



Association Between Iron Deficiency Anemia and Perceived Academic Stress Among Medical Technology Students

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Abstract

Iron deficiency anemia may affect fatigue, concentration, physical functioning, and cognitive performance, while academic stress is a common concern among students enrolled in demanding health-sciences programs. This study examined the association between iron-deficiency-related hematologic status and perceived academic stress among third-year Medical Technology students. A quantitative correlational design was employed. Students were initially screened using predefined eligibility criteria, after which 126 qualified participants proceeded to laboratory assessment involving hemoglobin and hematocrit testing, with ferritin evaluation included in the clinical protocol. Perceived academic stress was measured using the 18-item Perceptions of Academic Stress Scale (PASS). Among the 126 participants, 76 (60.3%) had normal hemoglobin and hematocrit levels, whereas 50 (39.7%) had low levels. Perceived academic stress was evident across all three measured dimensions; faculty work and examinations obtained the highest mean ($M = 3.79$), followed by academic self-perception ($M = 3.67$) and academic expectations ($M = 3.57$), with an overall mean of 3.68. Correlation analysis yielded a statistically significant but negligible inverse association ($r = -.159$, $p = .005$). The findings indicate that hematologic status and perceived academic stress were statistically associated in this student population, although the magnitude was very small. The results support integrated attention to student health monitoring and academic stress management and warrant further longitudinal research using broader samples and more precise physiological measures.

Keywords: *academic stress; hematologic status; iron deficiency anemia; medical technology students; PASS; student health*

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1. Introduction

Iron is essential to hemoglobin production and oxygen transport. Inadequate iron availability can impair red blood cell production and may contribute to iron deficiency anemia, a condition associated with fatigue, weakness, reduced physical endurance, and impaired concentration. These manifestations are relevant in university populations because sustained attention, memory, and physical stamina are integral to academic functioning. Iron deficiency can also affect neurobehavioral processes through changes in brain iron status, myelination, and monoamine metabolism (Ferreira et al., 2019; Kim & Wessling-Resnick, 2014).

Academic stress is likewise common among university students and may be intensified by examination demands, workload, performance expectations, and fear of failure. Reddy et al. (2018) identified personal inadequacies, fear of failure, teacher-related concerns, and academic conditions as important sources of student stress. Among medical students, the COVID-19 period also demonstrated the vulnerability of students to substantial perceived stress and coping difficulties (Abdulghani et al., 2020).

The intersection of these concerns is particularly relevant among Medical Technology students, whose academic preparation combines intensive theoretical coursework, laboratory requirements, repeated assessments, and preparation for professional practice. Previous work among third-year Medical Technology students has reported the co-occurrence of symptoms associated with iron deficiency anemia and anxiety- and depression-related criteria (Buita et al., 2021). Nutritional deficiency anemia may also produce symptoms capable of interfering with everyday academic activity, including fatigue, lethargy, headache, and exertional discomfort (Rani et al., 2017).

Although iron-deficiency-related conditions and academic stress have each been examined in student populations, their direct statistical relationship remains comparatively underexplored within Medical Technology students. The present study

addressed this gap by combining laboratory-based hematologic assessment with the Perceptions of Academic Stress Scale (PASS), a standardized instrument developed for university students (Bedewy & Gabriel, 2015).

Objectives of the Study

This study aimed to examine the association between iron deficiency anemia and perceived academic stress among third-year Medical Technology students. Specifically, it sought to:

1. determine the respondents' hemoglobin and hematocrit status in relation to the detection of iron deficiency anemia;
2. assess perceived academic stress in terms of academic expectations, faculty work and examinations, and academic self-perception; and
3. determine whether a statistically significant association exists between iron-deficiency-related status and perceived academic stress.

2. Review of Related Literature

2.1 Iron Deficiency Anemia and Hematologic Health

Iron deficiency anemia reflects inadequate iron availability for normal erythropoiesis and oxygen transport. Clinically, iron deficiency may present with fatigue, weakness, reduced exercise tolerance, and cognitive complaints. At the neurological level, altered iron homeostasis can affect processes involved in cognition and behavior (Ferreira et al., 2019; Kim & Wessling-Resnick, 2014).

Women and adolescents may be particularly vulnerable to iron deficiency because of physiological demands, dietary factors, and blood loss. Mirza et al. (2018) emphasized the substantial impact of iron deficiency and iron deficiency anemia on women's health. Within diagnostic practice, complete blood count measures such as hemoglobin and hematocrit provide important initial evidence, while ferritin and other iron studies can strengthen assessment. Okocha et al. (2020) demonstrated the value of systematic testing protocols in the identification of iron deficiency anemia.

2.2 Academic Stress Among University and Health-Sciences Students

Academic stress arises from the interaction of performance expectations, workload, examinations, time pressure, interpersonal experiences, and students' own perceptions of competence. Reddy et al. (2018) reported that university students experience academic stress from multiple sources, including fear of failure, teacher-related difficulties, and academic conditions. These pressures may affect students' emotional state, study behavior, and general well-being.

Philippine evidence likewise indicates that student distress is multidimensional rather than reducible to a single academic or personal cause. Malabanan (2026) identified closely interconnected individual, interpersonal, and systemic risk domains among university students in CALABARZON, including academic distress within the broader systemic context.

Motivational conditions also shape how academic pressure is experienced. Among Filipino college students, controlled motivation arising from grades, requirements, expectations, and internalized pressure was significantly associated with academic engagement, suggesting that visible participation can coexist with pressure-based rather than fully autonomous motivation (Borinaga et al., 2026).

Health-sciences students may face additional stress because of specialized courses and frequent high-stakes assessment. Abdulghani et al. (2020) documented substantial perceived stress among undergraduate medical students during the COVID-19 period. In the Philippine health-professions education literature, these pressures have been framed as part of an interconnected system involving learner well-being, licensure expectations, faculty demands, curriculum conditions, and institutional constraints (Bermido et al., 2025).

Comparable psychological concerns have also been observed among medical students outside the Philippines. Qi (2026), for example, documented substantial variation in fear of intimacy, identity development, and self-disclosure among Chinese medical college students, reinforcing the broader point that health-professions learners may carry psychological burdens alongside academic demands. These findings support the view that medical and allied-health students constitute a population in which academic pressures and health concerns may meaningfully coexist.

2.3 Iron Deficiency, Psychological Function, and Academic Outcomes

Iron-deficiency-related symptoms may overlap with experiences commonly associated with academic strain. Fatigue, reduced concentration, weakness, and impaired functional capacity may interfere with studying and classroom participation. Rani et al. (2017) found that nutritional deficiency anemia among undergraduate medical students was accompanied by symptoms capable of hindering academic life, although the relationship with scholastic performance was not uniformly strong.

Within Medical Technology students, Buita et al. (2021) reported an association between symptoms-based iron deficiency anemia and anxiety- and depression-related criteria. This does not establish causality, but it suggests that physiological and psychological concerns may overlap within the same student population. Such evidence supports simultaneous consideration of student physical health and perceived academic stress.

Adjacent Philippine student-health evidence further supports this integrated view. Among dormitory medical students, nutrition and lifestyle indicators such as sleep, screen time, physical activity, snacking, and body mass index were associated with stress- and burnout-related profiles, although the cross-sectional design did not establish causality (Quinto et al., 2025).

Sleep research among Filipino engineering students similarly found uniformly poor baseline sleep quality, short sleep duration, and persistent academic stress, illustrating how behavioral and physiological conditions can coexist within demanding academic environments (San Juan et al., 2026).

Academic functioning is also sensitive to apparently peripheral contextual conditions. Manio et al. (2026) found faster task completion under an organized-desk condition than a disorganized one among first-year engineering students, suggesting that performance can be influenced by environmental factors beyond health status alone.

In technology-mediated learning, perceived personalization, engagement, and educational outcomes likewise depend on multiple institutional and learner conditions rather than on a single input, providing a parallel example of the multicausal nature of academic functioning (Rao et al., 2025).

2.4 Measurement of Academic Stress

The Perceptions of Academic Stress Scale was developed by Bedewy and Gabriel (2015) to measure perceived sources of academic stress among university students. The instrument contains 18 items and demonstrated acceptable internal consistency together with evidence of content and convergent validity. Its use is appropriate when the objective is to distinguish stress associated with academic expectations, workload and examinations, and students' academic self-perceptions.

Use of a standardized stress measure alongside objective hematologic testing provides a useful multi-method approach. Rather than treating physical health and psychological-academic experience as entirely separate, the combination allows both domains to be examined within the same analytic framework.

2.5 Synthesis and Research Gap

The literature indicates that iron deficiency can influence physical and cognitive functioning, while academic stress can arise from workload, examinations, performance expectations, and self-evaluative concerns. Evidence among medical and allied-health students further suggests that nutritional, physiological, and psychological concerns may coexist (Abdulghani et al., 2020; Buita et al., 2021; Rani et al., 2017). The adjacent studies reviewed above reinforce a broader interpretation: student functioning emerges from interacting physiological, behavioral, psychological, motivational, and contextual conditions, so a weak bivariate relationship between any two indicators should not be treated as evidence that either domain is unimportant.

However, the literature contained in the source study provides more evidence on these concerns separately than on their direct association among Medical Technology students. The present study responds to this gap by linking laboratory-based hematologic findings with PASS-based perceived academic stress within one defined student population.

3. Methodology

3.1 Research Design

The study employed a quantitative correlational design to examine the relationship between iron-deficiency-related hematologic status and perceived academic stress. No experimental manipulation was introduced; the analysis focused on the association between naturally occurring measurements.

3.2 Participants and Study Setting

Participants were third-year Medical Technology students enrolled during the 2022-2023 academic year at a private university in Manila, Philippines. The target population consisted of 564 students after excluding the eight student-researchers. Of these, 256 agreed to participate in the preliminary screening, and 126 met the eligibility requirements and proceeded to laboratory assessment.

3.3 Sampling and Eligibility

The source study describes the initial approach as total-population screening followed by purposive selection of participants who met predefined eligibility criteria. Inclusion indicators covered medical history and symptoms associated with iron deficiency anemia, while exclusion criteria included factors that could materially affect iron status, such as iron supplementation, selected medical conditions, routine blood donation, and heavy menstrual bleeding as defined in the study protocol.

3.4 Research Instruments and Measures

Data were obtained through a preliminary eligibility survey, laboratory blood testing, and the Perceptions of Academic Stress Scale (PASS). The PASS developed by Bedewy and Gabriel (2015) contains 18 items assessing academic expectations, faculty work and examinations, and students' academic self-perception. Laboratory assessment included hemoglobin and hematocrit measurements; ferritin evaluation was also included in the clinical protocol. The source methodology reports clinical review of laboratory findings using sex-specific hemoglobin and hematocrit thresholds.

3.5 Data Gathering Procedure

The preliminary survey was administered using printed and electronic forms. Qualified participants were then referred for blood collection by trained laboratory personnel. Specimens were processed within the university clinical laboratory and reviewed together with screening information. The academic stress scale was administered during the post-screening phase, and the resulting data were organized for statistical analysis.

3.6 Data Analysis

Frequency and percentage were used to summarize hematologic classifications. Weighted means and standard deviations were used to describe perceived academic stress. Pearson's product-moment correlation coefficient was used to evaluate the direction and magnitude of the relationship between iron-deficiency-related status and perceived academic stress. Statistical significance was assessed using the reported two-tailed p value.

3.7 Ethical Considerations

The research underwent institutional ethics review. The protocol was initially submitted in February 2023, revised following requested modifications, and approved in June 2023. Participants provided informed consent and were informed of voluntary participation, confidentiality, anonymity, potential risks, and their right to withdraw without penalty.

4. Results and Discussion

4.1 Hematologic Findings

Among the 126 participants who proceeded to laboratory assessment, 76 (60.3%) had normal hemoglobin and hematocrit levels and 50 (39.7%) had low levels. Thus, although the majority were within the normal category, a substantial minority demonstrated low hematologic values.

Table 1. Hematologic Status of the Respondents

Hemoglobin and Hematocrit Status	Frequency	Percentage
Low	50	39.7
Normal	76	60.3
Total	126	100.0

The table reports measured hematologic categories rather than a separate ferritin distribution. Accordingly, the results are interpreted conservatively as normal versus low hemoglobin and hematocrit status. Systematic assessment is important because classification of iron deficiency anemia is strengthened when hematologic indicators are interpreted with appropriate iron studies and clinical review (Okocha et al., 2020).

4.2 Perceived Academic Stress

Perceived academic stress was evident across all three dimensions. Faculty work and examinations obtained the highest mean ($M = 3.79$), followed by academic self-perception ($M = 3.67$) and academic expectations ($M = 3.57$). The overall mean was 3.68, corresponding to the descriptive interpretation used in the original study.

Table 2. Perceived Academic Stress by Dimension

Dimension	Weighted Mean	Interpretation	Rank
Faculty work and examinations	3.79	Agree	1
Academic self-perception	3.67	Agree	2
Academic expectations	3.57	Agree	3
Grand Mean	3.68	Agree	-

Examination difficulty and workload were the most prominent stressors in the original item-level results. Fear of failing courses and concern about future employment were also highly rated. This pattern is consistent with the multi-source character of academic stress described by Reddy et al. (2018), in which performance demands, fear of failure, and educational conditions contribute to student stress.

4.3 Association Between Hematologic Status and Perceived Academic Stress

The reported correlation between iron-deficiency-related status and perceived academic stress was $r = -.159$ with $p = .005$. The coefficient indicates a statistically significant but negligible inverse relationship. Statistical significance therefore should not be interpreted as evidence of a strong association.

Table 3. Relationship Between Hematologic Status and Perceived Academic Stress

Statistical Measure	Result
Pearson correlation coefficient	-.0159
Two-tailed p value	0.005
Magnitude	Negligible
Statistical decision	Reject null hypothesis

Interpretation	Statistically significant inverse relationship
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The negative coefficient indicates that the variables moved in opposite directions under the coding used in the study, but the magnitude was very small. Because the design was correlational, the result does not support the claim that academic stress causes iron deficiency anemia or that iron deficiency anemia causes academic stress.

4.4 Discussion

The findings show the co-occurrence of two concerns within the study population: a substantial minority had low hemoglobin and hematocrit levels, while academic stress was evident across all measured dimensions. Faculty work and examinations emerged as the strongest stress domain. This is consistent with prior research indicating that academic demands, fear of failure, and performance-related conditions are major stressors among university students (Reddy et al., 2018).

The hematologic findings are also relevant because iron-deficiency-related conditions may be accompanied by fatigue, reduced concentration, weakness, and other symptoms that can interfere with day-to-day academic functioning. Neurobehavioral literature further indicates that iron status can influence cognition and emotional behavior through several biological mechanisms (Ferreira et al., 2019; Kim & Wessling-Resnick, 2014). Rani et al. (2017) similarly described symptoms of nutritional deficiency anemia that may hinder students' academic activity.

Nevertheless, the principal association was negligible in magnitude. An r of $-.159$ indicates that hematologic status and perceived academic stress shared little linear variation despite the statistically significant p value. The finding therefore supports only a limited association and suggests that other nutritional, physiological, behavioral, psychological, and contextual factors may be more important in explaining either condition.

The contribution of the study lies in combining laboratory-based hematologic assessment with a standardized academic stress instrument. This integrated approach is useful in health-sciences education because it considers physical and psychological-academic indicators within the same student population while avoiding causal conclusions unsupported by the design.

5. Conclusions, Recommendations, and Implications

5.1 Conclusions

The majority of participants had normal hemoglobin and hematocrit values, although 39.7% were classified as having low levels. Perceived academic stress was evident across academic expectations, faculty work and examinations, and academic self-perception, with faculty work and examinations producing the highest mean.

The inferential analysis identified a statistically significant but negligible inverse relationship between iron-deficiency-related status and perceived academic stress ($r = -.159$, $p = .005$). The effect was small and does not support causal interpretation. The appropriate conclusion is therefore that the variables were statistically associated in the observed sample but only to a limited degree.

5.2 Recommendations

1. Future studies should include broader and more diverse samples across year levels, academic programs, and institutions to improve external validity.
2. Longitudinal designs should be considered to examine whether changes in hematologic status and academic stress occur together over time and to clarify temporal relationships.
3. Future studies should report iron-related biomarkers and diagnostic classifications in greater detail, particularly when distinguishing low hemoglobin or hematocrit from confirmed iron deficiency anemia.
4. Objective physiological measures of stress, such as cortisol or heart-rate variability, may be used alongside validated self-report measures where feasible.
5. Health-sciences institutions may consider integrated wellness strategies that include nutrition awareness, appropriate health screening, counseling support, and evidence-based academic stress management.

5.3 Implications of the Study

The study has practical and methodological implications for student health research. The coexistence of low hematologic values and elevated perceived academic stress suggests that physical and psychological-academic concerns should not always be considered in isolation. Methodologically, combining laboratory-based measures with a standardized stress instrument provides a more comprehensive assessment than reliance on self-report alone. The findings also illustrate the importance of interpreting effect size and direction together with statistical significance: a significant p value does not necessarily indicate a strong or clinically meaningful relationship.

At a broader analytical level, the logic of integrating distinct data domains is consistent with conceptual work arguing that health-related decision quality improves when information streams are considered together rather than maintained in isolated silos (Atento et al., 2025). This study applies that general integrative logic at the student level by examining a physiological indicator alongside a psychological-academic measure.

Nutrition-related outcomes may likewise reflect broader interacting systems rather than isolated determinants. In a cross-national ASEAN analysis, Quinto and Atento (2025) showed that macroeconomic and labor conditions did not translate uniformly into child-nutrition outcomes, providing a cautious parallel for interpreting nutritional health as embedded in wider contextual conditions rather than attributable to a single correlate.

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