



## Maximum Mouth Opening among Saudi Arabian Adults

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### Abstract

**Background:** The mouth opening range is one of the major characteristics features that different one person from the other. Literature has shown that the maximal mouth opening range varies among different people, ages and regions. On average, a person should be able to fit 3 fingers in an opened mouth. However, differences exist.

**Aim:** To set a reference measurement for maximal mouth opening in Saudi Arabian adult population.

**Methods:** The study was conducted on patients attending dental clinics in Riyadh, Kingdom of Saudi Arabia. The maximum mouth opening (MMO) was recorded for adult patients using a ruler. The patients were requested to open their mouth at maximum level and the length between the maxillary central incisor edge and the mandibular central incisor edge in the same side of the mouth was measured. Correlation of the mouth opening with age was determined using a Spearman correlation matrix. Besides, Kruskal Wallis and Mann Whitney tests were used for comparing the continuous variables.

**Results:** The maximal mouth opening mean  $\pm$  SD of the participants was  $50.1 \pm 6.3$  mm. Mean  $\pm$  SD maximal mouth opening for males ( $52.5 \pm 6.3$  mm) was statistically significantly higher than females ( $47.8 \pm 5.3$  mm) ( $p < 0.05$ ). Spearman's test between maximal mouth opening and age showed a negative correlation of  $p > 0.05$ . No statistically significant difference was found between the mean  $\pm$  SD maximal mouth opening and age groups ( $p > 0.05$ ).

**Conclusion:** The conclusion obtained from the findings is that the males mean maximal mouth opening of an adult was significantly higher than females in Saudi. A negative correlation suggesting that mouth opening decreases with age.

**Keywords:** Maximum Mouth Opening; Saudi; Age

### Introduction

The normal mouth opening refers to the distance of the inter-incisal at the maximal mouth opening. Wood and Branco [1] described the maximal mouth opening as the largest distance between the maxillary central incisor to the mandibular central incisor edge when a patient's mouth is painlessly wide opened. One of the most commonly used methods in determining the distance of the mouth opening is by measuring the distance of the inter-incisal using scales, calipers or ligature wires. This technique is simple and non-hostile. According to Agrawal, et al. [2] mouth opening can also be assessed using the subject's body size which is directly proportional to the individual's fingers. The average person should be able to comfortably fit in his 3 fingers into his mouth in the opened position.

Trismus refers to limited mouth opening of any cause, mostly muscle spasm. It is simply a limitation of movement of the jaw. The term 'lockjaw' has been used as a synonym for trismus. Clinicians working on oral cavity are faced by limited mouth opening problems. Examination of the oral cavity becomes a limitation in mouth opening could be one of the early signs of pathology and/or trauma to the temporomandibular joint or the craniofacial region. Orofacial infections, myopathies, malignancies and fractures in the neck and head region may cause reduced mouth opening [3].

When a limited and decreased mouth opening is recognized its always necessary for a quick prompt diagnosis. It is very important to plan for early and prompt diagnosis for effective treatment

of the underlying pathology [4]. It is necessary to estimate and identify an individual's mouth opening normal range to diagnose decreased mouth opening. It is estimated that the mouth-opening normal range is 35 - 45 mm. However, studies have shown that the mouth opening measurements differs significantly with gender, race, and age [5]. Males usually have a slightly greater mouth opening than females. MMO is also related to body size and height. Taller people can open their mouths more than shorter people.

Most studies conducted indicated that the changes in mouth opening vary with age where the mean of the maximal mouth opening decreased age in adults. Mouth opening varies considerably in different populations and the ranges obtained are specific to the population given. Various studies in the world have measured the mouth opening range in their particular populations. List of studies carried across the globe with the mean MMO values has been tabulated in table 1. Yao., *et al.* [6] concluded that the MMO reduced with age differences and males had a higher MMO than fe-

males of the same age in the Chinese population studied [6]. Due to these differences, there is a critical need for more research to study specific factors that may determine mouth opening range of people from different geographical locations.

Gallagher, *et al.* [7] working on the Irish adult population found no connection between stature and mouth opening. Mean mouth opening values of Caucasians seemed to be bigger than those of Asians [8]. Three decades ago, El Abdin., *et al.* [9] assessed the MMO in Saudi patients aged five to seventy years. The mean value MMO in males was 48.19 mm (peak 20 - 30 years) and for females, it was 44.05 mm (peak 10 - 30 years) [9]. Al-Dlaigan., *et al.* [10] estimated the MMO in Saudi adolescents (12 - 16 years) and found that the mean and range MMO in males and females was 43.5 ± 4.23 mm (29 - 59 mm) and 35.5 ± 4.4 mm (20 - 45 mm), respectively [10]. There is a paucity of evidence in the present day regarding the mean MMO of Saudi adult population. Hence this cross-sectional study was planned to set a reference measurement for maximal mouth opening in Saudi adult population.

| Author (s)                        | Study population  | Maximal mouth opening (MMO)   |
|-----------------------------------|---|---|
| El Abdin., <i>et al.</i> (1991)   | 1158 Saudi patients aged 5 to 70 years  | Males 48.19 mm (Peak 20 - 30 years)<br>Females 44.05 mm (Peak 10 - 30 years)        |
| Al-Dlaigan., <i>et al.</i> (2014) | 1825 Saudi adolescents (1007 males, 818 females) aged 12 - 16 years                           | Males 43.5 ± 4.23 mm (range 29 - 59 mm)<br>Females 35.5 ± 4.4 mm (range 20 - 45 mm) |
| <b>Studies across the globe</b>   |   |   |
| Agerberg (1974)                   | 150 Sweden children, 75 boys, and 75 girls under 6 years; 200 adolescents aged 18 - 25 years. | Mean 44.8 mm (children) Mean 55.5 mm (adolescents)                                  |
| Gallagher, <i>et al.</i> (2004)   | 1513 Irish adults, aged 16 to 99 years  | Males 43 mm<br>Females 41mm   |
| Yao., <i>et al.</i> (2009)        | 1442 (705 males, 737 females) ethnic Chinese (Taiwanese) adults aged 20 to 80 years           | Males 49.92 ± 6.55 mm<br>Females 48.32 ± 5.95 mm                                    |
| Sawair, <i>et al.</i> (2010)      | 496 Jordan patients aged 15 to 80 years   | Males 45.3 ± 5.7 mm (range 33 - 71 mm) Females 41.5 ± 5.3 mm (range 29 - 60 mm)     |
| Khare., <i>et al.</i> (2012)      | 894 Indian adults, 463 males and 431 females aged 21 to 70 years                              | Males 51.3 ± 8.3 mm (range 39 - 70 mm) Females 44.3 ± 6.7 mm (range 36 - 56 mm)     |
| Muller., <i>et al.</i> (2013)     | 20719 Swiss children (10060 girls, 10659 boys) aged 4-17 years                                | Males 45 mm (range 25 - 70)<br>Females 45 mm (range 25 - 69 mm)                     |
| Patel., <i>et al.</i> (2016)      | 985 Indian children, 560 males and 425 females aged 5 to 18 years                             | Males 44.24 ± 5.84 mm<br>Females 43.5 ± 5.19 mm                                     |
| Li., <i>et al.</i> (2017)         | 452 young Chinese adults, aged 20 to 35 years (238 males, 214 females)                        | Males 54.18 ± 5.21 mm<br>Females 49.62 ± 3.69 mm                                    |
| Koruyucu., <i>et al.</i> (2018)   | 1059 Turkish children (569 males, 490 females), aged 3 to 15 years                            | Males 33.32 ± 5.71 mm<br>Females 33.24 ± 5.54 mm                                    |

**Table 1:** List of studies carried across the globe with the mean MMO values.

### Aim of the Study

Our aim is to set a reference measurement for maximal mouth opening in Saudi Arabian adult population.

### Materials and Methods

#### Study site

The study was conducted on patients attending dental clinics in Riyadh, Kingdom of Saudi Arabia. The study's ethical approval was obtained from the university's research center. The IRB approval number is RC/IRB/2018/1017. The maximum mouth opening (MMO) was recorded in mm for adult patients using a plastic ruler. The patients were requested to open their mouth at maximum level and the length between the maxillary central incisor edge and the mandibular central incisor edge in the same side of the mouth was measured. A standardized protocol was used to measure mouth opening in patients. Three readings were taken for each patient and the mean value was recorded.

#### Data collection

Patients attending dental clinics aging between 20 and 59 years old were included in this study. Patients younger than 20 years old and older than 59 years old and patients with temporomandibular disorders, history of maxillofacial trauma, history of oral malignancy, dental and/or skeletal developmental deformities, pathological conditions that may affect MMO such as oral submucous fibrosis, history of bruxism with clinical evidence of attrition, and patients with more than 2 missing teeth (excluding wisdom teeth) were omitted from this research.

The patients' age and gender were recorded. The age was further grouped as 20 - 29, 30 - 39, 40 - 49 and 50 - 59 years. Informed consent was obtained from patients. Data were analyzed using IBM® SPSS® Statistics version 22 software. Mean (SD) was used to report continuous variables while frequency (percentage) was used to report categorical variables. To determine the correlation of mouth opening with age Spearman correlation test was performed. Kruskal Wallis and Mann Whitney tests were used to compare the continuous variables. A p-value of ≤ 0.05 was used to show statistical significance.

### Results

#### Participants distribution based on gender and age

A total of 1368 who participated, 674 (49.3%) were males and 694 (50.7%) were females. Table 2 shows the distribution of participants by gender and age group. Mean (SD) age of the partici-

|           |         | Frequency (Percent) |
|-----------|---------|---------------------|
| Gender    | Male    | 674 (49.3)          |
|           | Female  | 694 (50.7)          |
| Age group | 20 - 29 | 584 (42.7)          |
|           | 30 - 39 | 422 (30.8)          |
|           | 40 - 49 | 240 (17.5)          |
|           | 50 - 59 | 122 (8.9)           |

Table 2: Demographics.

pants was 33.2 (10.1) years, ranging from 18 - 59 years. The mean (SD) maximal mouth opening (MMO) of the participants was 50.1 (6.3) mm, ranging from 32 - 75 mm.

#### The MMO based on gender and age

Table 3 shows the mean (SD) MMO by gender and age group. The mean (SD) MMO for males was 52.5 mm (6.3), ranging from 35 - 75 mm. Mean (SD) females MMO was 47.8 mm (5.3), ranging from 32 - 64 mm. Mean (SD) MMO for males was statistically significantly higher than females (p < 0.05). There was no statistically

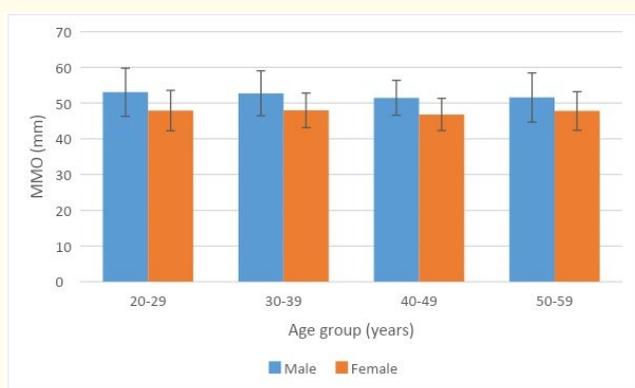
|           |         | MMO        | p-value |
|-----------|---------|------------|---------|
|           |         | Mean (SD)  |         |
| Gender    | Male    | 52.5 (6.3) | 0.000*  |
|           | Female  | 47.8 (5.3) |         |
| Age group | 20 - 29 | 50.1 (6.7) | 0.172   |
|           | 30 - 39 | 50.6 (6.2) |         |
|           | 40 - 49 | 49.4 (5.3) |         |
|           | 50 - 59 | 49.6 (6.4) |         |

Table 3: MMO (mm) by gender and age group.

\*: Statistically significant.

significant difference in the MMO and age group (p > 0.05). A negative correlation between MMO and age was obtained, this represented that as an increase in age leads to a decrease in mouth opening. However, this correlation was not statically significant (rho = -0.013, p = 0.625).

The mean (SD) MMO for males and females of between age 20 - 29 years, was 53.1 (6.7) mm and 47.9 (5.7) mm, respectively. The mean (SD) MMO for males and females of the age group 30 - 39 years, was 52.8 (6.3) and 48.0 (4.8) mm for males and females, respectively. The age group 40 - 49 years, the mean (SD) MMO was



**Figure 1:** Comparison of Mean (SD) MMO by gender and age group

51.5 (4.9) mm in males and 46.8 (4.5) mm in females. In the 50 - 59 years age group, the respective values in males and females were 51.6 (6.9) and 47.8 (5.4) mm (Figure 1). However, in the mean (SD) MMO for both males and females there was no statistically significant difference observed among the age groups ( $p > 0.05$ ).

## Discussion

Temporomandibular disorders, maxillofacial trauma, oral malignancies, oral submucous fibrosis, and craniofacial syndromes are associated with jaw pain and restricted mouth opening. Restricted mouth opening can be broadly classified under joint or muscular related disorders. The restricted mouth opening values has been reported as  $< 35$  mm and  $< 40$  mm for joint-related and muscular disorders, respectively [11]. But, these parameters cannot be applied to all individuals in general because maximal mouth opening varies from one individual to another.

The treatment of any of the above disorders always aims at restoring the mouth opening to normal limits. Therefore, it has always been vital to establishing a normal range for maximal mouth opening in specific populations. The last published work on maximal mouth opening of exclusive Saudi adults dates back to 1991, 27 years back. The data about the current generation of adults is presently unavailable and hence, this research was aimed to establish the average maximal mouth opening of Saudi adult population.

Numerous methods have been described in different kinds of literature as maximal mouth opening measurements. The most common measurement used to measure the mouth opening is by measuring the inter-incisal distance using a ruler, during ac-

tive mouth opening by the individual. Linear mouth opening measurements have been done using different instruments. Wood and Branco [1] assessed the effectiveness of three methods to measure inter-incisal distance and they concluded that the most accurate method was direct measurement using a ruler.

Since mouth opening can be influenced by age, in this study, 1368 Saudi adults were divided into four subgroups based on their age to assess the changes in mean maximal mouth opening with age increase. The difference in results based on gender was also assessed. The present study results showed that the mean maximal mouth opening was higher in males compared to the female Saudi adults. The results were in accordance with various other studies carried out in different parts of the world. Based on the existing literature, normal mouth opening ranges from 40 - 74 mm in males and 35 - 70 mm in females [9,12]. Mezitis, *et al.* [13] in a study on 1160 Greek adults and discovered that the mean maximal mouth opening was 52.85 mm in males and 48.34 mm in females [13]. Gallagher, *et al.* [7] found that mean maximal mouth opening was 43.3 mm and 41.1 mm in male and females Irish, respectively [7].

Yao, *et al.* [6] conducted a study on 1442 Chinese (Taiwanese) adults aged 20 to 80 years, they found that the mean maximal mouth opening was 49.92 mm in males and 48.32 mm in females [6]. Sawair, *et al.* [14] initiated that the mean maximal mouth opening was 45.3 mm in Jordanian males and 41.5 mm in Jordanian females [14]. Khare, *et al.* [4] conducted their research on 894 Indian adults, aged 21 to 70 years and found the maximal mouth opening mean was 51.3 mm and 44.3 mm in males and females respectively. The maximal mouth opening mean was found to be 54.18 mm and 49.62 mm in Chinese male and females respectively [15]. Nagi, *et al.* [16] found that the maximal mean mouth opening was 51 mm and 46 mm respectively in Indian males and females.

The common finding seen in all the studies conducted in different parts of the world is that the males had a higher maximal mouth opening mean than the females. The male anatomical structure of the craniofacial bones maybe bigger than the female bones and hence could contribute to the increased maximal mouth. Greater mandibular length, greater muscle strength can also result in the increased ability to open mouth maximally in males [16]. However, Pullinger, *et al.* [17] found two interesting results on the maximal mouth opening in females. Women have a smaller maximal jaw opening than men according to linear inter-incisal measurements. In the present study, the difference recorded was 2.7%. Secondly,

using a geometric angle estimation of maximal jaw opening, it was found that women had a 5.4% wider jaw opening range compared to men. Pullinger, *et al.* [17] noted that an increased opening range is a measure of hyper-extensibility and does not essentially infer laxity or instability [17].

This present study findings present are consistent in that mouth opening decreases with age increase. Also, the mouth opening mean in females was greater than in males and the finding was true across all age groups examined in this study. The maximal mouth opening mean was 53 mm in the 20 - 29 years old group of males and 52.8 mm in the 30 - 39 years old group of males. Similarly, the maximal mouth opening mean was almost equal in the 40 - 49-year-old males (51.5 mm) and 50 - 59-year-old males (51.6 mm). This finding was true about the younger and older females also. The younger age groups had a slightly higher maximal mouth opening mean compared to the old age groups in both genders of the Saudi population.

Gallagher, *et al.* [7] in a study on the Irish population concluded that mouth opening decreases with age and this is independent of TMJ and gender status. Nagi, *et al.* [16] showed that the maximal mouth opening mean in males was highest for the young age group (18 - 29 years) and lowest for the old age group (50 - 60 years). Maximal mouth opening decreased with increase in age because as age advances there is an increase in the fibrous tissues. The mucosa loses its elasticity leading to a decrease in mouth opening [9,13].

There are several reasons for the difference in the results of the different studies discussed above. Firstly, the individuals belonging to different races have different facial proportions and this could contribute in a significant way to the maximal mouth opening [18]. Ying, *et al.* [19] demonstrated a positive correlation between race and maximal mouth opening. The maximal mouth opening for the subpopulation in Jordanian was  $42.9 \pm 5.7$  mm [14] and it was found to be much lesser than the European population [20].

It has been reported that 25 - 40% of inter-individual variations in the range of mouth opening could be explained by inter-individual variations in facial morphology with the angle between the posterior cranial base and mandibular ramus being the most important morphological variable. Second, age contributes significantly to maximal mouth opening scores. Maximal mouth opening steadily increases after birth through adulthood and gradually decreases with aging. Development of articular eminence of temporomandibular joint, morphological changes related to bruxism and trauma attributes to the changes in maximal mouth opening

values.

A literature search showed that stature is one of the significant factors influencing mouth opening. This reason has also been offered to explain the mouth opening differences between different people. Landtwing [21] concluded that significant increases in mouth opening are attributed to stature. The maximal mouth mean opening, accessed as inter-incisal distance plus overbite for males was stated to be 58.6 mm and 53.3 mm for females in the Swedish population [22]. The average Swedish adult males' height was 1.78m and in females, it was 1.66m, as reported by Eurostat [23]. In the Nepalese population the maximal inter-incisal distance mean was found to be  $47 \pm 1$  mm and the mean height for the adult Nepalese adult males was 1.62m while in females it was 1.51m [12,24]. These figures suggest the formation of a trend, that a smaller mouth opening range was observed in lower average stature populations. However, it appears that mouth opening is affected by multiple variables and although stature may be one of them, it is not the only factor affecting the mouth opening.

### Limitation of the Study

There was one limitation in this present study. The participants enrolled in this study were the patients attending dental clinics in Riyadh, Kingdom of Saudi Arabia. They might not have been a representative sample of native Saudi Arabia born individuals. A multicentre cross-sectional survey conducted in different parts of Saudi Arabia could give more precise data on the mean maximal mouth opening of Saudi Arabian adults. Considering the magnitude of such a study, its cost, time, logistic expenses and the dearth in the present-day evidence on mean maximal mouth opening of Saudi adults, this study has warranted.

### Conclusion

In conclusion, the basic standard value of mean maximal mouth opening in Saudi Arabian adults was established as 50.1 mm, ranging from 32 - 75 mm. The maximal mouth opening mean for Saudi Arabian adult males was 52.5 mm, ranging from 35 - 75 mm. It was higher than the mean maximal mouth opening seen in Saudi Arabian adult females which were 47.8 mm, ranging from 32 - 64 mm. A negative correlation between maximal mouth opening and age was obtained indicating that mouth opening decreases with age increase. The implication of these findings is that individual differences and variations among people with regards to mouth opening range exists and the exact factors explaining these differences are an interesting subject area for future studies.

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