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ASSESSMENT OF RESPIRATORY MUSCLE STRENGTH IN HEALTHY YOUNG INDIVIDUALS ACCORDING TO THE CLASSIFICATION OF BODY MASS INDEX"

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Abstract: Respiratory muscle strength (RMS) is responsible for respiratory mechanics and is measured as MEP (Maximum expiratory pressure) and MIP (Maximum inspiratory pressure). Increment in MIP and MEP are probably due to deposition of fat around the chest making chest region stiff. The respiratory muscles in obese individuals are inefficient, and of low endurance. In undernourished, the lower absolute lean body mass leads to poor respiratory muscle strength and reduces lung functions. The cross-sectional comparative study was conducted on 40 healthy young individuals of age group 18-25 years. Initial assessment of the study group was done which included demographic data, height, weight, MIP, MEP (predicted). MEP and MIP (actual) was measured with the subject seated. For results unpaired t test was used and MIP values are extremely significant with p value of **0.0001** in underweight individuals and MIP values are very significant with p value of **0.0100** in obese individuals. This study concludes that the inspiratory muscle strength is reduced in underweight and obese healthy young individuals.

Index terms: BMI, Maximum inspiratory pressure, Maximum expiratory pressure, Healthy young individuals.

I. Introduction

Respiratory muscle strength (RMS) is responsible for respiratory mechanics. Expansion during inspiration & recoiling during expiration is totally depends on the respiratory muscle strength. The RMS is measured as MEP (Maximum expiratory pressure) and MIP (Maximum inspiratory pressure) which are the pressure values produced during forced expiration & deep inspiration respectively.[1] Respiratory muscles generate the pressure differences that drive ventilation.[2]

Maximal expiratory pressure (MEP) and maximal inspiratory pressures (MIP) together provide a composite index of respiratory muscle strength [3]. The measurement of MIP in the field requires either a negative pressure gauge or a pressure transducer, which adds to the cost of the measurement. The measurement of MEP on the other hand is extremely cost effective requiring no more than an aneroid blood pressure gauge attached to a mouth[4]

Increment in MIP was probably due to deposition of fat around the chest. This makes chest region stiff. Deposition of fat on the diaphragm increases load on it. This leads to reduction in Functional residual capacity (FRC). More pressure and efforts are required to expand the chest against stiffness to fulfil the need. This mainly increases the MEP & MIP. [5]

Also, from the respiratory point of view, obese individuals may present changes in the distribution of ventilation, with the risk of manifesting gas exchange abnormalities. With the deposition of fat in these compartments, pulmonary compliance can be reduced by up to 66%, implying damage to mechanical ventilation with increasing respiratory effort, potential inefficiency, and decreased ability to generate strength for ventilation. [(6-7-8)] The respiratory muscles in obese individuals have been characterized as inefficient, and their endurance has also been found to be lower. According to several authors, this inefficiency results from reduced chest wall compliance, smaller pulmonary volumes, greater metabolic demand on the respiratory musculature and increased work required for breathing.[9]

While in the undernourished, the lower absolute lean body mass that may cause poor respiratory muscle strength, may result in reduced lung functions. while in undernutrition; depletion of body resources of proteins and calories is associated with wasting of skeletal muscles, including respiratory muscles[10]

II. METHODOLOGY:

2.1 STUDY DESIGN: Cross sectional comparative study

2.2 STUDY SET UP: The study will be conducted in the Dr. Vitthalrao Vikhe Patil Institute of Medical Sciences, Vilad Ghat, Ahmednagar, Maharashtra, India.

2.3 STUDY POPULATION: Healthy young individuals of Dr. Vitthalrao Vikhe Patil Institute of Medical Sciences

2.4 SAMPLE SIZE: 40 healthy young individuals

2.5 SAMPLING TECHNIQUES: Purposive sampling

2.6 STUDY MATERIAL:

1. Nose clip.
2. Mouth piece.
3. Chair with arm rest and back support.
4. Weighing scale.
5. Maximum Inspiratory Pressure instrument- Negative pressure manometer with tube and mouthpiece will be used to measure the diaphragm strength. The manometer is normally used to check the negative pressure and comparing with the normal value.
6. Maximum Expiratory Pressure instrument

2.7 INCLUSION CRITERIA:

- Healthy young individuals of Dr. Vitthalrao Vikhe Patil Institute of Medical Sciences.
- Age group 18-25 years

2.8 EXCLUSION CRITERIA:

- Subjects not willing to participate.
- Presence of neurological impairment or significant cardiopulmonary or musculoskeletal disorders.

2.9 PROCEDURE:

- The ethical clearance from ethical committee of college of physiotherapy was obtained. Subjects fulfilling the inclusion and exclusion criteria were included in the study. Participants willing to participate in the study were screened for inclusion and exclusion criteria. Participants meeting the inclusion criteria were included in the study. The entire procedure involved in the study was explained to each subject. After explaining the purpose of the study, a written informed consent was obtained from the participants.
- Based on BMI all the participants were allocated into four groups –

Group A = Underweight, Group B =Normal, Group C =Overweight, Group D=Obese

- Initial assessment of the study group was done which included demographic data, height, weight, MIP, MEP
- Procedure of Maximum Inspiratory Pressure and Maximum Expiratory Pressure:

➢ The manoeuvre consists of a maximum inspiratory effort against a closed airway and requires a considerable degree of patient cooperation and coordination.

➢ Pressures was measured with the subject seated. Physiotherapist demonstrated the correct manoeuvre.

➢ For MEP, the participant was instructed to inhale completely, seal the lips around the mouthpiece and then blow out hard.

➢ For MIP, the participant was instructed to exhale completely, seal the lips around the mouthpiece and then pull in hard.

➢ Manoeuvre was repeated at least three times and until two identical readings were obtained. Pressures were maintained for at least one second. An interval of about one minute was given between these efforts.

2.10 OUTCOME MEASURES:

- MIP
- MEP
- BMI

2.11 STATISTICAL ANALYSIS:

It will be analysed by using descriptive test.

III. RESULTS:

The present study was conducted on 40 healthy young individuals who were in the age group of 18-25 years from DVVPF'S College of Physiotherapy.

Results were carried out using Unpaired t-test

7.1 FIGURES AND TABLES

AGE (MEAN±SD)	21.25 ± 1.446
FEMALES/MALES (%)	29 (72.5)/11(27.5)
BMI (MEAN±SD)	28.155 ± 6.380
MEP PREDICTED (MEAN±SD)	86.376925 ± 13.614
MEP ACTUAL (MEAN±SD)	96 ± 41.436
MIP PREDICTED (MEAN±SD)	94.329875 ± 15.898
MIP ACTUAL (MEAN±SD)	66 ± 54.044

Table 1: Baseline Characteristics of participants

NORMAL		MEAN ± SD	P VALUE	RESULT
	MEP PREDICTED	90.0229 ± 14.588	p value is 0.0469	Considered significant
	MEP ACTUAL	131 ± 58.963		
	MIP PREDICTED	99.9915 ± 18.383	p value is 0.5881	Considered **not** significant
	MIP ACTUAL	110 ± 54.365		

Table 2: Table depicting results of MEP and MIP values using Unpaired t-test in Normal individuals.

Table 2 depicts that the MEP values being statistically significant with a p-value of **0.0469**, and MIP values being statistically not significant with p value of **0.5881** in normal individuals.

UNDERWEIGHT		MEAN ± SD	P VALUE	RESULT
	MEP PREDICTED	77.6386 ± 8.498	p value is 0.0548	Considered **not** quite significant
	MEP ACTUAL	71 ± 5.676		
	MIP PREDICTED	84.9433 ± 11.161	p value is < 0.0001	Considered **extremely** significant
	MIP ACTUAL	27.5 ± 12304		

Table 3: Table depicting results of MEP and MIP values using Unpaired t-test in underweight individuals.

Table 3 depicts that the MEP values being statistically not quite significant with a p-value of **0.0548**, and MIP values being extremely significant with p value of **0.0001** in underweight individuals.

OVERWEIGHT		MEAN ± SD	P VALUE	RESULT
	MEP PREDICTED	85.3163 ± 11.849	p value is 0.4589	Considered **not** significant
	MEP ACTUAL	93 ± 29.833		
	MIP PREDICTED	92.7905 ± 13.710	p value is 0.3661	Considered **not** significant
	MIP ACTUAL	75 ± 59.114		

Table 4: Table depicting results of MEP and MIP values using Unpaired t-test in Overweight individuals.

Table 4 depicts that the MEP values being statistically not significant with a p-value of **0.4589**, and MIP values being statistically not significant with p value of **0.3661** overweight individuals

Table 5: Table depicting results of MEP and MIP values using Unpaired t-test in Obese individuals.

OBESE		MEAN ± SD	P VALUE	RESULT
	MEP PREDICTED	92.6602 ± 14.151	p value is 0.3309	Considered **not** significant
	MEP ACTUAL	82 ± 46.294		
	MIP PREDICTED	96.19235 ± 15.259	p value is 0.0100	Considered **very** significant
	MIP ACTUAL	63.25 ± 52.120		

Table 5 depicts that the MEP values being statistically not significant with a p-value of **0.3309**, and MIP values being very significant with p value of **0.0100** in obese individuals.

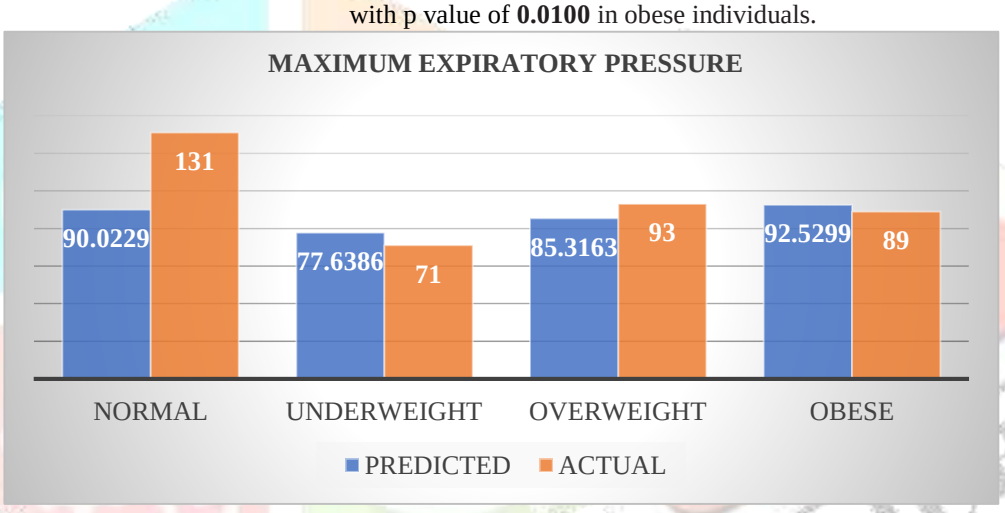

Figure 1: Comparison of mep predicted and actual values between normal, underweight, overweight & obese.

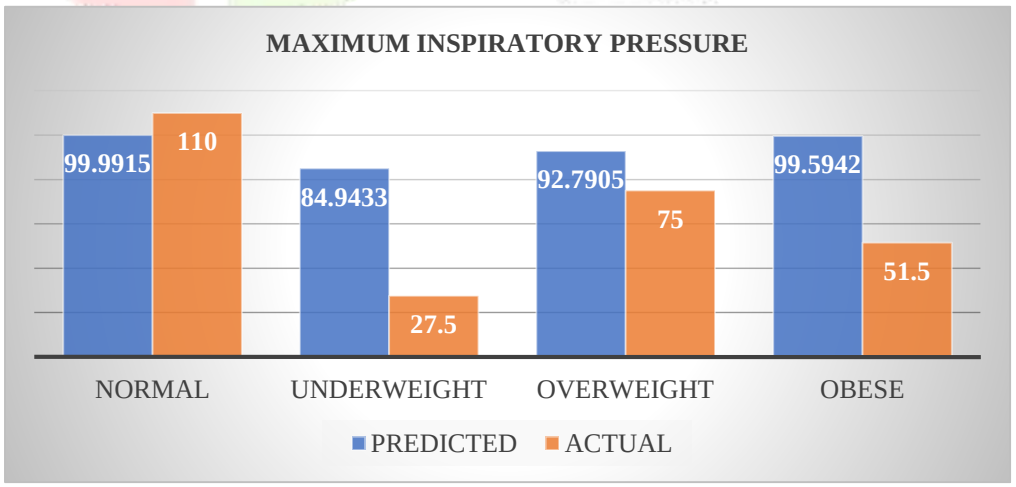

Figure 2: Comparison of mip predicted and actual values between normal, underweight, overweight & obese.

IV. DISCUSSION:

- Similar result of reduction of MIP was found by Sarikaya Selda et al in her study, she investigated the pulmonary function tests, respiratory muscle strength and endurance of subjects suffering from obesity and the effect of different categories of obesity on these parameters. She concluded subjects suffering from obesity have reduced respiratory muscle endurance and maximum inspiratory strength which support the results obtained in our study and also, she suggested that respiratory muscle training programs can be useful in obesity exercise programs.
- Similarly, Arora and Rochester assessed the respiratory muscle strength and maximum voluntary ventilation in undernourished patients and concluded that there was 60% reduction in respiratory muscle strength which was shared equally among inspiratory and expiratory muscles which support the results obtained in our study and PEmax was linearly related to body weight in undernourished individuals. The reason to it was explained as malnutrition reduces both respiratory muscle strength and maximum voluntary ventilation which impair the respiratory muscle capacity to handle increased ventilatory loads in thoracopulmonary disease.
- Also, Myra A Carpenter measured MIP in Atherosclerosis Risk in Community Study individuals by correlating the demographic and anthropometric data with Maximum Inspiratory Pressure and found a low mean PImax in individuals with higher WHR and BMI which is similar to the results found in our study. The reason to it was explained as, low MIP was due to severe obesity which leads to inspiratory muscles working inefficiently and reduction in chest wall compliance. Also, lower MIP was found in men who reported less activity during leisure time4 as compared to those who have greater physical activity.
- Karla Luciana Magnani et al evaluated the strength of the respiratory muscles in obese individuals and analysed the effect of distribution of adipose tissue. A cross sectional study was conducted within the pre-operative period before bariatric surgery and respiratory muscle strength was quantified by measuring maximum inspiratory and expiratory pressures (PImax and PEmax). Waist-hip circumference ratio (WHR) was assessed. They found that excess weight did not result in impairment of RMS, and their predominant upper-body fat distribution also did not influence RMS because obese individuals have more strength of contraction and large muscle mass than do non-obese individuals.

V. CONCLUSION:

- Therefore, the study concludes that the inspiratory muscle strength reduces in underweight and obese healthy young individuals. So clinically it is important to improve inspiratory muscle strength by inspiratory muscle strengthening exercises in order to improve the exercise endurance.

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