

# The Impact of Anemia on Academic Indicator in Nursing Students: Intelligence Quotient, Academic Potential, Study Concentration and Academic Performance

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## ABSTRACT

*Anemia, particularly iron deficiency anemia, is a common health issue among nursing students that can significantly impact their academic performance. Purpose: This study aimed to investigate the prevalence of anemia and its effect on key academic indicators, including Intelligence Quotient (IQ), Academic Potential Test (APT) scores, study concentration, and cumulative Grade Point Average (GPA). This study employed a cross-sectional design. A total of 192 nursing students were selected as participants. Anemia status was assessed through blood tests, with participants classified as non-anemic, mildly anemic, or moderately anemic based on hemoglobin levels. Cognitive function was evaluated using standardized measures of IQ and APT scores. Study concentration was assessed through self-reported questionnaires, while academic performance was measured using the students' cumulative GPA. The chi-square test was used to examine the relationship between anemia status and various academic performance indicators. Students with anemia exhibited lower APT scores, reduced study concentration, and poorer GPA outcomes compared to their non-anemic peers ( $p < 0.001$ ). However, the relationship between anemia and IQ was not statistically significant ( $p < 0.05$ ). Conclusion: Anemia negatively impacts cognitive function and academic performance.*

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## 1. INTRODUCTION

Anemia, a condition characterized by a decrease in hemoglobin concentration or red blood cell count, is a widespread public health concern, particularly among adolescents and young adults [1]. Nursing students represent a particularly vulnerable population due to the unique academic demands, mental stress, and potential nutritional deficiencies associated with their training, all of which can predispose them to anemia. The high cognitive and physical requirements of nursing education make anemia a critical concern for this group, as it can directly impair their ability to focus, process information, and perform well in both theoretical and clinical settings [2], [3].

If left untreated, anemia can lead to several negative health outcomes, including fatigue, impaired cognitive function, and reduced productivity [4]. These consequences are especially concerning for nursing students, whose academic success relies heavily on maintaining high levels of focus and cognitive performance.

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Anemia's impact on attention, memory, and motor performance can hinder their capacity to meet the demands of rigorous coursework and clinical practice. Studies have indicated that up to 53.2% of female nursing students may suffer from anemia, often due to poor dietary habits and insufficient knowledge about nutrition, further exacerbating the problem [5], [6].

Anemia leads to brain hypoxia, which impairs critical cognitive processes such as attention and memory, making it harder for students to concentrate, retain information, and perform well in academic and clinical tasks. This condition can result in chronic cognitive deficits if left untreated, potentially affecting students' long-term academic and professional development [7]. Given the demanding nature of nursing education, early identification and management of anemia through screening and nutritional interventions are crucial to ensure students' academic success [8].

While several studies have explored the prevalence of anemia and its link to academic performance in general student populations [1], [9], [10], there is a lack of research specifically focused on nursing students. This group faces unique health and academic challenges that could amplify the impact of anemia on their academic performance. More research is needed to explore the specific relationship between anemia, cognitive function, and academic outcomes in nursing students [4], [11], [12].

Thus, this study aims to investigate the prevalence of anemia and its impact on key academic indicators, including Intelligence Quotient (IQ), Academic Potential Test scores, study concentration, and cumulative Grade Point Average (GPA) among nursing students. The findings from this research will contribute to a better understanding of how anemia affects cognitive and academic performance in this specific population, highlighting the need for effective interventions to improve both health and academic outcomes.

## 2. RESEARCH METHOD

This study employed a cross-sectional design and was conducted at the Faculty of Health Science, Universitas Muhammadiyah Purwokerto, during the 2023/2024 academic year. The study population consisted of nursing students from all academic levels at Universitas Muhammadiyah Purwokerto. The sample size was determined using the Slovin formula, with a 95% confidence level and a 5% margin of error. A total of 192 nursing students were selected as participants, with stratification based on year of study to ensure proportional representation across all academic levels.

Anemia status was assessed through blood tests, with participants classified as non-anemic, mildly anemic, or moderately anemic based on hemoglobin levels. The cutoff values for anemia were set at <12 g/dL for women and <13 g/dL for men [10]. Cognitive function was evaluated using standardized measures of IQ and Academic Potential Test (APT) scores. Study concentration was assessed through self-reported questionnaires, while academic performance was measured using the students' cumulative GPA.

Data were analyzed using SPSS version 21.0. Descriptive statistics were applied to summarize the demographic and health characteristics of the participants. The chi-square test was used to examine the relationship between anemia status and various academic performance indicators, including IQ, APT, study concentration, and GPA.

## 3. RESULTS AND DISCUSSIONS

The study involved 192 nursing students, predominantly female, with an average age of 20.11 years. Half of the participants were non-anemic, while 25% had mild anemia and the remaining 25% exhibited moderate anemia. In terms of cognitive abilities, most students had IQ scores below average, with 29.2% achieving average scores and only 8.3% scoring above average. APT results were similar, with 63% of students scoring low, 32.8% in the medium range, and 4.2% obtaining high scores. Regarding concentration, the majority were reported to be less focused, 24% moderately focused, and 8.3% highly focused. As for academic performance, 57.8% had excellent GPAs, 40.1% satisfactory, and 2.1% less than satisfactory. This is shown in **Table 1**.

IQ analysis revealed that 54.2% of non-anemic students scored below average, compared to 66.7% of those with mild anemia and 75% of those with moderate anemia. However, the relationship between anemia and IQ was not statistically significant ( $p > 0.05$ ) which is shown in **Table 2**. Although no direct link between anemia and IQ was found, there is substantial evidence suggesting that anemia, particularly iron deficiency, negatively affects cognitive function. Anemia has long been associated with delayed cognitive development in children and cognitive decline in adults. In this case, the non-significance might be explained by the stability of IQ, which is less influenced by temporary health conditions like anemia. Research suggests that more severe and chronic anemia has a greater impact on IQ, which might not be fully reflected in the present sample [13], [14], [15], [16].

The APT results showed that most non-anemic students performed in the average range, while 66.7% of mildly anemic students and 95.8% of moderately anemic students had low scores. The relationship between anemia and APT was statistically significant ( $p > 0.0001$ ), supporting the theory that anemia reduces the brain's ability to quickly process and comprehend information. The oxygen deficit associated with anemia impairs cognitive functions, particularly logical, numerical, and verbal reasoning. This finding aligns with previous

research, which demonstrates that adolescents with iron deficiency anemia tend to perform worse on cognitive tests due to reduced oxygen delivery to the brain [17].

**Table 1. Characteristics of Respondent (n=192)**

Characteristics	Result
<b>Sex</b>	
Male	63 (32.8%)
Perempuan	129 (67.2%)
<b>Age, yr</b>	
Mean ± SD	20.11 ± 1.28
Min-Max	18-23
<b>Anemia</b>	
Non-anemic	96 (50%)
Mild anemia	48 (25%)
Moderate anemia	48 (25%)
<b>IQ Assessments</b>	
Below average	120 (62.5%)
Average scores	56 (29.2%)
Above average	16 (8.3%)
<b>Academic Potential Test</b>	
Low scores	121 (63%)
Medium range	63 (32.8%)
High scores	8 (4.2%)
<b>Study Concentration</b>	
Less focused	130 (67.7%)
Moderately focused	46 (24%)
Highly focused	16 (8.3%)
<b>Academic Performance</b>	
Less than satisfactor	4 (2.1%)
Satisfactory	77 (40.1%)
Excellent	111 (57.8%)

**Table 2. Impact of Anemia on IQ, Academic Potential, Study Concentration and Academic Performance**

Variable		Anemia			X <sup>2</sup>	p-value
		Non-anemic n=96	Mild anemia n=48	Moderate anemia n=48		
<b>IQ Assessments</b>	Below average	52 (54.2%)	32 (66.7%)	36 (75.0%)	8.114	0.087
	Average scores	32 (33.3%)	14 (29.2%)	10 (20.8%)		
	Above average	12 (12.5%)	2 (4.2%)	2 (4.2%)		
<b>Academic Potential Test</b>	Low scores	43 (44.8%)	32 (66.7%)	46 (95.8%)	39.157	0.0001
	Medium range	45 (46.9%)	16 (33.3%)	2 (4.2%)		
	High scores	8 (8.3%)	0 (0.0%)	0 (0.0%)		
<b>Study Concentration</b>	Less focused	51 (53.1%)	39 (81.3%)	40 (83.3%)	22.682	0.0001
	Moderately	30 (31.3%)	8 (16.7%)	8 (16.7%)		
	Highly	15 (15.6%)	1 (2.1%)	0 (0.0%)		
<b>Academic Performance</b>	Less than satisfactor	0 (0.0%)	1 (2.1%)	3 (6.3%)	46.326	0.0001
	Satisfactory	18 (18.8%)	31 (64.6%)	28 (58.3%)		
	Excellent	78 (81.3%)	16 (33.3%)	17 (35.4%)		

In terms of study concentration, 53.1% of non-anemic students reported difficulty focusing, with this percentage increasing to 81.3% in the mild anemia group and 83.3% in the moderate anemia group. This significant relationship highlights that anemia directly affects concentration ( $p > 0.0001$ ), likely due to fatigue and reduced brain oxygenation, making it harder to maintain focus over extended periods. Previous research supports this by showing that anemia leads to a decline in mental capacity, slower reaction times, and increased fatigue, all of which impair concentration and academic performance [18], [19].

Finally, GPA analysis revealed a significant relationship between anemia and academic performance ( $p > 0.0001$ ). Among non-anemic students, 81.3% achieved excellent GPAs, compared to 33.3% in the mild anemia

group and 35.4% in the moderate anemia group. This aligns with the understanding that iron is crucial for hemoglobin production and oxygen transport, both essential for optimal brain function. Reduced oxygen levels in the brain due to anemia impair cognitive functions, leading to lower academic performance. These results mirror previous findings that adolescents with anemia have lower cognitive scores and face greater academic challenges [13], [20], [21].

Overall, the results of this study emphasize the negative impact of anemia on academic performance and cognitive function in students. Students experiencing anemia are more likely to face difficulties in learning and exhibit lower academic performance. It is important to note that although the relationship between anemia and IQ was not significant in this study, the results found in GPA, APT, and study concentration still support the hypothesis that anemia has a significant impact on critical aspects of cognitive and academic abilities. Therefore, health interventions, such as the provision of iron supplements and education on healthy dietary patterns, may need to be considered by educational institutions, campus health centers, and policymakers as part of efforts to improve academic performance among students at risk of anemia.

#### 4. CONCLUSIONS

This study demonstrates that anemia has a significant impact on the academic performance and cognitive abilities of nursing students, particularly in terms of cumulative GPA, APT scores, and study concentration. Students experiencing mild or moderate anemia tend to exhibit lower academic achievement and greater difficulty in maintaining focus compared to their non-anemic counterparts. Although the relationship between anemia and IQ was not significant, the impact of anemia on other cognitive abilities, such as information processing and concentration, is quite evident. It is recommended that educational institutions implement routine screening to detect anemia among students, accompanied by counseling on iron-rich, healthy dietary patterns. Additionally, students with anemia should receive supplementary academic support, such as tutoring and schedule adjustments, to address their concentration challenges. Collaboration between campus health centers and academic departments is also crucial to provide more comprehensive interventions. Further research is needed to explore the long-term effects of anemia on students' academic performance and overall well-being.

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