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Research Article

# THE CHARACTERISTICS AND DETERMINANTS OF MAXIMAL EXPIRATORY PRESSURE IN YOUNG ADULTS FROM TRIPURA

*Dipayan Choudhuri[1], Soma Choudhuri[2]

[1]Department of Human Physiology, Tripura University (A Central University), Suryamaninagar, Agartala, Tripura, India

[2]Department of Physiology, Tripura Medical College & Dr. B.R. Ambedkar Teaching Hospital, Hapania, Agartala, Tripura, India.

*Corresponding author email: dipayanchoudhuri@gmail.com

## ABSTRACT

**Objective:** To obtain values for normal maximal expiratory pressure (MEP) in adolescent subjects (age 17-21yrs) of Tripura and to correlate the normal values of MEP with different anthropometric and respiratory parameters of the subject.**Materials and Methods:** Seventy (70) male and sixty seven (67) female subjects were included in the study through a randomized method of sampling. The height, weight, chest circumference, mid upper arm circumference, hip and waist circumference, blood pressure, heart rate, forced vital capacity (FVC), forced expired volume in 1 second (FEV1), peak expiratory flow rate (PEFR) were recorded in the subject. Maximal expiratory pressure was recorded by using a modified Black's apparatus. **Results:** MEP recorded in adolescent subjects from Tripura was comparable with those recorded in previous study for the similar age group. MEP correlated significantly with Age, Body weight, BMI, Chest expansion, and FEV1 of the subjects. **Conclusion:** The results of the study can be used to predict respiratory muscle strength in adolescent subjects. Methodology employed in the study will serve as a means for simple assessment of respiratory muscle strength of the subjects with lung disorder and also aid in planning the treatment strategy.

**Keywords:** MEP, Age, Weight, Chest expansion, BMI, FEV1.

## INTRODUCTION

Maximal expiratory pressure (MEP) evaluates the strength of respiratory muscles and is utilized for diagnostic and prognostic values in various neuromuscular and cardiovascular diseases by clinicians.[1,2] It is useful to detect and quantify respiratory muscle weakness associated with malnutrition and physical work capacity.[3] Procedure for measurement of respiratory pressure is very simple and can be performed in field condition without much difficulty.[4]Bothphysical characteristics and ethnicityare reported to play important role in determining maximal expiratory pressure in different population study.[5] No previous study has provided reference values for MEP using randomly selected healthy adolescent from population of Tripura. With this purpose, we evaluated various anthropometric, physiological and respiratory parameters in adolescent subjectsfrom a population of Tripura, a North Eastern state of India. Correlation between various anthropometric and respiratory parameters with maximal expiratory pressure was also evaluated.

## MATERIALS AND METHODS

The study was conducted on 137 randomly selected adolescent subjects of both sexes aged17 – 21 yearsfrom Tripura. 70 of them were male and 67 were

female. The study included only healthy non-smoking subjects. Subjects with any respiratory, neuromuscular, cardiac and endocrine disorders were excluded from the study. The study protocol was approved by Institutional ethical committee. Each participating subject signed an informed consent before volunteering for the study.

Age (yr), standing height (cm), body weight (kg), chest circumference (cm), mid upper arm circumference (cm), waist – hip ratio were measured using standard procedure.[6] Height was measured to nearest of 0.1 cm and weight was measured to nearest of 0.1 kg. Chest circumference was recorded both during normal respiration and maximal expansion. Waist circumference was measured by placing the tape between coastal margin and iliac crest of the subject. Body mass index was calculated by formula from height and weight of the subject.[7]

Physiological parameters recorded included resting heart rate, respiratory rate and blood pressure. Forced Vital capacity (FVC) and forced expiratory volume during 1st second of expiration (FEV1) were recorded according to American Thoracic Society (ATS)[8]guidelines by using an expirograph (Helios 401, RMS, India). Peak expiratory flow rate (PEFR) was recorded by using Wright's peak flow meter.

For measurement of maximal expiratory pressure (MEP) of the subject, a modified Black's apparatus was used. For the purpose, the subject expired from total lung capacity after a maximal expiration. All the recordings were taken in sitting posture. Maximum of three trials with an interval of one minute between the trials were allowed for each subject. The highest value was accepted for computation.[9]

All parameters were recorded during morning hours (7.30am to 9.30am) to minimize possible diurnal variation. First, the manoeuvres were demonstrated and then the subjects were asked to perform the manoeuvre. During the measurements of respiratory parameters the subjects were asked to use the nose clip.

All the values were presented as mean ± SD. Level of significance was assessed by using unpaired student's t test. A linear associationwas established by using Pearson's correlation. The statistical analysis was performed using software SPSS version 19.0.

## RESULTS

Values of various anthropometric, physiological and respiratory parameters recorded in both male and female subjects are presented in Table 1.

**Table 1: Various Anthropometric parameters recorded in subjects.**

| Parameters | Male Subject | Female Subject |
|---|---|---|
| Age ( years) | 19.68± 1.583 | 19.0 ± 1.288 |
| Height (cm) | 155.61± 1.29 | 143.95 ± 1.79 |
| Weight (kg) | 56.96 ± 1.94 | 52.12 ± 2.67 |
| Arm circumference (cm) | 34.80 ± 1.26 | 26.51 ± 1.53* |
| Hip circumference (cm) | 89.33 ± 1.59 | 86.80 ± 1.85 |
| Waist circumference (cm) | 78.29 ± 1.12 | 82.79 ± 1.23 |
| Chest expansion ( cm ) | 4.78 ± 0.57 | 2.60 ± 0.62* |
| Hip : Waist Ratio | 1.358 ± 0.18 | 1.879 ± 0.62 |
| BMI (kg/sq.mt ) | 24.57 ± 2.6 | 22.76 ± 2.1 |

(Values are Mean ± SD, * $p < 0.01$)

All the parameters including BMI are within the normal range for the age and sex of the subjects. Data on various physiological and respiratory parameters recorded are presented in Table 2.Blood pressure and heart rates of the subjects are within the normal range. Respiratory parameters like VC, FEV1 and PEFR are found to be significantly lower in female subjects in comparison to male subjects.

**Table 2: Physiological and Respiratory parameters recorded in subjects.**

| Parameters | Male subject | Female subject |
|---|---|---|
| Heart Rate (beats/ min) | 77.93 ± 3.48 | 79.47 ± 2.91 |
| SBP (mmHg) | 123. 89 ± 5.42 | 118.73 ± 6.89 |
| DBP (mmHg) | 78.30 ± 4.27 | 71.68 ± 5.92 |
| Vital Capacity (ml) | 2896.59±37.68 | 1968.34±35.58* |
| FEV1 (%) | 86.93 ± 1.78 | 76.24 ± 1.95* |
| PEFR (ml/min) | 530.42 ± 17.82 | 372.60 ± 19.46* |
| MEP(mm Hg) | 93.39 ± 2.74 | 71.23 ± 1.97* |

SBP=Systolic Blood Pressure, DBP= Diastolic Blood Pressure, PEFR= Peak expiratory flow rate, MEP= Maximal Expiratory Pressure, (Values are Mean ± SD, * $p < 0.01$)

Maximal expiratory pressure (MEP) recorded in male and female adolescent subjects of Tripura are93.39 ± 1.74 and 71.23 ± 0.97 respectively. Recorded MEP value in female is significantly less than the male value.

Regression equations of MEP values using a linear regression model with anthropometric variables like age, body weight, chest expansion, BMI and respiratory variable FEV1 are proposed for young adult subjects from Tripura and are presented in Table 3.

**Table 3: Regression Equations using various Predictors of Maximal Expiratory Pressure in Male and Female subjects**

| PREDICTOR | Male subject | Female subject |
|---|---|---|
| **AGE (years)** | MEP = 38.4779 + 2.986 AGE<br>( R2 = 0.092 , SEE = 8.353 , F 0.05 = 3.911 ) | MEP = 40. 221 + 1.717 AGE<br>( R2 = 0.464 , SEE = 4.682 , F 0.05 = 3.982 |
| **Body Weight (Kg)** | MEP = -33.2011+2.394 WEIGHT<br>( R2 = 0.402 , SEE = 6.78, F 0.05 = 90.609 ) | MEP = 11.1449 + 1.228 Weight<br>( R2 = 0.464 , SEE = 4.682 , F 0.05 = 3.982 ) |
| **Chest Expansion** (cm) | MEP = 45.775 + 8.204 Chest Expansion<br>( R2 = 0.415 , SEE = 4.889 , F 0.05 = 3.982 ) | MEP = 16. 483 + 2.347 CHEST EXPANSION<br>( R2 = 0.440 , SEE = 4.785 , F 0.05 = 3.982 ) |
| **BMI** | MEP = - 86.225 + 7.575 BMI<br>(R2 = 0.774 , SEE = 4.162 , F 0.05 = 3.911 | MEP = - 14.249 + 3.408 BMI<br>( R2 = 0.687 , SEE = 3.574 , F 0.05 = 3.982 ) |
| **FEV 1** | MEP = 7.4 + 0.896 FEV1<br>( R2 = 0.612 ,SEE = 5.458, F 0.05 = 3.911 ) | MEP = 15.998 + 0.656 FEV1<br>( R2 = 0.668 , SEE = 3.572 , F 0.05 = 3.982 ) |

## DISCUSSION

The strength and function of respiratory muscles in young subjects can easily be assessed by recording of maximal expiratory pressure.[8]Establishment of reference values for respiratory muscle pressures have been undertaken among different population groups by various researchers.[2-4] Wide variations are reported in predicted values and reference equations proposed for different groups of people. Differences in methods used and motivation of the subjects to perform the manoeuvre are considered as prime cause behind such variations.[10]

The modified Black's apparatus used in our study is easy to use with minimum leakage through the mouthpiece.[11] All our subjects were motivated and enthusiastic to perform the manoeuvre. Values of maximal expiratory pressure recorded in young adult subjects from Tripura are found to be comparable with the values reported in literature for subjects of the similar age group.[12]In our study, we observed a significantly lower MEP value for female subjects in compassion to male subjects. This finding is corroborated by previous research with similar subjects.[13]

Anthropometric characteristics, nutritional status and physical fitness and biotype of the subject plays very important role in determining maximal expiratory pressure (MEP) in different groups of subjects.[14] MEP, in our study, is found to be positively correlated with age, body weight, chest expansion and BMI of the subject in both the sexes. Age, in most of the previous studies, is found to be a good predictor of respiratory pressure in both male and female subjects.[15] Both body weight and height are found to be correlated with MEP of the subjects in various studies.[16]A positive correlation of MEP with body weight, both in male and female subjects was reported by Harik-Khan and Leech.[17] However, a negative correlation of height with an MEP in female subjects was observed by Wilson and Harik-Khan.[18] MEP, in our study, showed a negative correlation with height and a positive correlation with body weight of the subjects from both the sexes. MEP of our subjects correlated positively with BMI of the subject, though there was no correlation with waist-to-hip ratio. Increase in muscle mass with higher body weight and BMI may explain the influence of body weight and BMI on MEP.[19]In our female subjects MEP correlated positively with their mid upper arm circumference, the similar correlation was not observed in male subjects. The present observation also revealed a positive correlation of MEP with ability of the subjects to expand the chest during deep inspiration. Similar observation regarding the relationship of MEP and chest circumference is also reported by several other authors.[20,21]

The relationship between respiratory pressure and vital capacity of the subject is studied by various authors under different conditions. Most of these studies revealed a correlation between vital capacity and respiratory pressure.[22]The relationship of MEP with other respiratory parameters in our study

revealed that MEP of the subjects correlated positively with FEV1. But it does not correlate with either vital capacity or PEFR of the subject. Studies in patients with COPD showed a significant positive correlation between both MIP and MEP with anthropometric parameters and FEV1.[23] Nishimura,et.al., have also reported a decreasing relationship between respiratory mouth pressure and FEV1.[24]Vimal G, et.al., recently found a positive correlation of MEP with FEV1.[25]

## CONCLUSION

The maximal expiratory pressures obtained in the present study for a sample of 17 to 21 years old subjects from a population of Tripura are comparable with reported values on subjects from other region of India. The present study will provide important insight into the characteristics and determinants of maximal expiratory pressure in young adults from Tripura. However, it is also important to note that further studies are still necessary, involving a greater sample of subjects including a wide age and socioeconomic range from various regions and different ethnic groups of Tripura.

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