

# Gender-Based Comparison of Body Mass Index, Red Blood Cell Indices and Mentzers Index in Medical Students

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## ABSTRACT

**Objective:** To assess body mass index, red blood cell indices and mentzers index in medical students.

**Study design:** Comparative Cross-sectional study.

**Place and Duration of study:** This study was conducted in Physiology department of Baqai Medical University, Karachi from February 2017 to August 2017.

**Materials and Methods:** A total of 500 students were enrolled. Anthropometric measurements and Completed blood count i-e Hb%, Red Blood Cell Count, Mean Corpuscular Volume (MCV), Mean corpuscular hemoglobin (MCH), Mean corpuscular hemoglobin concentration (MCHC), Red cell distribution width (RDW) was done and Mentzer's Index were calculated. Data were analyzed by using SPSS version 22.0.

**Results:** Among the categories of Body mass index, It was seen in this study participants that only mean values of overweight, when compared in males ( $27.33\pm 1.47$ ) and females ( $26.67\pm 1.40$ ) showed statistically significant ( $p<0.05$ ) difference and mean values of hemoglobin comparison in males ( $13.75\pm 2.05$ ) and females ( $12.83\pm 1.96$ ), the mean Red Blood Cell Count comparison in males ( $5.08\pm 0.71$ ) and females ( $4.88\pm 0.75$ ), the mean Mean Corpuscular Volume comparison in males ( $81.49\pm 8.08$ ) and females ( $79.82\pm 8.81$ ) showed statistically significant ( $p<0.05$ ) difference, but mean values of Mentzer's Index comparison had showed statistically non-significant ( $p>0.05$ ) differences in this study.

**Conclusion:** With regard to our study results Body mass index (only overweight), and complete blood count (hemoglobin, red blood cell count and mean corpuscular volume) showed statistically significant values in gender based comparison. So it is considered as major issues for health of participants.

**Key Words:** Anemia; Body mass index (BMI); Obesity.

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## INTRODUCTION

Anemia is defined as a decreased concentration of blood hemo-proteins (Red Blood Cells) or low hemoglobin (Hb%) level. Anemia is considered as public health problem in the world (developing and developed countries) especially in younger generation<sup>1</sup>. Anemia mainly affects the physical activities or performances, growth, cognitive function, as well as class attendance and daily performance especially in adolescents. Adolescence is the stage of life, where rapid spurt in the growth of human body occurs that

leads to increased nutritional demand. Medical students are vulnerable to nutritional deficiencies due to sedentary life style to complete the syllabus, less time for physical exercise, hostel life and use of junk foods or improper dietary habits. It is one of the most common nutritional diseases present globally and affects 1/4<sup>th</sup> of the world's population<sup>2</sup>. BMI or Quetelet index is an independent of age and sex as it is a simple, economical and practical to assess. World Health Organization (WHO), food intake is categorized into good and poor nutrition. Good nutrition is the intake of micro and macronutrient along with any kind of regular activity and poor nutrition makes human body vulnerable to diseases, decreases immunity and decreases work performance in daily living<sup>3</sup>.

Globally, there were twice or two fold increase in the obesity from 1980 to 2014 years. In the world there were 13% of the adults belongs to obese group, of which more females (15%) as compared to males (13%)<sup>4</sup>. Overweight and obesity are linked to elevated threat of mortality<sup>5</sup>. Body mass index or Quetelet index is defined as weight (kilogram) divided by square of the height (meters square) and it is expressed as  $\text{kg}/\text{m}^2$  or

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Body mass index (BMI) is proportional to the body mass (muscle, fat, and bone) and inversely proportional to the square of the body height and it is always considered as a valid index of adiposity. Obesity is considered as a risk factor for developing anemia<sup>6,7</sup>. It is always due to energy intake greater than energy expenditure or lack. One unit increase in the BMI will increase risk of developing anemia up to 1.6- fold<sup>7</sup>. It is also reported in another study, that significant correlation exist between BMI and anemia<sup>8</sup>. This coexistence of obesity and anemia may be due to consumption of excessive energy dense food that is deficient in iron or poor source of iron<sup>9</sup> or due to decreased absorption of iron and/or poor utilization due to inflammation induced by obesity<sup>10,11</sup>. The main objective of this study was to evaluate the gender based comparison of body mass index, red blood cell indices and Mentzers index in medical students of ages between 18-25 years.

## MATERIALS AND METHODS

A Comparative, Cross-sectional study was carried out in the Department of Physiology at Baqai Medical University, over a period of 6 months in 2017. A total of 500 students (250 males & 250 females) were included in this study. All those students, who were willing and had a written consent, were enrolled in this study. Students having history of thalassemia minor or major, iron or folate or vitamin B12 treatment, Blood donation or blood transfusion in last six months, passing worms in stools, ileal surgery ( leads to vitamin B12 deficiency) and chronic diseases were excluded. Data were gathered with the help of pre-tested questionnaire. Anthropometric measurements for body mass index (BMI) were done by using Digital Scale and height was measured by measuring tape. Each student was asked to stand straight along the wall with the back towards the wall. Height was marked on the wall with a marker or pencil and the height was measured by measuring the distance between the floor and the mark. The height was taken in inches, which had been converted to meter square to calculate the Body Mass Index (BMI) in  $\text{kg}/\text{m}^2$  as per the SI unit recommendations.

The students had been divided into four groups according to the World Health Organization (WHO) criteria (Table-1)<sup>12</sup>

Three millimeter of blood had been collected in a tube containing EDTA (anticoagulant) in order to be transported to the lab. Cell Blood Count was performed by Sysmex (XS-1000i). Complete blood count will be performed as to determine and record hemoglobin levels and Red Blood Cell indices and Red cell distribution width (RDW). The Hemoglobin (Hb%) is an oxygen-binding conjugated protein, present in the cytoplasm, Hb% in range is 12-15.5gm/dl in females, and Hb% concentration in range is 14-18 gm/dl in

males. The Packed cell volume (PCV) is the volume of cellular elements, mainly Red Blood Cells (RBCs) or Hct% value and its normal values in females is about 42% and in males is about 45% respectively. This value is decreased in anaemia and increased in polycythemia. The RBC indices include the Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), Mean corpuscular hemoglobin concentration (MCHC). The Mean Corpuscular Volume (MCV) is defined as the average volume of a single Red Blood Cell (RBC), and it is calculated by dividing the hematocrit (Hct%) by red cell count, (Normal range: 80-100 fL). The MCH is the average weight of Hb% present in the erythrocyte and is calculated by dividing the Hb% by the RBC count.

Normal values of MCH are 30 and its range is 27-33 pg. The MCHC is the amount of Hb% expressed as a percentage of the volume of packed cells in 100 ml of blood and then multiplying by 100. The RDW indicates the range of variation of RBC volume; The RDW is in range of 11.5-14.5%. The RDW-CV is calculated with the following formula:

$\text{RDW-CV} = (\text{Standard deviation of MCV} \div \text{MCV}) \times 100$ .

The RBC indices provide useful information about the diagnosis of anemia and its type<sup>13</sup>. The mentzers index is calculated as MCV per red cell count and if the quotient is expressed less than 13, and then thalassemia will be most likely and if the quotient is greater than 13, then iron-deficiency anemia will be most likely. The mentzers index is used for diagnosing type of anemia.

The collected data were analyzed by using SPSS software version 22 was used for the analysis of the data and for Microsoft word and Excel had been used to generate graphs, tables etc. The descriptive statistics and inferential statistical analysis were done in this study. Mann-Whitney U Test and P- value of less than 0.05 (95% confidence level) were considered as significant. Study had been approved by Ethical committee and BAS&R of Baqai Medical University.

## RESULTS

A total of 500 students of MBBS, BDS & DPT were participated in this study. Table: 1.2. Shows the Gender-based comparison of BMI had slightly higher percentage of males 31.2% were overweight than females 26.0% and a slightly higher percentage of females 2.8% were obese than males 0.8% (Table 2).

As shown in table 3-Gender-based comparison of categories of mean values of BMI, had shown in this study participants that only mean values of overweight, when compared in males ( $27.33 \pm 1.47$ ) and females ( $26.67 \pm 1.40$ ) showed statistically significant ( $p < 0.05$ ) difference, while the BMI mean values of underweight, normal weight and obese subjects showed statistically non-significant ( $p > 0.05$ ) differences.

Table 4 Gender-based comparison of mean hematological values, had shown, the mean values of

Hb% comparison in males (13.75±2.05) and females (12.83±1.96), the mean RBC Count comparison in males (5.08±0.71) and females (4.88±0.75), the mean MCV comparison in males (81.49±8.08) and females (79.82±8.81) showed statistically significant ( $p < 0.05$ ) difference, while the mean values of MCH, mean values of MCHC, mean values of RDW and mean values of Mentzers Index comparison had showed statistically non-significant ( $p > 0.05$ ) differences.

**Table No.1: WHO criteria for BMI standard levels**

Category (Groups)	BMI(Kg/m <sup>2</sup> )
Underweight	< 18.4 Kg/m <sup>2</sup>
Normal	18.5- 24.9 Kg/m <sup>2</sup>
Overweight	25-29.9 Kg/m <sup>2</sup>
Obese	>30 Kg/m <sup>2</sup>

**Table No.2: Gender-based comparison of BMI.**

Variable	Gender			
	Male (n=250)		Female (n=250)	
	Frequ-ency	%	Frequ-ency	%
BMI				
Underweight	29	11.6%	31	12.4%
Normal Weight	141	56.4%	147	58.8%
Overweight	78	31.2%	65	26.0%
Obese	2	0.8%	7	2.8%

**Table No.3: Gender-based comparison of categories of mean BMI.**

Categories of Parameter	Gender		p-value
	Male(n=250) Mean ±S.D	Female(n=250) Mean ±S.D	
BMI			
Normal weight	22.01±1.80	21.16±2.13	0.157
Under Weight	17.19±1.07	16.90±0.99	0.128
Overweight	27.33±1.47	26.67±1.40	0.022
Obese	31.51±0.68	31.44±0.51	0.889

P-value < 0.05 significant,

P-value > 0.05 Non-significant.

**Table No.4: Gender-based comparison of Hematological means values.**

Parameters	Gender		p-Value
	Males (n=250) Mean ±S.D.	Females (n=250) Mean ±S.D.	
Hemoglobin (g/dl)	13.75±2.05	12.83±1.96	0.001
RBC Count (x 10 <sup>12</sup> /l)	5.08±0.71	4.88±0.75	0.001
MCH (pg.)	27.13±3.73	26.65±4.05	0.079
MCV (fl)	81.49±8.08	79.82±8.81	0.032
MCHC(g/dl)	34.33±21.06	32.76±2.50	0.105
RDW (%)	42.15±10.28	43.44±29.15	0.775
Mentzers Index	16.26±3.22	16.79±3.72	0.121

<sup>1</sup> Mann-Whitney U Test, P-value < 0.05 significant,

P-value > 0.05 Non-significant

## DISCUSSION

Anemia is having the global impact and it is considered as major health problem in both developed as well as in developing countries. The type of anemia can be assessed by doing simple arithmetic calculation of red blood cell indices and mentzers index. High BMI (overweight and obesity) prevalence has been observed in the world. It had been considered as an important public health problem in developed and developing countries<sup>14</sup>. Mainly it had been due to the close inter relationship between inadequate nutritional status and cardiovascular diseases, so that it was resulting in early morbidity and mortality due to coronary heart disease (CHD)<sup>15</sup>. High BMI (overweight and obesity) had been affected by genetic and environmental factors like dietary habits, for example, the preference for quick or repeated meals (snacks or junk foods and soft drinks), mostly consisting of high-calorie foods<sup>16</sup>. In our study, the evaluation of gender-based comparison of BMI and RBC indices were conducted in Students of Baqai Medical University. As we are facing the double burden of diseases, that is communicable or infective and non-communicable or non-infective in our society. Our aim was to address prevalence of non-communicable diseases like overweight or obesity, anemia and thalassemia in our society<sup>17</sup>. In our study, male and female participants were underweight [29(11.6%) vs. 31 (12.4%)], normal weight [141(56.4%) vs 147(58.8%)], overweight [78(31.2%) vs 65(26.0%)] and with obesity [2(0.8%) vs 7(2.8%)]. (Table 1.2); our results were showing that more females are underweight (12.4%), as compared to males (11.6%). Iranian study also observed that more females are underweight than males (20% vs 18.2%)<sup>18</sup>, that supports this study. Another study carried out on Indian population, also observed, that more females were underweight than males with the BMI < 18.5 kg/m<sup>2</sup><sup>19</sup>. This Indian study were also strengthens this study. These results would be attributed to physiological pubertal growth spurt in females, and had been leading to a decline in BMI in adolescence period and would suffers many psychological and physical disorders like infertility<sup>20</sup>. It had been observed in our study, that the mean Hb%, mean RBC count and the mean MCV comparison in males and females showed statistically significant ( $p < 0.05$ ) differences. (Table-1.4). It had also observed in Iranian study, that showed statistically significant ( $p < 0.05$ ) differences in mean Hb%<sup>21</sup> and another study also showed statistically significant ( $p < 0.05$ ) difference in gender -based comparison as similar results to this study, mean Hb%, RBC count<sup>22</sup>. In this study the mean RDW comparison in males (42.15±10.28) and females (43.44±29.15) and mean Mentzer Index comparison in males (16.26±3.22) and females (16.79±3.72) showed statistically non-significant ( $p > 0.05$ ) differences on

gender basis. Like this study, similar results showed statistically non-significant ( $p>0.05$ ) of mean RDW in asmarian study<sup>21</sup> and an Ethiopian study<sup>22</sup>. These studies support this study. There were differences in observation on gender basis, that had been attributed to a multiple factors including: menstruation; is a period of intense activity in girls and may alter the autonomic nervous system due to intense hormonal production<sup>23</sup>, hormonal influences of estrogens and androgen (testosterone) on erythropoiesis, and the relatively high prevalence of iron deficiency anemia in women<sup>24-25</sup>.

## CONCLUSION

It is an essential for us to find ways to alleviate the burden of non-communicable diseases like obesity, anemia and thalassemia worldwide, and to strive against malnutrition and thalassemia.

**Recommendations:** Lifestyle modification, dietary modification, promotion of physical activities and use of fruits in diet. Regular BMI, anaemia and thalassemia screening programs should be launched in society.

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### Author's Contribution:

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