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Original Research

Maximum Mouth Opening in Saudi Adolescents

Yousef H Al-Dlaigan¹, Moshabab A Asiry²

Contributors:

¹Associate Professor, Department of Pediatric Dentistry and Orthodontics, Division of Pediatric Dentistry, College of Dentistry, King Saud University, Riyadh 11545, Saudi Arabia; ²Assistant Professor, Department of Pediatric Dentistry and Orthodontics, Division of Orthodontics, College of Dentistry, King Saud University, Riyadh 12372-7325, Saudi Arabia.

Correspondence:

Dr. Asiry MA. Department of Pediatric Dentistry and Orthodontics, Division of Orthodontics, College of Dentistry, King Saud University, Building No 3500, Riyadh 12372-7325, Saudi Arabia. Fax: +966-1-4679017. Email: masiry@gmail.com

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Abstract:

Background: The aim of this study was to investigate the maximum mouth opening (MMO) in a representative sample of the Saudi adolescents.

Materials and Methods: A total of 1825 Saudi adolescents (1007 males and 818 females) aged 12-16 years were randomly selected. The subjects were asked to open their mouth maximally till no further opening was possible and then the distance from the incisal edge of the maxillary incisors to incisal edge of the mandibular incisors was recorded. All data were analyzed using SPSS program and simple descriptive statistics of MMO with regard to gender and age groups were reported. The Student's *t*-test and one-way analysis of variance were used to examine differences in mouth opening relative to gender and age groups.

Results: The mean maximal mouth opening for males was 43.5 ± 4.23 mm (range 29-59 mm). The mean maximal mouth opening for females was 35.5 ± 4.4 mm (range 20-45 mm). There was a significant difference between the mouth opening of males and females in all the age group ($P = 0.000$). The mouth opening, regardless of gender, increases significantly with age from the age of 12 years to the age of 14 years ($P = 0.000$), then remained unchanged till the age of 16 years.

Conclusion: The mouth opening of males is significantly higher than that of females in all the age group. There was a significant increase in MMO with age up to the age of 14 years regardless of gender.

Key Words: Adolescent, maximum mouth opening, mouth opening

Introduction

The maximum mouth opening (MMO) has been defined as "the greatest distance between the incisal edge of the maxillary central incisors to the incisal edge of the mandibular central incisors at the midline when the mouth is open as wide as possible."¹ The measurement of MMO is a valuable diagnostic

tool for assessing the function of the temporomandibular joint (TMJ). Limitation of mouth opening can be related to many clinical conditions such as temporomandibular disorders, odontogenic infections, oral malignancies, submucous fibrosis, mandibular fractures, myopathies, and trauma.²

Several studies^{1,3-14} investigated MMO among different populations (Table 1). The variation in the range of MMO was reported. Further, most of these studies revealed that the mouth opening increases with age until adulthood and the females have a decreased mouth opening compared to males. Therefore, it is important to establish normal MMO for each specific population in order to be able to make a diagnosis of reduced mouth opening.

After searching the studies of the maximal mouth openings for Saudi population; it is appeared that only one study reported by El-Abdin *et al.*⁴ who studied the maximal mouth openings of 1158 Saudi patients with age range from 5 to 70 years. The authors found the mean opening for men was 48.19 mm with a peak at the age of 20-30 years and 44.05 mm for women with a peak at the age of 10-30 years. The sample derived from patients attended college of dentistry; this may not be considered a representative of the population. Additionally, it covered a wide range of age and the adolescent sample was limited. Therefore, the aim of the present study was to investigate the average MMO and range of mouth opening in a representative large sample of Saudi adolescents.

Table 1: MMO from different studies.

Studies	Sample size	Country	Age group	MMO (mm)
Agerberg ³	200	Sweden	18-25	54.55
El-Abdin <i>et al.</i> ⁴	1158	Saudi Arabia	5-70	46.12
Rothenberg ⁵	189	USA	4-14	43.99
Zawawi <i>et al.</i> ⁶	140	USA	21-42	48.8
Gallaghe <i>et al.</i> ⁷	1513	Ireland	16-99	42.2
Placko <i>et al.</i> ¹	228	France	18-84	50.7
Sousa <i>et al.</i> ⁸	303	Brazil	6-14	43.70
Yao <i>et al.</i> ⁹	1442	China	20-80	49.10
Sawair <i>et al.</i> ¹⁰	496	Jordan	15-80	42.9
Sohail and Amjad ¹¹	450	UAE	19-24	53.24
		India	19-24	52.6
		Pakistan	19-24	53.6
Casanova-Rosado <i>et al.</i> ¹²	254	Mexico	14-24	46.61
Khare <i>et al.</i> ¹³	894	India	21-70	47.8
Müller <i>et al.</i> ¹⁴	20719	Swiss	4-17	45

MMO: Maximum mouth opening

Materials and Methods

The present study was conducted on twenty governmental schools (10 for males and 10 for females) which randomly selected from the list of Intermediate schools utilizing the random number table from the strata composite of different areas of Riyadh City (4 schools from each region; north, south, east, west and middle center). A total of 1825 Saudi students (1007 males and 818 females) aged 12-16 years with a mean age 14 years were randomly selected and examined. The data was extracted from the original approved research (NF 2320) done in March 2012 for which an ethical approval for human research was given by College of Dentistry Research Centre (CDRC), Deanship of Scientific Research. All the students were informed about their rights to participate in the study and consent forms were signed.

Demographic data included names, age, sex, medical history; dental history, and history of orthodontic treatment and TMJ problems were recorded on the composed chart. Students with a history of orthodontic treatment, TMJ involvement, trauma, infections, dental prosthesis on the anterior teeth, congenital anomalies in the maxillofacial region were not included in the sample.

Clinical examination was carried out in the schools within the students' classrooms by two experienced examiners using small light source and calibrated fiber ruler. The students were asked to open their mouth maximally till no further opening was possible and then the distance from the incisal edge of the maxillary central incisors to incisal edge of the mandibular central incisors was recorded.

Statistical analysis was conducted using the Statistical Package for the Social Sciences (Version 16.0; SPSS Inc., Chicago, IL, USA). Simple descriptive statistics of MMO with regard to gender and age groups were reported. The Student's *t*-test and one-way analysis of variance were used to examine differences in MMO relative to gender and age groups.

The intra-examiner reliability was tested on a group of 21 girls and 20 boys aged 12-16 years old. All the subjects were examined by the same examiner on two separate occasions, within 1 week interval from the date of the first examination. The charts of the first examination were not available with the examiner at the second examination. The inter-examiner reliability was tested on another group of 20 children at King Saud University, Dental School. All the subjects were examined twice by the two examiners. The results of intra-examiner reliability on examined 20 boys and 21 girls showed 97%, and 93% agreement, and weighted Kappa coefficient was found 0.87 and 0.81 respectively. The inter-examination reliability disclosed 93% agreement, and weight Kappa value was 0.83. These figures indicate a high level of agreement.

Results

MMO was measured in Saudi students (1007 males and 818 females), with a mean age of 14 years. Table 2 shows that the mean of maximal mouth opening was 43.5 ± 4.23 mm and 35.5 ± 4.4 mm in male and female students, respectively. The range of MMO was 29-59 mm in male students and 20-45 mm in female students. The MMO of males was significantly larger than that of females ($P = 0.000$).

Table 3 shows the mean and range of MMO in different age group. In the age group of 12 years old of students, the mean of MMO was 36.4 mm (standard deviation [SD] ± 4) in females. In the age group of 13 years old students, the means of MMO were 42.8 mm (SD ± 3.9) and 34.3 mm (SD ± 4.4) in males and females students, respectively. In the age group of 14 years old students, the MMO was 43.7 mm (SD ± 4) in males and 36.2 mm (SD ± 4.4) in females. For the age group of 15 years old students, the mean of MMO was 43.6 mm (SD ± 4.4) in males students and 36.3 mm (SD ± 4.5) in females students. In the age group of 16 years old students, the mean of MMO in males and females were 44.6 mm (SD ± 4.6) and 36.5 mm (SD ± 3.5), respectively. A significant difference was observed between male and female students in each age group ($P = 0.000$), with male students having higher MMO.

There was a significant increase in MMO with age up to the age of 14 years, regardless of gender. Average MMO values at the age of 12 years, 13 years, and 14 years were 36.4 ± 4 mm, 38.1 ± 5.9 mm, and 41.2 ± 5.4 mm, respectively ($P = 0.000$). No significant increase was observed in MMO between the age of 14 years, 15 years, and 16 years. Average MMO values at the age of 15 years and 16 years were 41.7 ± 5.5 mm and 42.5 ± 5.6 mm, respectively.

Discussion

The present study showed that the means of MMO were 43.5 mm (29-59 mm) and 35.5 mm (20-45 mm) in male and female students, respectively. These findings were unlike to the results of other studies assessed the MMO among different populations (Table 1). These variations could be due to the differences in sample size, conducted methodology, age, or could be explained by the existence of differences in anatomic characteristics of these populations. This explanation is supported by several studies who reported that the MMO was

Table 2: Mean value of MMO.

	MMO (mm)		
	Male	Female	Total
N	1007	818	1825
Mean (mm)	43.5	35.5	40
SD	4.23	4.4	5.8
Range (mm)	29-59	20-45	20-59
P value	0.000 (significant difference)		

MMO: Maximum mouth opening, SD: Standard deviation

Table 3: Mean values of MMO in different age groups.

Age group	Gender	N	Mean	MMO (mm)	Minimum	Maximum	P value
				SD			
12 year old	Female	157	36.4	4	28	45	
	Total	157	36.4	4	28	45	
13 years old	Male	287	42.8	3.9	30	56	0.000
	Female	356	34.3	4.4	25	45	
	Total	643	38.1	5.9	25	56	
14 years old	Male	325	43.7	4	29	59	0.000
	Female	164	36.2	4.4	20	45	
	Total	489	41.2	5.4	20	59	
15 years old	Male	280	43.6	4.4	30	56	0.000
	Female	100	36.3	4.5	29	45	
	Total	380	41.7	5.5	29	56	
16 years old	Male	115	44.6	4.6	32	59	0.000
	Female	41	36.5	3.5	30	45	
	Total	156	42.5	5.65	30	59	

MMO: Maximum mouth opening, SD: Standard deviation

correlated with craniofacial morphology, mandibular length, body height and weight.^{2,5,14-17}

In the literatures, MMO has been measured either as inter-incisal distance^{2,6,9,12,14,18} or as inter-incisal distance plus overbite.³ Further, MMO has been determined either by using a ruler/caliper^{2,9-11} or by using the width of three/four fingers.^{6,18} Some studies^{9,19,20} performed MMO measurement more than once and recorded the highest value while other studies^{11,12,14} performed it once. Hesse *et al.*²⁰ found it necessary to open the mouth maximally more than four times in adult females and three times in adult males to record a maximum value of MMO. In contrast, Yao *et al.*⁹ displayed that the first measurement of MMO was generally the greatest among the three measurements taken for each subject, and this is due to decreasing muscle power with succeeding measurements. The measuring point is relatively more permanent and more easily determined in inter-incisal distance measurement.⁹ In addition, Wood and Branco²¹ concluded that intraoral measurements using a ruler were precise and accurate. It is of great value to use a method of measurement that is easy, quick, and precise. Hence, MMO was measured in the present study with a ruler positioned between the incisal edge of the maxillary central incisors and the incisal edge of the mandibular central incisors (inter-incisal distance) during MMO, and the first measurement of MMO was recorded.

The result of the present study displayed that the MMO of males was significantly larger than that of females ($P = 0.000$). This observation is in agreement with the observation of Casanova-Rosado *et al.*¹² who assessed MMO among Mexican adolescents and young adults. They also suggested that the difference between males and females in MMO is likely due to the physical size; males are generally larger than females and hence the head and face bone structures are accordingly bigger. Similar findings were observed by Sawair *et al.*,¹⁰ Sohail and Amjad,¹¹ Gallaghe *et al.*,⁷ and Yao *et al.*,⁹ who assessed

MMO in adult subjects. In contrast, children studies found no significant differences in MMO between males and females.^{2,5,8} The reason for these variations is the differences in skeletal age and growth stage of subjects examined in these studies. Müller *et al.*¹⁴ mentioned that growth results in increasing mandibular length which geometrically influences the linear inter-incisal measurements. Further, Sousa *et al.*⁸ reported that the influence that gender has on MMO in adults is not observed in children because they do not have the sexual maturity of adults.

Several studies documented a gradual increase in MMO with age in children and adolescents.^{2,9,14,18,22} Müller *et al.*¹⁴ pointed out that the increase of MMO with age in children and adolescents is partly explained by mandibular growth. Therefore, the influence of age on the MMO is related to the amount of mandibular growth remains and sexual maturity. This may explain the results of the present study, which show that the MMO increased significantly with age up to the age of 14 years, and then it remained with no significant change till the age of 16 years.

It is important to establish normal MMO for each specific population in order to be able to make a diagnosis of reduced mouth opening. Therefore, the results of the present study will be of a useful guide for diagnosis of numerous diseases related to the function of the masticatory system affecting mouth opening.

Conclusion

The MMO for Saudi adolescents was 43.5 ± 4.23 mm and 35.5 ± 4.4 mm in male and female students, respectively. (The ranges of MMO were 29-59 mm in males and 20-45 mm in females). The MMO, regardless of age, increased significantly with age in Saudi adolescents from the age of 12 years to the age of 14 years then remained unchanged till the age of 16 years. Gender has a significant influence on the MMO value of Saudi adolescents, with males having a larger mouth opening.

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