e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(6); 572-576

Original Research Article

Relationship Between Haematological Profile and Body Mass Index in Adults: A Cross-Sectional Study

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Received: 25-01-2024 / Revised: 23-02-2024 / Accepted: 26-03-2024
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Conflict of interest: Nil

Abstract:

Background: Obesity is a serious global public health concern that has been linked to several health problems. The purpose of this study was to evaluate the association between adult population BMI and haematological profile.

Methods: 200 participants were included in this study, 100 of whom were females and 100 of whom were males, and their age range was between 18 to 30. This study was conducted from July 2023 to December 2023 at the Department of Physiology, ESIC Medical College, Bihta, Patna, Bihar, using a cross-sectional study design. A 10-milliliter venous blood sample was taken from the antecubital vein using aseptic precautions, and it was subsequently transferred to an EDTA tube. The Sysmex Haematology Analyser was then used to measure haematological parameters such as PCV, hemoglobin concentration, RBC, and WBC count. The participants were divided into four groups: underweight, normal, overweight, and obese. Using ANOVA, statistical significance was ascertained. The significance of the results was assessed using the Scheffe post-hoc test, and the link between the variables was ascertained using Pearson correlation. Data was analysed using SPSS software and presented as mean±standard deviation. Values of $P \leq 0.05$ were considered significant.

Result: According to our study, PCV is statistically higher in overweight and obese people than in people with other BMI categories in both males and females. When compared to normal subjects, the total leucocyte count was considerably greater in overweight and obese subjects. All BMI categories showed no change in hemoglobin concentration or red blood cell count.

Conclusion: In contrast to underweight and normal weight BMI categories, we found in our study that leucocytosis and increased PCV were present in overweight and obese person groups. The total leucocyte count and BMI have a direct positive association. Among all BMI groups, there is no statistically significant difference in the haemoglobin concentration and RBC count. Young people need to be encouraged to lead stress-free lives, engage in regular exercise, eat healthily, and have a healthy lifestyle.

Keywords: Body mass index, PCV, Haemoglobin concentration, RBC, WBC.

Introduction

Obesity is a major public health concern since it affects 13% of adults worldwide [1]. A number of health problems, including type 2 diabetes, cardiovascular disease, and several malignancies, are associated with obesity [2]. It is generally accepted that an imbalance in energy intake and expenditure is the cause of obesity, despite the complexity of its etiology. Recent research indicates that obesity may also affect the haematological profile, which includes hemoglobin, red blood cell count, WBC count, platelet count, and mean corpuscular volume [3-5]. Oxygen is carried to human tissues by a protein called "hemoglobin (Hb)" that is present in red blood cells. Numerous studies have shown that obese individuals have higher Hb levels than non-obese individuals [6–9]. The reason for this has been ascribed to increased erythropoiesis in reaction to hypoxia caused by unhealthy adipose tissue[10]. The association between Hb and BMI is currently unknown, so more research is needed to determine whether Hb might serve as a biomarker for health problems related to obesity. The red blood cell count indicates how many red blood cells are present in the blood. Numerous studies have found a favorable correlation between red blood cell count and BMI [11–13].

However, the actual mechanism of this relationship remains unknown. One possibility is that increased adipose tissue stimulates the production of the hormone erythropoietin, which boosts the production of red blood cells [14]. Alternatively, it has been suggested that the relationship between red blood cell count and BMI may be due to inflammation, which is known to be associated with obesity [15]. The WBC count indicates how many white blood cells are present in the blood. Obesity is known to be associated with chronic low-grade inflammation, which can increase the WBC count[16,17].

There is currently no known cause for the association between WBC count and BMI, which has been shown in some study [18–20]. The platelet count, which indicates how many platelets are present in a specific volume of blood, is routinely measured as part of a "complete blood count (CBC)" test. The typical range for platelet count is thought to be between 150,000 and 450,000 platelets per microliter of blood [6]. Blood coagulation and bleeding prevention depend on platelets, which are tiny, disc-shaped blood cells. After being produced in the bone marrow, they are sent into the bloodstream and remain there for a week or ten days [7].

An elevated platelet count, also known as thrombocytosis, can indicate several medical conditions, such as cancer, blood disorders, inflammation, and infections. Conversely, thrombocytopenia, or a low platelet count, can result from medications, autoimmune disorders, infections, or issues with the bone marrow. With varied degrees of success, numerous research studies have looked at the relationship between platelet count and BMI. A substantial correlation between platelet count and BMI has been observed in certain research, but not in others [8,9]. Similarly, the relationships between certain hematological variables, such as the count of "white blood cells (WBC)," Hb level, and body mass index (BMI), are also being debated [10,11].

ln order to gain a better understanding of the connection between BMI and other hematological parameters in an adult sample, including platelet count, WBC count, and Hb level. The diagnosis and treatment of obesity-related health problems can be greatly impacted by an understanding of the relationships between these components.

Materials and Methods

200 participants were included in this study. There were 100 males and 100 female in the 18–30 age range. This cross-sectional study took place from July 2023 to December 2023 at the Department of Physiology, ESIC, Bihta, Patna, Bihar. Every subject gave their informed consent.

Excluded from the study were those whose answers to a well-structured questionnaire indicated that they were smokers, drinkers, pregnant, known diabetics, with endocrine disorders, peptic ulcers, HIV/AIDS, hypertension, or on medication for any of these conditions.[1]

10 ml of blood was drawn from the antecubital vein using aseptic precautions, and it was then transferred to an EDTA tube. The Sysmex Haematology Analyser was then used to obtain the whole haematological profile.

A weighing machine was used to determine the subject's weight in kilograms (kg). Without shoes, the subject's height was measured in centimeters. The formula for calculating BMI was to divide weight in kilograms by height in meters square(kg/m^2).

Adults can be categorized as underweight, overweight, or obese using the BMI, a straightforward weight-to-height index. It is calculated as follows: kg/m^2, which is the weight in kilograms divided by the height in meters squared.

WHO classification of BMI:

- BMI <17.0: thinness
- BMI <18.5: underweight
- BMI 18.5-24.9: normal weight
- BMI ≥25.0: overweight
- BMI ≥30.0: obesity.

The participants were divided into four groups: underweight, normal, overweight, and obese. Using ANOVA, statistical significance was ascertained. The significance was ascertained using the Scheffe post-hoc test, and the link between the variables was ascertained using Pearson correlation. SPSS software was used to analyze the data, which was then shown as mean±standard deviation. P-values less than 0.05 were regarded as significant.

Results

According to our study, PCV is statistically higher in overweight and obese people than in people with other BMI categories in both males and females. When compared to normal patients, the total leucocyte count was considerably greater in overweight and obese subjects. All BMI categories showed no change in hemoglobin concentration or red blood cell count.

Table 1: Haematological parameters of the study population according to body mass index (kg/m^2)

Parameters	Underweight N=13	Normal N=117	Overweight N=47	Obese N=23	P value
PCV (%)	43.8±0.51	43.2±0.38	45.1±0.21	45.9±1.29	0.547
Haemoglobin Concentration (g/dl)	13.6±1.94	13.6±1.23	13.7±1.65	13.6±2.43	0.547
RBC Count (x10$^6\mu$L)	4.9±0.003	4.7±0.21	4.8±0.34	4.9±1.23	0.547
WBC count (x10$^3\mu$L)	5.1±1.2	5.2±0.21	5.5±2.3	5.7±3.2	0.675

Table 2: Haematological parameters in males and in females according to body mass index (kg/m^2) class

Parameters Male	Underweight N= 08	Normal N=55	Overweight N=22	Obese N=15	P value
PCV (%)	44.3±0.12	44.5±0.87	47.5±0.12	48.5±0.45	0.547
Haemoglobin Concentration (g/dl)	14.4±1.26	14.3±1.34	14.2±2.23	13.6±2.65	0.234
RBC Count (x10$^6\mu$L)	5.5±1.87	5.6±2.23	5.7±1.45	5.8±1.25	0.456
WBC count (x10$^3\mu$L)	5.2±3.43	5.1±1.23	5.8±0.87	6.4±0.23	0.231
Parameters Female	**Underweight N= 05**	**Normal N=62**	**Overweight N=25**	**Obese N=08**	**P value**
PCV (%)	42.6±1.23	43.5±2.23	45.7±1.26	46.2±2.35	0.654
Haemoglobin Concentration (g/dl)	12.5±1.23	12.3±1.45	12.8±3.23	12.9±2.24	0.456
RBC Count (x10$^6\mu$L)	4.5±1.23	4.3±2.25	4.4±1.87	4.5±2.3	0.657
WBC count (x10$^3\mu$L)	4.5±2.34	4.7±1.45	5.1±2.34	5.4±1.34	0.345

Discussion

In our study, we discovered a statistically significant rise in the WBC count in both male and female participants who were overweight and obese. It can be caused by adipocyte hypertrophy and hyperplasia, which releases inflammatory leucocytes.[21] Increased white blood cell counts in obese people are indicative of an inflammatory process that may contribute to many disorders such as obesity, atherosclerosis, and other cardiovascular conditions.

It may even suggest the onset of metabolic syndrome in obese subjects. [21]

According to earlier research, obese people had worse bacterial clearance after infections and poorer granulopoiesis, making them more prone to infections.[22] These could point to a detrimental impact of obesity and overweight on immunity and infection defense.[23]

WBC count has been proposed as a useful technique for detecting overweight children who are at risk of overweight/obesity consequences since it may be linked to the development of dysregulated glucose metabolism as well as early symptoms of liver and vascular damage.[24] Obesity has been linked to changes in leukocyte formation and activity as well as disruptions in lymphoid tissue integrity, according to recent studies.[25]

In addition, we found that, in comparison to other BMI groups, there is higher PCV in the overweight and obese groups in both male and female participants. Obesity-related increases in PCV are a significant risk factor for the development of heart disease and stroke.[26] The most crucial metric for estimating blood viscosity is PCV.

Blood viscosity is a reliable predictor of vascular hazards, and higher blood viscosity is known to be correlated with higher BMI.[27] Consequently, the greater PCV seen in the study's obese male participants may indicate a higher risk of cardiovascular disease. Furthermore, the noteworthy correlation found between BMI and PCV may provide additional evidence for the potential alterations in PCV that coincided with elevated BMI.[28]

RBC count and Haemoglobin concentration between all BMI groups shows no statistical significance.

Conclusion

In contrast to underweight and normal weight BMI groups, we found leucocytosis and increased PCV in the overweight and obese person groups in our study. The total leucocyte count and BMI have a direct positive association.

Among all BMI groups, there is no statistically significant difference in the haemoglobin concentration and RBC count. Young people need to be encouraged to lead stress-free lives, engage in regular exercise, eat healthily and have a healthy lifestyle.

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