Normative Assessment of Maximum Mouth Opening and Neck Circumference as an Implications for Mandibular Function Evaluation

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Abstract

Background: Assessing mandibular function encompasses diagnostic procedures such as palpation of masticatory muscles and the temporomandibular joint (TMJ), occlusal assessment, and radiographic examinations. Measuring maximum mouth opening (MMO) is essential in evaluating conditions affecting the TMJ and surrounding structures. Previous studies have noted significant variability in MMO influenced by factors like age, sex, race, and body dimensions, highlighting the need for further demographic-specific research. Methods: This study aimed to establish normative MMO ranges in young Iraqi adults and investigate correlations between MMO and neck circumference. A multistage, stratified, and modest accidental sampling method was employed, recruiting 150 participants (75 males and 75 females) aged 18-40 from Ba'quba city. Data collection included demographic characteristics, medical history, physical examinations, and standardized measurements of neck circumference and MMO. Statistical analyses utilized Pearson correlation coefficients and t-tests to evaluate relationships between variables. Results: The mean MMO for all participants was 50.02 ± 4.09 mm, with males exhibiting significantly greater MMO (52.18 ± 4.21 mm) compared to females (47.63 ± 4.41 mm). The average neck circumference was 42.0 ± 4.8 cm for males and 36.1 ± 2.9 cm for females. Moderate positive correlations were observed between MMO and both height and weight. Additionally, partial correlations indicated relationships between neck circumference and factors such as physical activity, BMI, and blood pressure. Conclusion: The findings demonstrate significant correlations between neck circumference and MMO, suggesting neck circumference as a practical screening tool in clinical settings. The study emphasizes the variability in MMO across genders and its association with physical parameters, advocating for the integration of neck circumference in mandibular function assessments. Future research should explore additional anatomical factors influencing MMO to enhance diagnostic accuracy and patient care

Keywords: Maximum mouth opening (MMO), Neck circumference, Mandibular function, Temporomandibular disorders (TMD), Anthropometric markers

Significance | This study showed normative ranges for MMO and explored correlations with neck circumference in young Iraqi adults. It enhances mandibular health assessment precision and clinical outcomes.

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Editor Aman Shah Abdul Majid, And accepted by the Editorial Board Jun 08, 2024 (received for review Apr 08, 2024)

Introduction

Assessing mandibular function is integral to diagnosing a spectrum of conditions affecting the temporomandibular joint (TMJ) and associated musculature, crucial for both dental and medical professionals. Central to this evaluation is the measurement of maximum mouth opening (MMO), which serves as a fundamental diagnostic parameter. Restricted MMO can arise from various

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Please cite this article.
Nameer Fadhel, Duraid Hameed AbidAlkadem et al. (2024). Normative Assessment of Maximum Mouth Opening and Neck Circumference as an Implications for Mandibular Function Evaluation, Journal of Angiotherapy, 8(6), 1-6, 9730

pathologies such as temporomandibular joint disorders (TMD), oral submucosal tissue fibrosis, rheumatic diseases, and trauma-related injuries, underscoring its clinical significance (Dworkin and LeResche, 1992). Efforts to establish normative ranges for MMO have highlighted its significant variability influenced by factors including age, sex, race, craniofacial dimensions, and overall body size (Dworkin and LeResche, 1992). Despite these endeavors, the wide diversity in MMO measurements across demographic groups emphasizes the ongoing need for further exploration and standardization in clinical practice.

Understanding the relationship between MMO and physiological parameters is critical in comprehensive patient assessment. Recent studies have begun to explore associations between MMO and age in specific populations, such as young Iraqi adults, shedding light on demographic-specific variations (Martin et al., 1997). Additionally, investigations into neck circumference as a potential correlate to MMO offer promising insights, particularly in populations prone to restricted mouth opening (Assyov et al., 2017). However, gaps persist in understanding its broader applicability across diverse demographic profiles, warranting continued investigation (Assyov et al., 2017).

This study aimed to fill these gaps by establishing normative MMO ranges specifically among young Iraqi adults, and exploring correlations with neck circumference. By doing so, it sought to advance mandibular function assessment practices, potentially improving diagnostic precision and patient care outcomes in clinical settings. This research not only addressed the clinical relevance of MMO but also underscored the importance of integrating diverse physiological markers into comprehensive mandibular health evaluations

2. Materials and Methods

This comprehensive methodology ensured standardized data collection and rigorous analysis, aiming to elucidate normative MMO ranges and correlations with neck circumference in young Iraqi adults.

2.1 Study Population and Sampling Method

This study employed a multistage, stratified, and modest accidental sampling technique to select participants from diverse communities in Ba'quba City, Iraq. Ethical approval was obtained from Diyala University Medical College, and informed consent was secured from all participants. The study was conducted between September 2020 and February 2022 at Ba'quba Teaching Hospital, chosen for its accessibility to a varied socioeconomic and geographical demographic. A total of 150 participants (75 males and 75 females) aged between 18 and 40 years were recruited. Exclusion criteria included a history of thyroid diseases, neck lumps, oral submucosal fibrosis, head or neck tumors, jaw or facial pain, temporomandibular disorders (TMD), bruxism, and TMJ-related issues.

2.2 Data Collection

Data collection encompassed demographic characteristics (age, sex, occupation, education level, physical activity), medical history (including diabetes), and nutritional habits. Trained examiners utilized a standardized questionnaire to collect this information. Physical examinations were conducted to measure height, weight, and neck circumference according to established protocols.

2.3 Measurement of Neck Circumference

Neck circumference was measured at two points: just below the thyroid cartilage (front) and near the mid-cervical spine (back). Participants stood upright with their heads in a neutral position as a measuring tape was horizontally placed around the neck, ensuring it rested comfortably on the skin without compression. Measurements were taken thrice within 15 minutes by two trained examiners for accuracy.

2.4 Maximum Mouth Opening (MMO) Measurement

MMO was assessed with participants sitting upright, relaxed, and facing forward. They were instructed to open their mouths maximally while the distance between the upper and lower incisors was measured using a ruler. Each participant's MMO was measured thrice within 15 minutes by two trained examiners to ensure reliability.

2.5 Neck Circumference Measurement Technique

The measurement involved accurate localization of anatomical landmarks, defining the neck's boundary from cervical vertebrae to the top of the collarbone anteriorly. The tape measure was positioned horizontally at the level below the Adam's apple, with participants holding their heads still while measurements were taken to maintain consistency.

2.6 Measuring Tips

Tips included stabilizing the head during neck measurements, observing cervical spine curvature, identifying anatomical landmarks like the transverse process of C7, and palpating spinous processes and para-spinal muscles for any abnormalities.

2.7 Other Measurements

Additional assessments included a comprehensive questionnaire on sociodemographic information, dietary habits, physical activity levels, sleep patterns, and medical history, including drug use. Physical activity was defined based on international guidelines for aerobic activity.

2.8 Statistical Analysis

Data were presented as mean ± standard deviation for continuous variables. Statistical analyses utilized the Pearson correlation coefficient to examine relationships between neck circumference and other anthropometric measurements. Participants were categorized based on normal neck circumference ranges and compared using Student’s t-test. Logarithmic transformation

ensured data normality, with statistical significance set at a p-value of 0.05. SPSS Statistics 17.0 for Windows facilitated all analyses.

3. Results

A total of 150 participants were included in the study, with a mean age of 27.7 ± 4.3 years. Females (21.5 ± 3.1 years) were significantly younger than males (25.9 ± 5.2 years; $P < 0.025$) (Table 1). The distribution of age and gender was similar between individuals with high and normal neck circumference.

The average maximum mouth opening (MMO) among all participants was 50.02 ± 4.09 mm. Males exhibited a significantly greater mean MMO (52.18 ± 4.21 mm) compared to females (47.63 ± 4.41 mm, $P < 0.0001$). Regarding neck circumference, the average was 42.0 ± 4.8 cm for males and 36.1 ± 2.9 cm for females ($P < 0.000$). Participants with high neck circumference also demonstrated higher BMI values. There was a minor correlation between neck circumference and BMI, suggesting partial independence.

Positive correlations were observed between MMO and height ($P < 0.001$) as well as between MMO and weight ($P < 0.001$). Specifically, for every 11 cm increase in height or 11 kg increase in weight, MMO increased by approximately 4.56 mm and 2.1 mm, respectively.

Table 2 illustrates positive partial correlations between neck circumference and several factors including physical activity, drug history, sleep abnormalities, smoking, BMI, fasting glucose, and blood pressure. Participants with high neck circumference had slightly lower rates of physical activity (47.8% vs. 55.2%), drug history (39.6% vs. 46.6%), and higher prevalence of sleep abnormalities (30.1% vs. 39.5%), sleep breathing abnormalities (58.4% vs. 69.7%), smoking (15.4% vs. 21.4%), higher BMI (46.3% vs. 37.8%), elevated fasting glucose (84.9% vs. 86.4%), and high blood pressure (66.2% vs. 53.7%) compared to those with normal neck circumference.

Similarly, positive partial correlations were observed between MMO and these same factors. Participants with high MMO showed lower rates of physical activity (53.8% vs. 67.4%), drug history (27.7% vs. 31.6%), sleep abnormalities (24.6% vs. 28.1%), sleep breathing abnormalities (28.6% vs. 30.1%), smoking (29.7% vs. 30.4%), higher BMI (62.9% vs. 59.9%), elevated fasting glucose (79.3% vs. 91.8%), and high blood pressure (77.5% vs. 69.9%) compared to those with normal MMO.

Participants with high neck circumference and high MMO tended to exhibit higher BMI and a higher prevalence of health-related issues compared to their counterparts with normal measurements.

These findings provide valuable insights into the associations between MMO, neck circumference, and various health parameters among young Iraqi adults, highlighting potential implications for clinical assessment and care.

4. Discussion

The assessment of maximum mouth opening (MMO) holds significant clinical relevance in evaluating mandibular function, which is essential for diagnosing conditions like temporomandibular disorders (TMD) and other oral abnormalities. Our study explores the relationship between MMO and neck circumference, shedding light on their potential as crucial anthropometric markers in clinical practice.

Neck circumference, identified in our investigation as significantly correlated with MMO, emerges as a promising metric deserving of attention in clinical guidelines. This metric offers advantages over traditional anthropometric measures such as BMI, demonstrating a stronger association with MMO. Unlike BMI, which can be influenced by factors like muscle mass or hydration status, neck circumference provides a more direct reflection of upper body adiposity and may, therefore serve as a more reliable indicator in certain clinical contexts (Ben-Noun and Laor, 2004; Gallagher et al., 2013).

Our findings also highlight the implications of neck circumference and MMO beyond mere anthropometric correlations. Specifically, neck circumference has been linked to sleep-breathing abnormalities independent of obesity, suggesting its potential utility in broader health assessments beyond metabolic parameters alone (Ahbab et al., 2013). Moreover, the influence of height on MMO underscores the multifaceted nature of these anthropometric measures, indicating their applicability across diverse demographic groups (Placko et al., 2012; Reicheneder et al., 2011).

The practical advantages of MMO as a clinical parameter include its reliability and consistency, unaffected by variables like clothing or recent food intake, making it a robust tool in assessing mandibular function (Kawaguchi et al., 2011). The incorporation of neck circumference alongside MMO could enhance clinical protocols for evaluating obesity-related risks, particularly in settings where conventional measures may be impractical or insufficient (Preis et al., 2013).

However, our study also identifies areas for future research and refinement. Expanding the sample size and including a broader age range would strengthen the study's findings and generalize their applicability across different populations. Additionally, investigating additional anatomical factors such as the mandibular dimensions (length, breadth, angle) could provide deeper insights into the mechanisms influencing MMO and validate the comprehensive nature of our anthropometric approach.

The findings advocated for the integration of neck circumference and MMO into clinical practice, aiming to enhance precision in assessing mandibular function and obesity-related health risks. By emphasizing their robust correlations with specific physiological parameters and their practical advantages over traditional metrics, our study contributed to advancing comprehensive health

Table 1. Show Mean (±S.D.) of issue, MMO and Neck Circumference (mm) strength variables for the males and females issues.

	males	**females**	**differences**	**p- value**
age (years)	5.2± 24.9	3.1± 22.5	26± 11-	0.0235
maximum mouth opening MMO	mm 4.09 _ 50.18	mm 3.41 _ 47.62	10.63 mm	0.001
Neck Circumference (mm)	cm 4.8± 42.0	cm 2.9± 36.1	7.6±5.9	0.000
(MMO) with height	4.6±177.4	3.7±171.6	4.3±174	0.001
(MMO) with weight	4.5±76.4	3.4±69.7	3.95±74.1	0.001
BMI	29.1 ,25.3	29.6 ,25.0	0.3	0.001

*P value <0.05 is measured statistically significant *Test practical: Independent T-test*

Table 2. Show comprised of sociodemographic features

	Neck circumference			**maximum mouth opening MMO**			
	normal	**high**	**P-value**	**normal**	**high**	**p-value**	
(%)Physical activity	55.2	47.8	0.01	67.4	53.8	0.001	
(%)Drug history	46.6	39.6	0.01	31.6	27.7	0.01	
(%)Sleep abnormality	39.5	30.1	0.01	28.1	24.8	0.01	
(%)Sleep breath abnormality	69.7	58.4	0.01	30.1	28.6	0.001	
(%)smoking	21.4	15.4	0.001	30.4	29.7	0.001	
Body mass index kg/m2	37.8	46.3	0.001	59.9	62.9	0.001	
(%) Fasting glucose	86.4	84.9	0.01	91.8	79.3	0.001	
(%)Blood pressure	53.7	66.2	0.001	69.9	77.5	0.001	

*P value <0.05 is measured statistically significant. *Test practical: Independent T-test*

assessments and refining treatment strategies in clinical settings. Future studies should continue to explore these relationships to further optimize the use of anthropometric markers in enhancing patient care and management strategies.

5. Conclusions

The study underscores the clinical relevance of integrating neck circumference and maximum mouth opening (MMO) into routine assessments for evaluating mandibular function and obesity-related health risks. Neck circumference emerged as a significant anthropometric marker strongly correlated with MMO, offering distinct advantages over traditional metrics like BMI in clinical settings. Unlike BMI, which can be influenced by factors such as muscle mass, neck circumference provides a more direct reflection of upper body adiposity, making it a reliable indicator in assessing certain health conditions. Our findings support the utility of MMO as a consistent and practical parameter unaffected by external factors, thus enhancing its role in comprehensive patient evaluations. Moving forward, further research should expand sample sizes and include broader demographic groups to strengthen these findings and refine clinical applications across diverse populations. These efforts aim to optimize anthropometric markers for more precise health assessments and improved patient care outcomes in clinical practice.

Author contributions

N.F. and D.H.A. conceived the study, developed the hypothesis, and performed data analysis. N.F. and D.H.A. wrote the manuscript, including the introduction, methods, and discussion sections. S.F.A. contributed to data collection, literature review, and manuscript revisions. All authors read and approved the final manuscript.

Acknowledgment

Author was grateful to their department.

Competing financial interests

The authors have no conflict of interest.

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