Maximum Mouth Opening in Saudi Adolescents

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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 studies³-¹⁴ 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) |
|--------------------|-------------|----------|-----------|----------|
| Agerberg¹          | 200         | Sweden   | 18-25     | 54.55    |
| El-Abdin et al.⁴   | 1158        | Saudi Arabia | 5-70    | 46.12    |
| Rothenberg¹        | 189         | USA      | 4-14      | 43.99    |
| Zawawi et al.⁵     | 140         | USA      | 21-42     | 48.8     |
| Gallaghe et al.⁶   | 1513        | Ireland  | 16-99     | 42.2     |
| Placko et al.¹      | 228         | France   | 18-84     | 50.7     |
| Sousa et al.²       | 303         | Brazil   | 6-14      | 43.70    |
| Yao et al.³         | 1442        | China    | 20-80     | 49.10    |
| Sawair et al.⁷      | 496         | Jordan   | 15-80     | 42.9     |
| Sohail and Amjad¹⁵  | 450         | UAE      | 19-24     | 53.24    |
| Casanova-Rosado et al.¹² | 254 | Mexico   | 14-24     | 46.61    |
| Khare et al.¹³      | 894         | India    | 21-70     | 47.8     |
| Müller et al.¹⁴     | 20719       | Swiss    | 4-17      | 45       |

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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.
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

| N | Male | Female | Total |
|---|------|--------|-------|
| 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) |
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 distance2,6,9,12,14,18 or as inter-incisal distance plus overbite.3 Further, MMO has been determined either by using a ruler/caliper2,9,10 or by using the width of three/four fingers.6,18 Some studies9,10,20 performed MMO measurement more than once and recorded the highest value while other studies11,12,14 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 Branco12 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 Gallagher 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.

| 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.
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