

## Original Article

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# The Relationship between Orotracheal Intubation Difficulty Scoring Systems and Anthropometric Factors

Maryam Motamedi<sup>1</sup>, Maleh Soltani<sup>2\*</sup>, Marzieh Amiri<sup>3</sup>, Elham Memary<sup>4</sup>

1. Department of Emergency Medicine, Shohaday-e-Tajrish Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

2. Department of Emergency Medicine, Afshar Hospital, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

3. Department of Emergency Medicine, Razi Hospital, Guilan University of Medical Sciences, Rasht, Iran.

4. Department of Anesthesiology, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

\*Corresponding author: Maleh Soltani; Email: dr\_ms64@yahoo.com

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## Abstract

**Introduction:** Although rare, but it is very important to understand that intubation will be difficult for which of the patients. Some scoring systems are available in this regard that influenced by many factors such as body anthropometric factors.

**Objective:** This study was conducted to investigate the relationship between Mallampati score, biting the upper lip as well as 2-3-3 maneuver with body anthropometric factors in different population of society.

**Method:** This cross-sectional study was conducted during the years 2014-2015 in Yazd, Iran. The subjects using simple randomized sampling method, and they were included in study after obtaining their informed consent. Demographic (age and gender) as well as anthropometric parameters of body, including weight, height, neck, waist circumference, hip circumference, body mass index (BMI) and waist-to-hip ratio (WHR) were collected in a pre-prepared checklist. Then, Mallampati score, biting the upper lip score, maneuver 2-3-3 were examined and calculated by researchers. The results of these examinations were recorded for each person in checklist.

**Results:** In this study, 498 people with mean age of  $42.1 \pm 16.1$  were enrolled (51% female). Based on results of this study, although all three methods significantly correlated with age but none had any relation with gender. Significant relationship was found between upper lip biting and Mallampati score and all body anthropometric factors evaluated in this study ( $p < 0.05$ ). By increasing the mean of these factors, Mallampati score increases, while this relationship is reverse in the case of height. In addition, significant correlation was found between maneuver 2-3-3 and weight, height, waist circumference, hip circumference and BMI, while it showed no correlation with neck circumference ( $p = 0.328$ ) and WHR ( $p = 0.121$ ).

**Conclusion:** Based on findings of current study, it is likely that upper lip biting test and Mallampati score have significant relation with all body anthropometric factors evaluated in this study. But maneuver 2-3-3 has no correlation with neck circumference and WHR.

**Key words:** Airway Management; Body Mass Index; Emergency Medicine; Intubation, Intratracheal; Obesity

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## INTRODUCTION

Airway management is one of the major tasks, taking place mainly in emergencies. Failure to establish airway in patients can have severe and long-lasting consequences and even death (1). Failure to maintain the airway for a period of more than a few minutes leads to brain damage or death. Therefore, it is not surprising that more than 85% of cases of weakness in providing the airway lead to brain damage or death of patient, and it has been proven that over 30% of cases of death due to anesthesia caused by airway management failure (2, 3).

Intratracheal intubation is considered one of the

most common methods in airway management in emergency department. One of the risk factors increasing the stress of laryngoscopy and intubation is intubation difficulty in some patients. It is very important to understand that intubation will be difficult for which of the patients (4). To predict easy or difficult airway, some commonly used predictive tests are used. These methods are easy, costless and noninvasive (2, 5, 6).

Most of methods predicting difficulty of intratracheal intubation have been established based on the anthropometric observations (7, 8). Mallampati classification system is one of these

methods used to predict the difficulty of intubation, which has shown a sensitivity between 42 and 81 percent (9, 10). Other studies have shown that the biting the upper lip test and 2-3-3 maneuver are effective factors in predicting difficulty of intubation (11, 12).

These methods are also influenced by many factors such as body anthropometric factors, body mass index, neck circumference, waist-to-hip ratio, and obesity (13, 14). This study was conducted to investigate the relationship between Mallampati score, biting the upper lip as well as maneuver 2-3-3 with body anthropometric factors in different population of society.

## METHODS

### Study design

This cross-sectional study was conducted during the years 2014-2015 in Yazd, Iran. All subjects were informed of the objective and the process of the study before including in the study, and written consent was obtained of all of them to participate in the study. The study protocol was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences. Information obtained from any person was completely confidential and only general findings were reported without naming them.

### Participants

The source of sampling was the normal populations that were selected from the healthy subjects of community. The sample size was calculated to be 498 subjects using simple randomized sampling method.

### Definitions

- **Mallampati score:**

This test measures the ratio of the tongue to oral cavity. Mallampati classification is divided into four grades based on tonsillar folds covering and using the tongue base. Grade 1) tonsils folds, soft palate, and uvula are easily visible; Grade 2) folds of the tonsils and soft palate are visible, but uvula is covered by the base of the tongue; Grade 3) only soft palate is visible; Grade 4) soft palate is also invisible. Grades 1 and 2 indicate the possibility of easy intubation and class 3 and 4 indicates the likelihood of difficult intubation (7).

- **Biting upper lip test:**

The base of this method is biting the upper lip by lower incisors. Determining the biting rate of patient's upper lip varies, depending on the fact if patient has teeth or not. Classification of upper lip biting test in patients with teeth is determined as follows: Type 1) lower incisors can bite upper lip above the lip line (Vermilion line); Type 2) Lower

incisors can bite upper lip under lip line; Type 3) lower incisors cannot bite the upper lip. Classification of upper lip biting test in people without teeth is determined as follows: Type 1) lower lip, while covering the upper lip, goes up from 2 mm above the lip line as far as the middle of two lip lines, Type 2) lower lip, while covering the upper lip, covers the lip line as far as 2 mm above lip line; Type 3) lower lip, while covering the upper lip, covers the under the lip line. Grades 1 and 2 indicate the possibility of easy intubation and grade 3 indicate the possibility of difficult intubation (7).

- **Rule 2-3-3:**

In this maneuver, three distances are measured based on the size of fingers of the person as follows: The mouth opening as much as 3 fingers; distance from the chin to the hyoid bone as much as three fingers; distance of oral cavity of mouth to the thyroid cartilage as much as two fingers. If all three conditions are met, examination will be normal; otherwise, it will be interpreted abnormal (7).

### Data Collection

Demographic (age and gender) as well as anthropometric parameters of body, including weight, height, neck, waist circumference, hip circumference, body mass index (BMI) and waist-to-hip ratio (WHR) were collected in a pre-prepared checklist. Then, Mallampati score, biting the upper lip score, maneuver 2-3-3 were examined and calculated by researchers. The results of these examinations were recorded for each person in checklist.

### Statistical analysis

Data of questionnaires were extracted and they were analyzed using IBM SPSS software (version 21). Mean and standard deviation were used show interval variables such as age, height, weight, waist, hips, and neck circumstances. Nominal variables such as gender, history of anesthesia, intubation history, history of obstructive sleep apnea were reported using absolute frequency and frequency percentage. The relationship between Mallampati score and body anthropometric factors and age were evaluated using Spearman correlation test. In addition, the relationship between body anthropometric parameters and age was examined using Pearson correlation. To assess significance difference between gender and disease/therapy history with Mallampati score, Mann-Whitney U test was used. P-value less than 0.05 considered significant.

## RESULTS

In this study, 498 people with mean age of  $42.1 \pm$

**Table 1:** Demographic and basic data of subjects separately in terms of gender

Variable	Male (n=244)	Female (n=254)
Age (years)	41.6±16.1	42.6±16.1
Height (cm)	169.9±7.2	158.1±7.2
Weight (kg)	78.7±15.6	69.4±12.1
Neck circumference (cm)	38.3±3.3	34.5±2.2
Waist circumference (cm)	93.7±13.2	88.9±13.4
Hip circumference (cm)	101.6±11.0	106.0±11.2
BMI (kg/m)	27.3±5.1	27.9±5.0
Waist-to-hip	0.92±0.07	0.84±0.08

16.1 were enrolled (51% female). Table 1 shows the demographic and basic information of subjects separately in terms of gender. In total, 168 of males (69%) and 182 of females (72%) studied had body mass index (BMI) higher than 25. In addition, 74 of females (39%) had waist to hip ratio (WHR) higher than 0.93, and 152 of females (60%) had WHR higher than 0.81.

Table 2 shows the results of intubation difficulty measuring tests separately in terms of gender. Upper lip bite test score was 3 in 10 subjects (2%) indicating the likelihood of difficult intubation, while in other 488 (98%) people, the score of this test was 1 or 2.

Mallampati test result in 152 patients (31%) was score 3 or 4, which indicates the likelihood of difficult intubation, while in other 346 others (69 percent) it was 1 or 2, which indicates the likelihood of easy intubation. Result of maneuver 2-3-3 in 20 subjects (4%) indicated abnormal status, while it was normal in other 478 others (96%) subjects.

Table 3 shows the correlation of results of measurement tests of intubation difficulty with body anthropometric factors in studied subjects. Based on results of this study, Although all three methods significantly correlated with age but none had any relation with gender. Significant

relationship was found between upper lip biting and Mallampati score and all body anthropometric factors evaluated in this study. By increasing the mean of these factors, Mallampati score increases, while this relationship is reverse in the case of height. In addition, significant correlation was found between maneuver 2-3-3 and weight, height, waist circumference, hip circumference and BMI, while it showed no correlation with neck circumference and WHR.

## DISCUSSION

Based on findings of current study, it is likely that upper lip biting test and Mallampati score have significant relation with all body anthropometric factors evaluated in this study. But maneuver 2-3-3 has no correlation with neck circumference and WHR. In the present study, significant relationship was not found between gender of subjects and intratracheal intubation difficulty scoring systems. However, contrary to finding of present study, Ezeri et al reported the impact of gender in predicting the difficulty of intratracheal intubation (15). However, the study of Azeri et al was in line with the current study in terms of the role of age, and they have concluded that by increasing age, the likelihood of intratracheal intubation difficulty increases (15). The direct and significant relationship was found between Mallampati score and body mass index, waist-to-hip ratio and neck circumference in this study. In a study conducted by Mahmoudpour et al, the significant relationship was reported between body mass index and the difficulty of laryngoscopy, confirming the findings of present study (14). In line with results of the present study, some previous studies have shown that neck circumference could be a factor in predicting difficult intubation in obese individuals (16, 17).

Most previous studies, as our study, have reported

**Table 2:** Results of difficult intubation measurement tests in subjects separately in terms of gender

Variable	Male (n=244)	Female (n=254)
	N (%)	
<b>Upper lip biting</b>		
1	164 (67.2)	178 (70.1)
2	72 (29.5)	74 (29.1)
3	8 (3.3)	2 (0.8)
<b>Mallampati score</b>		
1	92 (37.7)	106 (41.8)
2	72 (29.6)	76 (29.9)
3	56 (22.9)	46 (18.1)
4	24 (9.8)	26 (10.2)
<b>Maneuver 2_3_3</b>		
Normal	234 (95.9)	244 (96.1)
Non-normal	10 (4.1)	10 (3.9)

**Table 3:** The relationship of results of difficult intubation measurement tests with body anthropometric factors in subjects

Variable	Age	Gender	Weight	Height	Neck circumference	Waist circumference	Hip circumferences	Body mass index	Waist-to-hip
P-value									
Upper lip biting	< 0.001	0.391	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.01	< 0.001
Mallampati score	< 0.001	0.319	< 0.001	0.007	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Maneuver 2-3-3	< 0.001	0.218	< 0.001	< 0.001	0.328	< 0.001	< 0.001	< 0.001	0.121

that obesity and other anthropometric factors describing obesity, neck circumference, waist circumference, waist to hip ratio and weight to height ratio have a direct role in predicting difficult intubation (18). However, contrary to the beliefs of the majority people, some studies have not approved the role of obesity in predicting difficult intratracheal intubation, and they have reported intubation difficulty in obese individuals does not differ significantly from other population of study (15, 19, 20).

The role of neck circumference in previous studies, including in a study conducted by Riaz et al, has been recognized influential in predicting difficult intratracheal intubation (21). Similarly, significant correlation was also found between this anthropometric factor and Mallampati and other methods used in assessing and predicting difficult intratracheal intubation in this study. Based on Mallampati test score, difficult intubation was predicted 10%, while this figure raised to 31% considering patients with Mallampati score of 3 in the difficult intubation probability class. However, based on upper lip biting test score, only 2% of people were predicted with possibility of difficult intubation. These figures are somewhat in line with results of study conducted by Alhag et al (22).

Additionally, Prakash et al reported difficult laryngoscopy lower than 10% in the studied population (23). The remarkable point in the studies conducted on the value of Mallampati score, upper lip biting, Rule 2-3-3 and other similar methods is the lack of agreement among researchers on superiority of each of them over others. It seems that using of all of them simultaneously will provide higher sensitivity, and therefore, preparing a checklist of all of these non-aggressive tests would be helpful (15).

#### Limitations

If cluster sampling were used for this study, its

results would be generalized for whole population, while convenient sampling was used in this study, and this is considered as the most important limitation of the current study. In addition, many similar studies have been conducted to examine such difficult intubation predicting methods on patients who were candidate for elective surgery to compare these methods and to assess their sensitivity and specificity after laryngoscopy. However, the evaluation of these cases was impossible in this study conducted on general population.

#### CONCLUSIONS

Based on findings of current study, it is likely that upper lip biting test and Mallampati score have significant relation with all body anthropometric factors evaluated in this study. But maneuver 2-3-3 has no correlation with neck circumference and WHR

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#### AUTHORS' CONTRIBUTION

All the authors met the standards of authorship based on the recommendations of the International Committee of Medical Journal Editors.

#### CONFLICT OF INTEREST

Hereby, authors stipulate that there is no conflict of interest in the current study.

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