Assessment of Maximum Mouth Opening of Public Primary and Secondary School Children in Ibadan, Nigeria.

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Abstract

Background: Excessive opening of the mouth has been reported to cause clinical problems such as luxations and traumatic injury to the temporo-mandibular joint (TMJ). The knowledge of the normal range of mouth opening will help to avoid excessive opening of the mouth which can cause injury to the TMJ of patients during procedures that involve mandibular manipulations. Maximum mouth opening (MMO) has age, race, gender and ethnic variations. Previous studies have looked at normal range of mouth opening among adults, but to the best of our knowledge, no study has looked at this among the paediatric/children population in Nigeria. Thus, this study aimed to determine the normal maximum mouth opening (MMO) among the paediatric population in Ibadan (South Western part of Nigeria) and the effect of gender, age, height and weight of these children on their MMO.

Materials and methods: Six hundred and nine primary and secondary school pupils aged 6 – 15 years were included in this study. Patients with any condition affecting the temporomandibular joint (TMJ) function were not included. Measurements of height, weight and two readings of maximum interincisal distance were performed for each participant. Student's t-test, one-way analysis of variance (ANOVA) and Pearson bivariate correlation were used to assess the sample.

Results: The mean MMO was 44.0 ± 5.3 mm and 42.6 ± 5.6 mm for males and females respectively. There was no significant difference in the MMO of males and females ($t = 0.335$, $p = 0.563$). MMO increases gradually with age irrespective of the gender and this was statistically significant ($F = 17.1$, $p = 0.001$).

Conclusion: The maximum mouth opening established for the paediatric population in this study will help practitioners whose care involves the stomathognathic system to have information about the normal range of mouth opening in this group of patients. The result will also be useful as baseline for future research.

Key words: Maximum mouth opening, paediatric, temporo-mandibular joint.

Introduction

Excessive opening of the mouth during treatment that involves mandibular manipulation can cause luxations and traumatic injury to the temporo-mandibular joint (TMJ)[1]. A knowledge of the normal range of mouth opening may help to avoid excessive opening of the mouth that can cause injury to the TMJ during procedures that involve mandibular manipulation. MMO is influenced by an interplay of a number of factors including genetic, morphologic, anatomic and functional factors[2,3]. Kumar et al.

opined that the gradual increase in MMO with increasing age is due to changes in the temporo-mandibular joint apparatus, facial morphology, muscle development and growth of cranial base and mandible particularly in length[2]. Studies have shown that the functional capacity of muscles of mastication is positively correlated with anterior facial height and the dental arch[3,4].

Various studies have established that mouth opening varies with age, race, gender and ethnicity[5,6,7]. This has prompted researchers to determine the normal range of mouth opening for different populations. Few studies have reported normal range of mouth opening in Nigeria[8,9] but to the best of our knowledge none has described the normal range of mouth opening in the paediatric population. Thus, our aim was to determine the normal maximum mouth opening (MMO) in Nigerian children and to find out the effect of their gender, age, height and weight on maximum mouth opening (MMO). Outcomes from this study will be useful as baseline for future research.

Patients and Methods

The eligible participants were pupils between the ages of 6 – 15 years in public primary and secondary schools within Ibadan North Local Government Area in Ibadan metropolis. Demographic data and previous history of trauma to TMJ, pain or clicking sound at rest or during jaw movements, head and neck pain disorders and oral habits were noted with the use of a questionnaire designed for the purpose. Systemic diseases, neurological disorders or craniofacial deformities that could affect mouth opening were also ruled with the use of the questionnaire. This was followed by clinical examination and inspection of the preauricular area for swellings, erythema, or tenderness. Palpation was done directly over the TMJ when the patient opened and closed the mandible, and the extent of the mandibular condylar movement and deviation of the mandible during the opening was also observed. Only those who met the inclusion criteria participated in the study while those with TMJ limiting abnormalities were excluded, counseled and referred to the hospital for further assessment and management.

The exclusion criteria were presence of severe orthodontic problems, neurological disorders, craniofacial deformities, systemic affectation of the joint and neck pain. Also, excluded were those who had traumatized. fractured or crowned incisors, those with missing central incisors, those on orthodontic treatment and those who did not assent and those whose parents did not consent to participate in the study.

Three hundred and six males and three hundred and three females participated in the study. The weight and height of each participant were taken after which their maximum mouth opening was measured by measuring the distance from the incisal edge of the central maxillary incisors to incisal edge of the corresponding mandibular incisors intraorally. The participant was asked to relax, sit upright with the head perpendicularly resting against the wall and asked to open as wide as possible without feeling pain after two minutes. Individual transparent plastic ruler with a millimetre scale was passively placed between the edges of upper and lower central incisors at the midline. The measurement was recorded to the nearest millimetre as the first reading. This measurement was repeated and recorded as second reading after the participant had rested for at least 5 minutes after the first measurement. The mean of the two readings was recorded for each participant as the MMO. To avoid inter-examiner variability, one investigator carried out all measurements. A pilot study was first carried out to test intra-examiner reliability. The pilot study included 30 pupils aged 8-12 years in a school outside the area of study. Pupils were examined on two separate occasions 2 weeks apart. The investigator was blinded to previous results at the second examination. The intra-examiner reliability showed 93% agreement with weighted kappa coefficient of 0.85.

All data were analyzed using Statistical Package for Social Sciences (SPSS). Descriptive statistics of MMO with regards to gender and age groups were reported. Student's t-test and one-way analysis of variance (ANOVA) were used to examine MMO relative to gender and age groups. Pearson bivariate correlation was used to assess relationship between MMO, height and weight in the participants. For all statistical analysis, a p-value of less than 0.05 was considered significant.

Results

Six hundred and nine children participated in this study, their anthropometric data is as shown in Table 1. There were 306 (50.2%) males and 303(49.8%) females with mean ages of 11.4 ± 2.4 years and 11.0 ± 2.3 years respectively. Mean height and weight according to the gender are as shown in **Table 1**.

Table 1: Anthropometric data of the participants based on gender.

Gender	n(%)	Mean Age± SD (years)	Mean Height ±SD (m)	Mean Weight ± SD (Kg)	Mean MMO±SD (mm)
Male	306(50.2)	11.4 ±2.4	1.43 ± 0.55	30.90 ± 8.09	44.0 ± 5.3
Female	303(49.8)	11.0 ± 2.3	1.39 ± 0.22	31.69 ± 9.54	42.0 ± 5.8
Total	609(100.0)	11.2 ± 2.4	1.41 ± 0.42	31.30 ± 8.84	43.0 ± 5. 6
			P >0.05	P>0.05	P>.0.05

The difference in the mean height and weight of males and females was not statistically significant (p = >0.05 for height and weight). The mean MMO for males was 44.0 ± 5.3 mm and for females was 42.6 ± 5.6 mm. There was no significant difference in the MMO of males and females (t= 0.335, p = 0.563). Table 2 shows the MMO according to the age groups and gender **(Table 2)**.

Table 2: Maximum mouth opening according to gender and age groups.

Age groups (years)	Gender	N	Mean ± SD (mm)	Minimum (mm)	Maximum (mm)	P value
6 - 7	Male	23	39.2 ± 5.1	30.0	50.0	
	Female	23	37.0 ± 5.0	30.0	48.5	0.525
	Total	46	38.0 ± 5.0	30.0	48.5	
8 - 9	Male	45	41.1 ± 4.4	33.0	53.5	
	Female	58	40.4 ± 0.5	32.5	52.0	0.710
	Total	103	40.7 ± 4.8	32.5	53.5	
10 - 11	Male	90	44.2 ± 4.7	34.5	56.5	
	Female	80	42.9 ± 5.9	34.0	55.0	0.106
	Total	170	43.5 ± 5.3	34.0	56.5	
12 -13	Male	79	46.0 ± 5.0	37.0	58.0	
	Female	94	45.4 ± 6.1	36.0	58.0	0.160
	Total	173	45.5 ± 5.6	36.0	58.0	
14 - 15	Male	69	48.2 ± 5.5	39.0	63.0	
	Female	48	47.3 ± 5.2	38.5	62.0	
	Total	117	47.8 ± 5.1	38.5	63.0	0.310

ANOVA (F= 17.1, p = 0.001)

MMO increases gradually with age irrespective of the gender and this was statistically significant (F= 17.1, p = 0.001) but no significant difference was found in MMO of males and females irrespective of the age groups (P>0.05). There was also gradual increase in the height and weight of the children with age which was statistically significant (p = 0.001 for height and p = 0.002 for weight) **(Table 3)**.

Table 3: Maximum mouth opening, weight and height according to the age groups.

Age groups (years)	Mean MMO± SD (mm)	Mean Height ± SD (m)	Mean weight ±SD (kg)
6-7	38.0 ± 5.0	1.18 ± 0.12	19.9 ± 3.20
8-9	40.7 ± 4. 8	1.35 ± 0.89	23.9 ± 3.54
10-11	43.5 ± 5.3	1.37 ± 0.25	28.75 ± 4.31
12-13	45.5 ±5.6	1.45 ± 0.24	33.69 ± 6.82
14-15	47.8 ± 5.1	1.53 ± 0.08	41.69 ± 7.30

Using Pearson bivariate correlation, there was a positive correlation between MMO and weight that was statistically significant (Rho = 0.32: p = 0.000). Similarly, a statistical significant positive correlation was also noted between MMO and height (Rho = 0.08: p= 0.000) and equally significant **(Table 3)**.

Discussion

The mean MMO obtained for the participants was 44.0 mm and 42.6 mm for males and females respectively. Our values are lower than that obtained by Kumar et al. and Oguta et al[2,10], higher than those of Dueñas et al. and Cortese et al. [11,12] but similar to the value of 45.9mm reported by Landtwig[13] in children aged five to nineteen years. Differences observed could be due to different methodologies employed by different researchers. In the study of Dueñas et al, 6-year old participants were examined[11], in the study of Cortese et al, participants with ages ranging from 3-13 years were examined[12] while in the present study participants with ages ranging from 6-15 years were examined. Age has been reported to have a strong influence on the range of mandibular opening by previous documented studies[14,15]. This has been attributed to variation in weight and stature, which bear strong influence on mouth opening especially in children[11]. Kumar employed the use of 'modified" vernier caliper in the measurement of MMO[2], Dueñas et al. employed the use of digital vernier calipers[11] whereas in the present study, transparent ruler was employed. Another possible reason for the observed differences could be due to ethnic differences in facial morphology which could have significant impact on MMO[16].

Measurement of MMO could be by intraoral[2,17,18,19] or extraoral[20,21] approach. However from documented literature, the intraoral approach seems to be more employed than the extraoral approach. The intraoral approach was employed in this study to ensure stable points of measurement for enhanced accuracy. The soft tissue landmarks that are normally used for the extraoral approach could be prone to movement which may introduce errors during MMO measurement[21]. MMO is measured as interincisal distance or interincisal distance plus overbite[22]. We made use of interincisal distance in this study like other previous studies[21,23,24,25] because it represents the functional opening of the mouth which is clinically relevant in terms of chewing and dental treatment[2,26]. Measurement is usually done either as active mouth opening or passive mouth opening. In this study measurement was done as active MMO similar to previous studies [7,27], although some other studies utilized passive MMO[28,29]. Dijkstra et al stated that the variable force applied to obtain passive mouth opening has the tendency to introduce error[30].

Different devices have been employed by different authors in the intraoral method of measurement of MMO with most of them achieving satisfactory result[2,8,17,31]. Transparent plastic metre rule was employed in this study similar to several other studies[27,28]. Wood and Branco in comparing three methods of measuring maximal opening of the mouth concluded that direct measurement using a metre rule was the most accurate[20]. We found this method to be easy, quick, convenient and accurate. In the literature, measurement of MMO was either taken once[18,19,32] or more than once[2,6] with the average of the measurements[2,7,31] or the highest measurement taken [6,21]. In this study, we recorded the average of two readings. We assumed participating children could be anxious initially and open sub-optimally, but after the first attempt and relaxation they were more likely to open maximally. More than 2 attempts might also cause muscle fatigue and give incorrect measurements[23].

The present study observed no significant statistical difference in MMO between males and females across all the age groups. This is in agreement with some studies among children[2,21,33] and contrasts with those among older age groups[23,24,27].

The relationship between MMO and stature (height and weight) remains controversial with some authors reporting strong correlation[13,34] and others showing weak[21,35] or no correlation[12,36]. Our study demonstrated a significant correlation between age, body weight and height but a weak correlation between MMO values in relation to height and weight in all age groups[21]. Children are yet to fully express the effect of functional forces that may influence jaw growth differently and this may partly explain the weak correlation between MMO, weight and height that is noted in this study.

Conclusion

In this study, we have established the average MMO for the paediatric group in our population. This will help practitioners whose care involves the stomathogantic system to have information about normal range of mouth opening and thus avoid excessive mouth opening in this group of patients.

Limitation of the study

MMO has been shown to have ethnic differences and we studied one out of several hundreds of ethnic groups in Nigeria, therefore broad generalization of the result is not possible. However, the results may form a reference in this environment for future studies.

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