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Hematological Responses to Academic Stress: Variations in Complete Blood Count Parameters Among Third-Year BSMLS Students

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ABSTRACT

Academic stress affects students psychologically and physiologically, particularly in health-related programs that require intensive academic and laboratory work. This study examined hematological responses to academic stress among third-year Bachelor of Science in Medical Laboratory Science (BSMLS) students at Lyceum of the Philippines University-St. Cabrini during the second semester of Academic Year 2025-2026. A one-group pretest-posttest quasi-experimental design was used. Twenty eligible BSMLS students underwent Depression Anxiety Stress Scales-21 (DASS-21) assessment and complete blood count (CBC) testing during low-stress and high-stress academic periods. CBC parameters included hemoglobin, hematocrit, red blood cell count, red blood cell indices, total white blood cell count, differential count, and platelet count. Data were analyzed using descriptive statistics, paired t-test, Shapiro-Wilk normality testing, and Pearson correlation. Results showed that students experienced mild stress during both low-stress (M = 18.10, SD = 7.99) and high-stress (M = 17.40, SD = 8.39) periods, with no significant difference in DASS-21 scores. Most CBC values remained within normal clinical ranges; however, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin concentration, and neutrophils showed statistically significant changes between low- and high-stress periods. No significant correlations were found between DASS-21 scores and CBC parameters during either period. The findings suggest that academic stress among BSMLS students may produce subtle hematological adaptations without overt pathological change. The study supports the relevance of CBC parameters as practical indicators of physiological stress responses and highlights the need for sustained stress management programs in allied health education.

Keywords: *academic stress, complete blood count, hematological response, BSMLS students, DASS-21, psychoneuroimmunology*

INTRODUCTION

Academic stress is a multidimensional condition that affects students cognitively, emotionally, behaviorally, and physiologically. In health-related programs, stress is intensified by heavy academic workload, frequent examinations, laboratory requirements, and high expectations for technical competence. Bachelor of Science in Medical Laboratory Science (BSMLS) students are particularly exposed to these pressures because they must master theoretical concepts while developing accuracy and proficiency in laboratory procedures. Stress physiology explains that academic pressure may activate the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis. These systems stimulate cortisol and catecholamine release, which can influence immune cell distribution, platelet activity, and selected blood indices. Because the complete blood count (CBC) is a routine laboratory test, it offers a practical way to observe possible physiological responses to stress through parameters

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such as white blood cell count, differential count, red blood cell indices, and platelet count. Previous studies have reported stress-related increases in neutrophils and platelets and reductions in lymphocytes during examination periods. However, findings remain inconsistent across populations and academic contexts. In the Philippine setting, localized evidence on hematological responses to academic stress remains limited, particularly among BSMLS students. This gap is important because cultural expectations, academic systems, student coping styles, and laboratory training demands may shape stress responses differently from those reported in international studies.

This study therefore investigated hematological responses to academic stress among third-year BSMLS students at Lyceum of the Philippines University-St. Cabrini. Specifically, it compared DASS-21 stress scores and CBC parameters during low- and high-stress academic periods and examined the relationship between psychological stress scores and hematological indices. The study contributes localized evidence on stress physiology in medical laboratory science education and provides a basis for stress monitoring and student well-being interventions.

Operational Framework

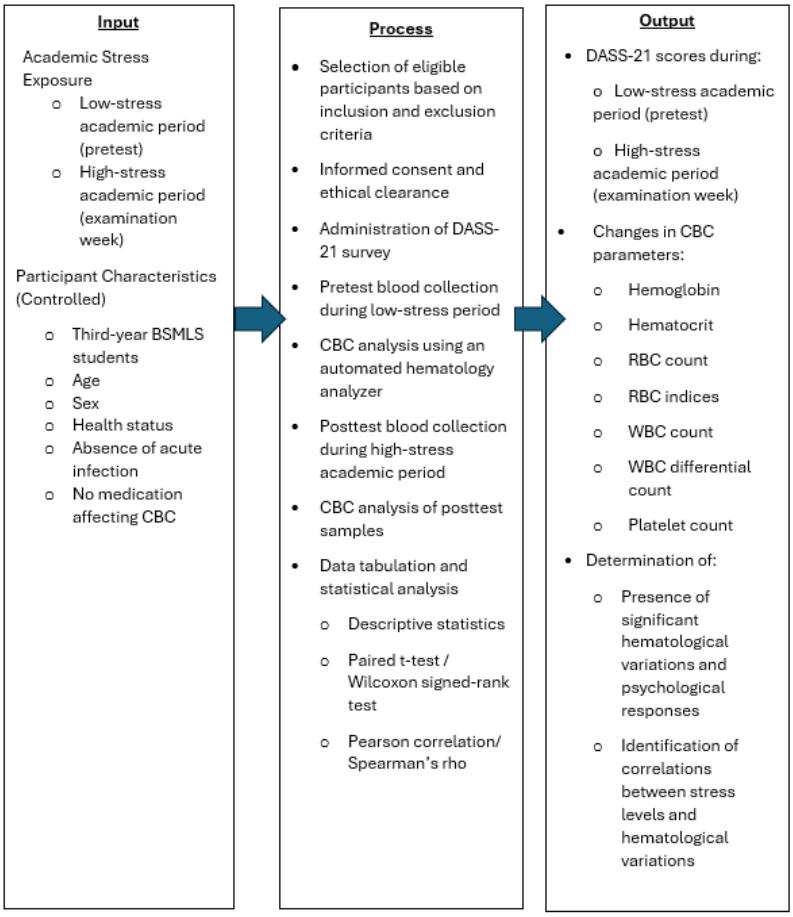

Figure 1. *Operational Model of the Study*

The operational framework shows that academic stress exposure and participant characteristics served as inputs, while DASS-21 administration, blood collection, CBC testing, and statistical analysis formed the process. The expected outputs included DASS-21 scores, CBC variations, and the determination of significant hematological and psychological responses.

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Literature Review

Academic Stress in Allied Health Students

Academic stress is consistently reported among students in medicine, nursing, medical laboratory science, and other allied health programs. Common stressors include examinations, clinical or laboratory tasks, intensive coursework, limited preparation time, and high expectations for academic performance. Studies among health science students show that stress can affect academic engagement, coping, sleep quality, emotional functioning, and overall well-being (Granizo et al., 2024; Labrague, 2024; Velando-Soriano et al., 2023).

BSMLS students experience a unique form of stress because their training combines theoretical knowledge, laboratory accuracy, specimen handling, and professional readiness. Local and international studies suggest that academic stress is common among health science students, but objective physiological assessment remains less frequently explored than psychological assessment. This makes CBC-based investigation relevant to the medical laboratory science field.

Stress Assessment Using DASS-21

The Depression Anxiety Stress Scales-21 (DASS-21) is widely used to measure psychological distress among students. It assesses depression, anxiety, and stress, and its stress subscale has been applied in academic and health education contexts. Recent studies using DASS-21 have shown that examination periods and clinical requirements can elevate stress scores among medical, nursing, and allied health students (AlAteeq et al., 2024; Cheung et al., 2023; Ramos et al., 2024). In the present study, DASS-21 served as the psychological measure paired with CBC testing.

Physiological and Hematological Mechanisms of Stress

Selye's General Adaptation Syndrome and Psychoneuroimmunology Theory provide the biological foundation of this study. Academic stress may activate the HPA axis and sympathetic nervous system, producing cortisol and catecholamine responses that affect leukocyte movement, platelet mobilization, and inflammatory signaling. Acute stress is commonly associated with neutrophil mobilization, while prolonged stress may contribute to lymphocyte redistribution and immune modulation (Dhabhar, 2014; Hasty & Rivera-Chavez, 2024; Obeagu, 2025).

CBC Variations During Academic Stress

Research on academic stress has documented measurable changes in CBC parameters, although results vary. Some studies report neutrophilia, lymphocyte reduction, increased platelet activity, or changes in red cell indices during examination periods (Alhmoud et al., 2020; Al-hatamleh et al., 2019; Maes et al., 1998; Sheikh et al., 2024). Other studies show modest or non-significant changes, suggesting that individual coping, academic adaptation, health status, and stress severity may influence hematological response. These inconsistencies justify the need for localized and discipline-specific studies among Filipino BSMLS students.

METHODS

Research Design

The study employed a one-group pretest-posttest quasi-experimental design. This design was appropriate because academic stress was a naturally occurring exposure that could not be ethically manipulated. The same participants were assessed during a low-stress academic period and again during a high-stress period, allowing each student to serve as their own control.

Research Locale and Participants

The study was conducted among third-year BSMLS students at Lyceum of the Philippines University-St. Cabrini, Calamba City, Laguna, during the second semester of Academic Year 2025-2026. The population consisted of 45 third-year BSMLS students. After applying inclusion and exclusion criteria, 20 physically healthy

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students who provided informed consent were included. Students with known hematological disorders, acute infections, chronic illness, or medication use that could affect CBC results were excluded.

Research Instruments

Two main instruments were used. First, a structured Google Forms questionnaire collected participant information and administered the DASS-21 during both stress periods. Second, an automated hematology analyzer measured CBC parameters, including hemoglobin, hematocrit, RBC count, RBC indices, WBC count, differential count, and platelet count. The analyzer was maintained and quality-controlled according to laboratory standards.

Data Gathering Procedure

After institutional approval and informed consent, data collection was conducted in two phases. During the low-stress period, students completed the DASS-21 and provided venous blood samples. The same procedure was repeated during the midterm examination week, representing the high-stress period. Blood was collected using standard phlebotomy procedures into EDTA tubes, properly labeled, transported, and analyzed using an automated hematology analyzer. CBC and DASS-21 results were encoded and secured for analysis.

Data Analysis

Frequency and percentage were used to describe DASS-21 classifications. Mean and standard deviation summarized CBC and DASS-21 values. Shapiro-Wilk testing assessed normality. Paired t-test determined significant differences between low- and high-stress values. Pearson correlation examined relationships between DASS-21 scores and CBC parameters. The level of significance was set at 0.05.

Ethical Consideration

Participation was voluntary and based on informed consent. Respondents were informed of the purpose, procedures, and confidentiality measures of the study. Health-related information and laboratory results were handled with privacy and stored securely. Students who did not meet health criteria were excluded to protect participant safety and preserve the validity of the hematological findings.

RESULTS AND DISCUSSION

DASS-21 scores During Low and High Academic Stress Periods

Table 1. *DASS-21 scores of Third-Years BSMLS Students During Low and High Academic Stress Periods*

DASS-21 Classification	Low Stress f	Low Stress %	High Stress f	High Stress %
Normal (0-14)	6	30.00	9	45.00
Mild (15-18)	5	25.00	3	15.00
Moderate (19-25)	4	20.00	3	15.00
Severe (26-33)	5	25.00	4	20.00
Extremely Severe (34+)	0	0.00	1	5.00
Total	20	100.00	20	100.00
Mean ± SD	18.10 ± 7.99	Mild	17.40 ± 8.39	Mild

The DASS-21 results showed that students experienced mild stress during both periods. During the low-stress period, 70% of students reported some level of distress, while during the high-stress period, 55% reported distress. Although the proportion of students in the normal category increased during the high-stress period, one student reached the extremely severe category, showing variability in stress response. These findings suggest that stress among BSMLS students is not limited to examination week. Personal coping styles, academic adaptation,

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family expectations, and non-academic concerns may sustain psychological stress even during regular academic periods.

CBC Parameters During Low Academic Stress Period

Table 2. CBC Parameters of Third-Year BSMLS Students During Low Academic Stress Period

Parameter	Mean	Standard Deviation
WBC	8.22	1.85
RBC	4.97	0.49
HGB	131.45	16.36
HCT	40.73	3.87
MCV	82.44	8.86
MCH	39.19	56.57
MCHC	32.21	1.57
PLT	338.15	81.73
NEUT	55.83	5.85
LYMPH	31.96	4.66
MONO	17.95	32.78
EO	3.38	2.47
BASO	0.62	0.23

CBC values during the low-stress period generally reflected hematological stability. WBC, RBC, hemoglobin, hematocrit, platelet count, and differential values were within normal physiological expectations. This suggests that during periods with minimal academic demands, students maintained immune and hematopoietic equilibrium. The variability in monocytes and MCH may be related to individual physiological differences, but the overall pattern indicates stable baseline functioning.

CBC Parameters During High Academic Stress Period

Table 3. *CBC Parameters of Third-Year BSMLS Students During High Academic Stress Period*

Parameter	Mean	Standard Deviation
WBC	8.03	1.89
RBC	5.06	0.54
HGB	133.6	18.35
HCT	41.84	4.42
MCV	83.03	8.61
MCH	26.53	3.7
MCHC	31.83	1.46
PLT	355.5	71.41
NEUT	58.27	6.09
LYMPH	31.41	5.37

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MONO	6.38	1.44
EO	3.39	2.64
BASO	0.56	0.18

During the high-stress period, CBC values remained within clinically acceptable ranges but showed trends consistent with stress adaptation. Neutrophils increased, lymphocytes slightly decreased, and platelets rose modestly. These patterns are consistent with stress-induced immune redistribution, where sympathetic activation and cortisol influence leukocyte circulation and platelet mobilization. The findings do not indicate disease, but they demonstrate that academic stress may produce measurable physiological adjustments.

Difference in DASS-21 Scores Between Stress Periods

Table 4. *Difference in DASS-21 scores During Low and High Academic Stress Periods*

Indicator	Mean	t-test	p-value	Interpretation
Low academic stress period	18.1	0.429	0.673	Not Significant
High academic stress period	17.4			

The difference in DASS-21 mean scores was not statistically significant. This indicates that psychological stress did not increase significantly during the examination period. The result may suggest the presence of coping mechanisms, academic adaptation, or continuous baseline stress even during low-stress periods. Clinically, however, the persistence of mild stress remains meaningful because repeated or chronic mild stress may still activate physiological pathways over time.

Hematological Differences Between Low and High Stress Periods

Table 5. *Hematological Difference Between Low and High Academic Stress Periods*

Parameter	Low Mean	High Mean	t-test	p-value	Interpretation
WBC	8.22	8.03	0.603	0.554	Not Significant
RBC	4.97	5.06	-1.764	0.094	Not Significant
HGB	131.45	133.6	-1.669	0.112	Not Significant
HCT	40.73	41.84	-2.647	0.016*	Significant
MCV	82.44	83.03	-3.549	0.002*	Significant
MCH	39.19	26.53	1.009	0.326	Not Significant
MCHC	32.21	31.83	2.671	0.015*	Significant
PLT	338.15	355.5	-1.74	0.098	Not Significant
NEUT	55.83	58.27	-2.298	0.033*	Significant
LYMPH	31.96	31.41	0.578	0.57	Not Significant
MONO	17.95	6.38	1.604	0.125	Not Significant
EO	3.38	3.39	-0.044	0.965	Not Significant
BASO	0.62	0.56	1.207	0.242	Not Significant

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Four parameters showed significant changes between low- and high-stress periods: hematocrit, MCV, MCHC, and neutrophils. The rise in neutrophils is particularly relevant because neutrophil mobilization is a common acute stress response. The increase in hematocrit and MCV and decrease in MCHC suggest subtle erythrocytic adjustments during stress exposure. Although these changes were statistically significant, the values remained within normal clinical limits, indicating adaptive physiological response rather than pathology.

Relationship Between DASS-21 Scores and CBC Parameters

Table 6. *Relationship Between DASS-21 Score and CBC Parameters During Low Academic Stress Period*

CBC Parameter	Pearson r	p-value	Interpretation
WBC	-0.093	0.698	Not Significant
RBC	-0.181	0.444	Not Significant
HGB	-0.149	0.532	Not Significant
HCT	-0.166	0.484	Not Significant
MCV	0.029	0.905	Not Significant
MCH	0.231	0.327	Not Significant
MCHC	-0.051	0.83	Not Significant
PLT	-0.038	0.874	Not Significant
NEUT	0.368	0.111	Not Significant
LYMPH	-0.252	0.285	Not Significant
MONO	-0.124	0.602	Not Significant
EO	-0.158	0.507	Not Significant
BASO	-0.058	0.808	Not Significant

Table 7. *Relationship Between DASS-21 Score and CBC Parameters During High Academic Stress Period*

CBC Parameter	Pearson r	p-value	Interpretation
WBC	0.158	0.505	Not Significant
RBC	0.018	0.939	Not Significant
HGB	-0.179	0.451	Not Significant
HCT	-0.223	0.344	Not Significant
MCV	-0.216	0.361	Not Significant
MCH	-0.155	0.513	Not Significant
MCHC	-0.039	0.871	Not Significant
PLT	0.183	0.441	Not Significant
NEUT	0.414	0.07	Not Significant
LYMPH	-0.35	0.13	Not Significant
MONO	0.059	0.806	Not Significant
EO	-0.26	0.269	Not Significant
BASO	-0.21	0.375	Not Significant

No significant relationship was found between DASS-21 scores and CBC parameters during either low- or high-stress period. However, biologically plausible trends were observed. Neutrophils showed positive correlations with stress scores, while lymphocytes showed negative correlations. These patterns are consistent with stress-related immune redistribution, although the small sample size and mild average stress scores may have limited statistical detection.

CONCLUSION

The study concluded that third-year BSMLS students experienced persistent mild stress during both low- and high-stress academic periods. The absence of a significant difference in DASS-21 scores indicates that examination periods did not produce a substantial increase in psychological stress, possibly because students had already adapted to ongoing academic demands or were affected by non-academic stressors. CBC parameters during the low-stress period showed hematologic equilibrium. During the high-stress period, selected hematological changes were observed, particularly in hematocrit, MCV, MCHC, and neutrophils. These statistically significant changes remained clinically normal, suggesting physiological adaptation rather than pathological alteration.

No significant correlations were found between DASS-21 scores and CBC parameters during either stress period. Nevertheless, the observed neutrophil and lymphocyte trends are consistent with psychoneuroimmunology theory and suggest that CBC may still provide useful physiological information when interpreted alongside psychological measures. Overall, the study provides localized evidence that academic stress can produce subtle hematological responses among BSMLS students.

Recommendations

Academic institutions should strengthen student well-being programs by integrating stress management activities, resilience training, and academic workload monitoring, especially during examination periods.

Medical laboratory science programs should consider incorporating stress physiology discussions into student health promotion activities so that learners understand how psychological stress may influence laboratory parameters.

Future researchers should conduct longitudinal studies across multiple examination cycles to determine whether hematological adaptations remain stable or become more pronounced over time. Future studies should include larger samples, control groups from non-health science programs, and multi-institutional participants to improve generalizability. Researchers are encouraged to include additional biomarkers such as cortisol, C-reactive protein, ferritin, transferrin saturation, and cytokine profiling alongside CBC parameters for a more comprehensive assessment of stress physiology. Baseline samples may be collected at the start of the semester to establish a more stable reference point before academic demands intensify.

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