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ASSOCIATION OF WHITE BLOOD CELL AND PLATELET INDICES WITH BODY MASS INDEX AMONG FEMALE UNIVERSITY UNDERGRADUATES IN SRI LANKA

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Obesity is a significant health concern among young adults, yet its impact on haematological parameters in young individuals remains underexplored. The present study found that a higher body mass index (BMI) was linked to increased white blood cell (WBC) count and platelet indices, along with a decreased eosinophil percentage, suggesting obesity-related haematological alterations even in healthy undergraduates. This cross-sectional study was conducted among 91 healthy females aged 18-25 after obtaining ethical approval from the Ethics Review Committee of the Institute of Biology, Sri Lanka (ERC IOBSL 380/11/2024). Participants were required to complete a self-administered questionnaire to select healthy individuals without a diagnosed chronic illness. Participants were excluded if they smoked, consumed alcohol, were pregnant, recently ill, had haematological disorders, donated blood within the last six months, or used medications/supplements affecting haematological parameters. Anthropometric measurements were employed to calculate BMI. Height was recorded using a standard stadiometer, with participants standing upright, their heels, hips, and head aligned against the measuring surface. Body weight was assessed using a calibrated electronic scale. Participants were divided into four groups according to Asian BMI classification: underweight (BMI < 18.5kg/m2), normal weight (BMI=18.5-22.9 kg/m2), overweight (BMI=23.0-24.9 kg/m2) and obese (BMI ≥ 25.0 kg/m2). The full blood count analysis was performed using an automated haematology analyser (Mindray BC-20, Shenzhen, China). Correlation analysis was performed using Pearson or Spearman coefficients, with $p < 0.05$ considered statistically significant. Statistically significant positive correlations were observed between BMI and total WBC ($r = 0.434$, $p \leq 0.0001$), absolute granulocyte count ($r = 0.362$, $p = 0.0001$), platelet count (PLT) ($r = .326$, $p = 0.002$), and plateletcrit (PCT) ($r = 0.383$, $p = 0.000$), whereas eosinophil percentage showed a significantly negative association ($r = -0.272$, $p = 0.009$). Several WBC and platelet indices, including absolute lymphocyte count ($r = 0.032$, $p = 0.763$), monocyte percentage ($r = -0.187$, $p = 0.077$), mean platelet volume ($r = 0.002$, $p = 0.982$), and platelet distribution width ($r = 0.048$, $p = 0.653$), did not demonstrate statistical significance with the BMI. Future research should explore causal relationships between BMI and haematological alterations in more diverse populations. Therefore, the present study contributes to understanding obesity induced haematological alterations and provides a basis for future longitudinal investigations.

Keywords: body mass index, platelet count, white blood cell count

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INTRODUCTION

Haematological dysregulation associated with obesity is a prevalent concern in young adults (Lampignano et al., 2020). Recent studies have highlighted its significant impact on systemic inflammation and haematological alterations (Nishi et al., 2021). Despite these insights, the intricate relationship between body mass index (BMI) and haematological parameters, specifically among young, healthy individuals, remains incompletely understood, emphasising the necessity of further investigation to clarify the underlying pathophysiological mechanisms (Lampignano et al., 2020). This study aims to determine the association between white blood cell (WBC) and platelet indices with BMI among female university undergraduates in Sri Lanka. By examining the correlations between BMI and haematological parameters, this research aims to elucidate potential haematopoietic alterations associated with body composition, thereby contributing to a more nuanced understanding of haematological dysregulation induced by obesity. The findings of this study could offer valuable insights into the early haematological perturbations associated with increased BMI, potentially informing preventative strategies aimed at mitigating obesity-related health risks.

METHODOLOGY

This cross-sectional study was conducted in adherence to rigorous ethical standards, having received formal ethical approval from the Ethics Review Committee of the Institute of Biology, Sri Lanka (ERC IOBSL 380/11/2024). The sample size (N = 88) was calculated using Fisher's transformation, based on an anticipated correlation of 0.339, $\alpha = 0.05$, $\beta = 0.2$, and 80% power to detect significance (Sb et al., 2013). Participants were required to complete a self-administered questionnaire, which was used to identify individuals who met the inclusion criteria and to exclude those not eligible for the study. The inclusion criteria for the study, the participants encompassed female undergraduate students currently enrolled at NSBM Green University, aged 18-25 years, and healthy individuals without a diagnosed chronic illness. Participants were excluded if they exhibited any of the following characteristics such as smoking or alcohol consumption, pregnancy or a history of recent illness/infection within the past few months that could impact haematological indices, known haematological disorders or recent blood donation within the last six months, current use of medications influencing haematological parameters, such as folate, vitamin B12, or iron supplements and non-consent to participate in the study.

Height (in cm) and weight (in kg) were recorded using a stadiometer and an electronic scale, respectively. BMI was subsequently calculated using the standard formula: BMI = weight (kg)/height (m^2). Participants were then categorized into four groups based on Asian BMI classification: underweight (<18.5 kg/m^2), normal (18.5-22.9 kg/m^2), overweight (23-24.9 kg/m^2), and obese (>25 kg/m^2) (Lim et al., 2017). Venous blood (3 ml) was collected by an SLMC-registered Medical Laboratory Scientist (Reg. No. 3727) and analysed by using a three-part automated haematology analyser (Mindray BC-20, Shenzhen, China). Leishman-stained blood smears were used to quantify WBC indices including total WBC count, absolute lymphocyte count (Lymph#), absolute granulocyte count (Gran#), lymphocyte percentage (Lymph%), granulocyte percentage (Gran%), neutrophil percentage (Neut%), eosinophil percentage (Eo%), and monocyte percentage (Mono%) and platelet parameters including platelet count (PLT), mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT).

The Statistical Package for the Social Sciences (SPSS) software (version 25.0) was used to analyze the data. The descriptive statistics have been presented as mean ± standard deviation (SD). Normality was assessed via the Shapiro-Wilk test. Correlations between BMI and haematological indices were examined using Pearson's or Spearman's methods, and group differences were evaluated through one-way ANOVA with Tukey post-hoc testing. Statistical significance was set at $p < 0.05$.

RESULTS AND DISCUSSION

The total WBC count revealed a statistically significant positive correlation with BMI, where Pearson's correlation coefficient (r) was 0.434, while the p-value was 0.000. This indicates that the higher total WBC counts were observed with increasing BMI among participants.

A significant positive correlation was observed between the Gran# and BMI ($r = 0.362$, $p = 0.000$), demonstrating that as the BMI increases, a higher granulocyte count can be observed.

Eo% exhibited a statistically significant negative correlation with BMI ($r = -0.272$, $p = 0.009$). This inverse relationship demonstrates that individuals with higher BMI tend to have lower eosinophil levels on average.

A significant positive association was detected between PLT and BMI ($r = 0.326$, $p = 0.002$), suggesting that individuals with increased BMI values have elevated platelet counts. PCT also exhibited a significant positive correlation with BMI ($r = 0.383$, $p = 0.000$), indicating that when the participant's BMI increased, higher PCT levels can be observed.

Conversely, several WBC and platelet indices were not significantly associated with BMI. There was no statistically significant association between Lymph# and BMI ($r = 0.032$, $p = 0.763$), while Lymph% also failed to achieve statistical significance (r =

-0.134, p = 0.205). Similarly, there was no significant correlation between Mono% and BMI (r = -0.187, p = 0.077). Additionally, Neut# also remained non-significant with BMI (r = 0.135, p =0.202). Furthermore, indices reflecting platelet morphology and variability, such as MPV (r = 0.002, p = 0.982) and PDW (r = 0.048, p = 0.653), also did not significantly correlate with BMI.

These results demonstrate distinct variations in WBC and platelet indices among female undergraduates across different BMI categories, suggesting quantifiable haematological alterations associated with BMI. A study conducted by Lampignano et al. (2020) demonstrated that total WBC count was significantly positively associated with BMI (r = 0.02, p = 0.01) by considering 840 females between 14 to 74 years (Lampignano et al., 2020). Similar studies reported a significant positive association between total WBC count and BMI (Puspasari et al., 2020, Yang et al., 2017, Ren et al., 2023). This association corroborates that the higher BMI is associated with chronic low-grade inflammation, where adipose-derived cytokines like interleukin-6 (IL-6) and tumour-necrosis factor-α (TNF-α) stimulate bone marrow activity and enhance WBC synthesis (Lampignano et al., 2020). Excess adipose tissue secretes pro-inflammatory cytokines, leading to increased granulocyte production as part of the body's immune and inflammatory response (Raghavan et al., 2016). The findings of the present study reinforce this pathophysiological basis, indicating a significantly positive correlation between Gran# and BMI. In the study conducted by Anik et al. (2021), Gran# was significantly positively associated with BMI, which strengthens the present study results (Anık et al., 2021).

In addition to WBC indices, PLT also demonstrated a significant positive correlation with BMI in the present study. Evidence from Takaya et al. (2024) supports this observation, providing a statistically significant correlation between PLT and BMI (r = 0.392, p = 0.0026) (Takaya et al., 2024). In another study, the PLT markedly increased among the categories of higher BMI (Lampignano et al., 2020). A study conducted among populations in Central China showed that PLT has a significant positive correlation with BMI (Yang et al., 2017). These findings affirm that obesity-induced inflammation and endothelial activation are involved in promoting thrombopoiesis, resulting in elevated platelet counts in individuals with higher BMI. This pattern of positive correlation continued with PCT, which also showed a statistically significant positive correlation with BMI in the present study and is supported by previous literature (Goudswaard et al., 2022, Ren et al., 2023). The pathophysiological basis underpinning this association is that the increased BMI enhances both platelet number and volume, contributing to a higher PCT due to amplified hematopoietic and inflammatory signals (Kuzu & Ertugrul, 2019).

The present study revealed a weakly negative but significant correlation between BMI and Eo%. This finding, however, contradicts the previous investigations that showed a significantly positive correlation between BMI and Eo% (Amini et al., 2016, Nishi et al., 2021). This inconsistency highlights a potential conflict in the current understanding of the relationship between BMI and Eo%, warranting further investigation. Variations in study populations, methods, or underlying clinical

conditions may account for the observed disparities, emphasising the need for more accurate, stratified investigations to clarify the pathophysiological justifications underlying this association.

Additionally, the findings of the present study revealed that certain haematological indices did not exhibit a statistically significant correlation with BMI. Similar to the present study, several other studies have reported the absence of a significant association between PDW, Mono%, MPV, Lymp#, and BMI (Nishi et al., 2021; Koca, 2017; Ren et al., 2023). Furthermore, a significant association was not observed between Neut# and BMI, which is supported by the previous studies (Koca, 2017; Yang et al., 2017).

CONCLUSIONS/ RECOMMENDATIONS

This study reveals significant correlations between elevated BMI and haematological indices, highlighting early immuno-haematological changes in young females. These findings encourage the inclusion of haematological profiles in obesity risk assessment and early prevention strategies.

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