8	0.4 – 1.2
Left	0.8	0.2 – 1.4	0.9	0.3 – 1.5
Parotid depth dorsal to the mandible (cm^3)				
Right	2.2	1.6 – 2.8	2.4	1.8 – 3.0
Left	2.3	1.9 – 2.7	2.2	1.8 – 2.6
Parotid Volume (cm^3)				
Right	19.6	13.1 – 26.1	20.9	13.8 – 28.0
Left	19.8	13.9 – 25.7	19.9	15.0 – 24.8

[a]Mean±1.96 standard deviation

DISCUSSION

Knowledge of the dimensions of the parotid gland is crucial for detecting subtle changes in its size. The findings revealed no statistically significant differences in the length, transverse dimensions, depth dorsal to mandible, and depth lateral to mandible between men and women. The variation in volume between the right glands of men and women observed in this study aligns

with the findings of Amir *et al*[16] and Tower *et al*[17] in the Sudanese population. Interestingly, there was no discrepancy in the transverse dimension between men and women, which is in line with the findings of Dost *et al*.[18] Our findings are similar to the findings of Medbery and colleagues' who used magnetic resonance imaging for transverse measurement of the parotid gland.[19] Furthermore, the results are consistent with the values obtained in the adolescent group from the study conducted by Li *et al*[20] in the Chinese population using computed tomography. However, there were disagreements in the values of young and elderly males. This difference could be attributed to the smaller sample size used in their study. Regarding the left parotid gland, our study demonstrated that it was significantly longer and had a greater lateral depth to the mandible compared to the right parotid. Conversely, the right parotid exhibited a significantly greater dorsal depth to the mandible and parotid volume than the left parotid. There was no significant difference in the mean transverse size between the right and left parotid glands.

Our results do not fully align with the findings of Inoue *et al*,[21] who reported a significant gender difference in the size of the parotid gland. The non-significant difference in the volume are consistent with previous research conducted by Dost *et al*[18] and Bozzato *et al*[22] in the Caucasian population, which also reported significant differences in the volume of the parotid glands between men and women.

The comparison between the findings of this study and a previous study conducted by Brzoska *et al*[23] on a different race revealed a significant difference in the volume of both the right and left parotid glands. In contrast, there was no notable distinction observed in male parotid volume between this investigation and the study conducted by Amir *et al*.[16] However, a statistically significant difference was evident in the parotid gland of females in a study with the Sudanese population. This indicates that race and other factors have a significant influence on the volume of the parotid gland.[16]

Conclusion

This study delineates the mean and reference range values of parotid glands among healthy adults, which might be used for clinical decision making.

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Author contributions

Conception and design: OSM. *Acquisition, analysis, and interpretation of data:* OSM, NVK, OAD. *Manuscript drafting and revising it critically:* OSM, CHU, NVK, OAD. *Approval of the final version of the manuscript:* OSM, CHU, NVK, OAD. *Guarantor of accuracy and integrity of the work:* CHU, NVK.

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Conflict of interest

We do not have any conflict of interest.

Ethical approval

Ethical approval of this study was taken from the Human Research and Ethics Committee (HREC) of the Federal Medical Centre Asaba, Delta State, Nigeria (Memo no - FMC/ASB/AI/10 VOLVIII/89).

Data availability statement

The authors confirm that the data supporting the findings of this study are shared upon request of the corresponding author.

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