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Research Article

The Relationship Between Nutritional Status and Intellectual Intelligence in 13-15 Year Old Middle School Students at SMPN 2 Sumber Probolinggo

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Abstract: Currently, Indonesia faces three major nutrition-related problems among adolescents, known as the *triple burden of malnutrition*, namely undernutrition (stunting and wasting), micronutrient deficiencies, and obesity. Children's cognitive development is greatly influenced by adequate nutrition, as physical and brain growth go hand in hand in the growth and development process. A balanced and high-quality diet supports optimal growth and development and influences children's nutritional status and intellectual intelligence. This study aims to analyze the relationship between nutritional status and intellectual intelligence in students. This study is an observational analytical study with a cross-sectional approach. The subjects of this study were 68 students aged 13–15 years at SMPN 2 Sumber, Probolinggo Regency. Primary data were obtained through IQ tests and weight and height measurements, while secondary data were in the form of student identities. Data analysis used a two-sample t-test. The results showed that out of 42 students with poor nutritional status, 38 students (90.5%) had low IQ (<100). Among 23 students with normal nutritional status, 11 students (47.8%) had low IQ and 12 students (52.2%) had moderate IQ (100–109). The statistical test results showed a p-value of 0.000 ($p < 0.05$), indicating a significant relationship between nutritional status and intellectual ability. In conclusion, nutritional status is associated with intellectual ability among students at SMPN 2 Sumber, Probolinggo District. Students with poor nutritional status have a higher risk of having an IQ below average.

Keywords: Children aged 13–15 years; Intellectual intelligence; Nutritional status

1. Introduction

Adolescence is an important transitional phase characterized by accelerated physical growth, hormonal changes, and significant cognitive and emotional development. These changes greatly influence the quality of human resources in the future, as they shape an individual's identity, thinking abilities, and mental health [1], [2]. Adolescence is often referred to as a critical transition period due to the many changes that occur in a relatively short period of time. During this process, nutritional status plays a central role in supporting optimal growth and development. Without adequate nutrition, adolescents are at risk of various health problems, including intellectual development and learning disabilities [3], [4].

Indonesia currently faces complex nutritional problems. According to a report by the World Health Organization, Indonesia is among the countries with a triple burden of malnutrition, namely undernutrition (such as stunting and wasting), micronutrient deficiencies (e.g., anemia), and obesity [5]. These three issues do not occur in isolation but

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often affect the same population groups, including adolescents. According to the 2018 Basic Health Research, the prevalence of overweight or obese adolescents aged 13–15 years reached 16%, while those aged 15–18 years reached 13.5% [6]. On the other hand, the prevalence of undernutrition and stunting remains high. In fact, the rate of anemia, which is one form of micronutrient deficiency, reached 48.9% among the young productive age group, with those aged 15–24 years being the most affected [7].

Nutrition problems among adolescents have far-reaching impacts, not only on physical health but also on cognitive development and intellectual abilities. Poor nutritional status can hinder brain development, reduce learning concentration, and affect academic performance. This is particularly crucial because adolescents today are the generation being prepared to become Indonesia's high-quality human resources by 2045, often referred to as Indonesia's "golden generation" [8]. If the current nutritional status of adolescents is not addressed seriously, the target of achieving high-quality human resources is at risk of not being met.

Previous studies have attempted to examine the relationship between nutritional status and intellectual intelligence. Bulkis et al. (2024) found that good nutritional status is closely associated with intellectual intelligence levels in elementary school-aged children. This study showed that children with normal nutritional status tend to have higher IQs compared to those with malnutrition [9]. However, these results are not always consistent. Studies conducted by Akubuilo et al. (2020) and Pratiwi et al. (2017) in similar studies did not find a significant relationship between nutritional status and intellectual intelligence, indicating that other factors also play a role, such as social environment, cognitive stimulation at home, and the quality of education [10], [11].

The method commonly used in these studies is a cross-sectional design, which involves collecting data at a specific point in time to examine the relationship between two or more variables. The advantage of this approach is its ease of implementation and time efficiency, as it does not require long-term observation [12]. However, this approach has limitations in determining cause-and-effect relationships and is susceptible to the influence of unmeasured external variables, such as psychosocial factors, family economic conditions, or differences in educational curricula [13].

The issue becomes more complex when geographical and social contexts are considered. For example, areas like Probolinggo Regency in East Java Province face significant geographical challenges in terms of access to nutritious food and healthcare services. Data from the Riskesdas (2018) survey indicates that the stunting rate in this area reaches 39.9%, meaning that nearly four out of ten children suffer from growth disorders. In Sumber Subdistrict, a mountainous and remote area, the number of children aged 10–16 years with stunting is quite high. Data from the Probolinggo District Health Office (2016) indicates that more than 9 children in this area suffer from stunting, and the rate of malnutrition reaches 13.4% [14]. In comparison, major cities like Surabaya only report a malnutrition rate of 7.7%.

This indicates that geographical location and access to resources greatly influence children's nutritional status [6].

Given the importance of nutritional status in supporting children's cognitive development, as well as the limited empirical data on the relationship between nutrition and intellectual intelligence in rural areas such as Sumber District, this study is highly relevant. This study raises the following research question: *What is the relationship between the nutritional status of junior high school students and their intellectual intelligence?* To answer this question, this study used a quantitative approach with a cross-sectional design. Nutritional status data were obtained through anthropometric measurements (weight and height), which were then interpreted based on body mass index standards according to age (BMI/U) and height according to age (TB/U). Meanwhile, data on intellectual intelligence were obtained through IQ measurements using validated standardized tests. The study was conducted at SMPN 2 Sumber, Probolinggo Regency, which was selected because it represents the geographical and social conditions appropriate for the study objectives.

This study is expected to contribute scientifically and practically in several aspects. First, it provides the latest empirical data on the relationship between nutritional status and intellectual intelligence among adolescents in rural areas, an area that has been understudied. Second, the findings can serve as a reference for policy-making in health and education, particularly in designing nutrition intervention programs to support improved learning quality in schools. Third, this study can serve as a foundation for further research using stronger longitudinal or experimental approaches to determine causal relationships between variables. Thus, this study is expected not only to enrich the scientific knowledge in the fields of nutrition and education but also to have a tangible impact on efforts to improve the quality of Indonesia's youth, especially those in areas with limited access to health and educational resources.

2. Preliminaries or Related Work or Literature Review

2.1 Nutrition for Adolescents

Adolescence is a transitional phase from childhood to adulthood characterized by significant physical, psychological, and social changes. The World Health Organization (WHO) defines adolescents as individuals aged 10–19 years, while the Indonesian Ministry of Health and the National Family Planning Coordinating Board (BKKBN) set the age range at 10–18 years and 10–24 years. This period is marked by a growth spurt influenced by growth hormones, estrogen in females, and testosterone in males [15]. Males generally experience peak growth at age 14, while females do so at age 12. These changes also include bone growth, increased muscle mass, and redistribution of body fat, which require adequate nutritional intake.

During adolescence, nutritional needs increase sharply to support daily activities and physical development. A balanced diet is important to support brain function, the immune system, and physical and mental development. Deficiencies or excesses of nutrients, especially iron, protein, and calories, can cause health problems. Common nutritional problems among adolescents include anemia, obesity, and underweight [16], [17]. Therefore, adolescents' diets should contain adequate amounts of carbohydrates, protein, fat, vitamins, and minerals according to their daily needs.

Epidemiologically, the prevalence of anemia among adolescents is quite high. Data from the 2018 Riskesdas survey indicate that 48.9% of adolescent girls in Indonesia suffer from anemia, an increase from 37.1% in 2013. Additionally, obesity among adolescents is on the rise; 16% of adolescents aged 13–15 years are overweight or obese [6], [18]. Stunting remains a major issue, with Indonesia recording a stunting rate of 36.4% among adolescents, the highest in Southeast Asia after Laos and Timor-Leste [19]. To assess nutritional status among adolescents, one of the most commonly used methods is the Body Mass Index (BMI), which is the ratio of weight to height squared (kg/m^2). According to the WHO classification (2021), BMI is used to categorize nutritional status into underweight, normal, overweight, and obesity with several levels. BMI measurement is a simple yet effective indicator for monitoring the nutritional status of school-age children and adolescents [20].

Nutritional imbalances during adolescence, whether deficiencies or excesses, can have both short-term and long-term effects. Malnutrition, such as anemia and calorie deficiency, can disrupt concentration, lower academic performance, and hinder cognitive development [21], [22]. On the other hand, overnutrition, such as obesity, not only affects physical condition but is also associated with reduced brain function and social skills [23]. Obesity in adolescents can even affect nearly all organ systems, including the brain, impacting learning ability, cognitive function, and emotional development. Therefore, ensuring adequate and balanced nutrition in adolescents is a critical aspect of building a healthy and intelligent workforce for the future.

2.2 Intelligence Quotient (IQ)

Intelligence Quotient (IQ) is an indicator of a person's cognitive ability to think logically, solve problems, and understand and adapt to their environment. Wechsler defines intelligence as an individual's overall capacity to act purposefully, think rationally, and interact effectively with their environment [24]. IQ is one form of measuring intelligence through scores obtained from various standardized tests. IQ is generally categorized into groups ranging from very low, average, to high (genius), and IQ itself is influenced by a combination of biological and environmental factors. IQ assessment is conducted using various types of measurement tools, such as WPPSI, WISC, WAIS, Stanford-Binet, and CFIT. In the context of this study, the Culture Fair Intelligence Test (CFIT) was selected because it is neutral to cultural background, does not rely on verbal ability, and is efficient in terms of time. CFIT is designed to measure

abstract and visual thinking abilities without linguistic bias, making it suitable for use in adolescent populations with diverse educational and socioeconomic backgrounds [23]. However, a person's IQ level can also be influenced by various factors that cause a decrease in scores, both internal and external. Internal factors include low motivation to learn, fear of failure, suboptimal physical condition, and lack of self-confidence. External factors can come from an unsupportive family environment, low quality of education, and poor eating habits, such as excessive consumption of fast food and sugary drinks. Foods that are low in nutrients, high in fat and sugar, and low in protein and vitamins have been proven to hinder brain development, reduce concentration, and disrupt children's learning abilities [23]. Therefore, IQ is not only the result of intellectual tests, but also a reflection of an individual's health, nutrition, and the quality of environmental stimulation they receive throughout their growth and development.

2.3 The Relationship Between Nutrition and IQ

Nutritional status is known to influence brain development and intellectual intelligence, particularly during adolescence. Yuliwianti's (2017) research shows that malnutrition causes permanent damage to brain function and reduces cognitive potential. Ranabhat et al. (2016) also reported that children with low BMI had lower IQ scores than those with normal nutritional status. However, not all studies show consistent results [25]. Mahyiddin et al. (2019) found no significant association between nutritional status and IQ. This is attributed to various other factors influencing IQ, such as genetic factors, environmental stimulation quality, and parental involvement [26]. Additionally, the IQ measurement tools used in previous studies also have limitations in terms of accuracy and objectivity. This study aims to re-examine the relationship between nutritional status and IQ using a more neutral and efficient approach, namely by using BMI as an indicator of nutritional status and CFIT as an IQ measurement tool. Focusing on adolescents aged 13–15 years in high-risk nutritional environments also contributes significantly to filling the gaps in previous research.

3. Proposed Method

This study aims to analyze the relationship between nutritional status among junior high school students and their intellectual intelligence (IQ) levels. Using an analytical observational research design with a cross-sectional approach, this study involved 68 respondents, who were selected as a sample based on Lemeshow's formula (1991), consisting of students aged 13–15 years at SMP Negeri 2 Sumber in 2025. The study population consists of all students who meet the inclusion and exclusion criteria, with the sample selected using the Simple Random Sampling technique to ensure fair representation. Nutritional status was measured using Body Mass Index (BMI), while IQ levels were assessed using the Culture Fair Intelligence Test (CFIT) developed by Cattel and Cattel, with results consulted with a psychologist for validity. The collected data will be analyzed using an independent two-sample

T-test to see if there is a significant relationship between nutritional status and IQ in adolescents. This study was conducted by maintaining research ethics, namely maintaining the confidentiality and anonymity of the respondents' data and ensuring their consent through an informed consent form, so that this study was conducted in accordance with the principles of beneficence, non-maleficence, autonomy, and justice to ensure the welfare and justice of the respondents.

As illustrated in Figure 1, the conceptual framework of this study explains nutritional status as a key factor influencing children's cognitive and intellectual development, which is reflected in IQ. Factors influencing nutritional status, such as adequate nutrient intake and genetic factors, play a crucial role in supporting optimal brain development. Children with normal nutritional status have adequate nutrition that supports brain development and, in turn, enhances intellectual ability and IQ. Conversely, children with abnormal nutritional status tend to experience impairments in physical and cognitive development, which can affect their intellectual ability. In addition to nutritional status, external factors such as learning stimuli provided by the school and family environment also influence children's IQ development. Based on this conceptual framework, the hypothesis proposed is that nutritional status has a significant relationship with intellectual intelligence (IQ) levels among adolescents at SMPN 2 Sumber, Probolinggo District.

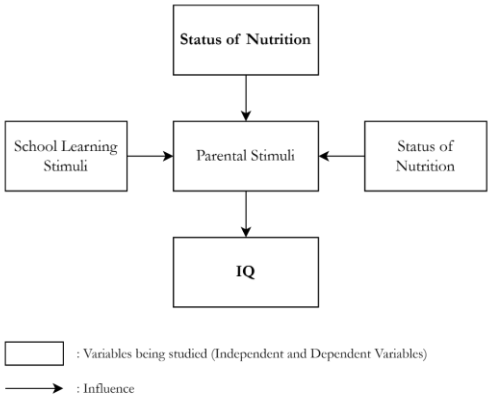

Figure 1. Conceptual Framework

4. Results and Discussion

4.1 Results

This study was conducted at SMPN 2 Sumber, located in Jajanga Hamlet, Cepoko Village, Sumber Subdistrict, Probolinggo Regency. This location is bordered by several areas, namely Rambaan Village to the north, Plalangan Hamlet to the south, Darungan Tempuran Hamlet to the west, and Gucialit Subdistrict to the east. SMPN 2 Sumber is situated in a mountainous area with poor road access, approximately 10 kilometers from the subdistrict center. The school is led by Tri Susilo, S.Pd., with a staff and faculty of 13 members, including 2 administrative staff. The school has three classes: 7th, 8th, and 9th grades, with a total of 124 students.

Table 1. Frequency distribution in percentages of sample age according to gender and class among students at SMPN 2 Sumber in February 2025

	13 years old		14 years old		15 years old	
	n	%	n	%	n	%
Male	9	35	7	26	9	67
Female	17	65	20	74	6	33
Grade 7	19	73	2	7	1	7
Grade 8	7	27	25	93	14	93
Total	**26**	**100**	**27**	**100**	**15**	**100**

Table 1. shows a sample consisting of three age groups (13, 14, and 15 years) with different gender distributions. At age 13, the majority of respondents were female (65%) and most were in grade 7 (73%). At age 14, females dominate (74%) with the majority in grade 8 (93%), while at age 15, males are more dominant (67%) and the majority are in grade 8 (93%).

Table 2. Frequency distribution in percent of nutritional status (BMI) of the sample according to gender, grade, and age among students at SMPN 2 Sumber in February 2025.

	Malnutrition		Adequate nutrition		Status gizi obese	
	n	%	n	%	n	%
Male	20	48	9	39	0	0
Female	22	52	14	61	3	100
Grade 7	15	36	7	30	1	33
Grade 8	27	64	16	70	2	67
13 years old	18	43	7	30	2	67
14 years old	14	33	13	57	1	33
15 years old	10	24	3	13	0	0
Total	**42**	**100**	**23**	**100**	**3**	**100**

Table 2 shows the frequency distribution of nutritional status (BMI) among students at SMPN 2 Sumber in February 2025, categorized by gender, grade, and age. In terms of gender, a higher percentage of female students have adequate nutrition (61%), while the majority of male students are malnourished (48%). No male students are classified as obese, while 100% of the obese students are female. Regarding grade, 36% of Grade 7 students are malnourished, and 30% have adequate nutrition. In Grade 8, the majority of students have adequate nutrition (70%), with 64% being malnourished. Based on age, 43% of 13-year-old students are malnourished, and 30% have adequate nutrition. Among 14-year-olds, 57% have adequate nutrition, while 33% are malnourished. For 15-year-olds, the majority are classified as having adequate nutrition (13%), and no students in this group are obese. Overall, most students at SMPN 2 Sumber experience malnutrition, with a very low prevalence of obesity, particularly among younger students and male students.

Tabel 3. Frequency distribution in percent of IQ scores of a sample according to gender, grade, and age among students at SMPN 2 Sumber in February 2025

	Low IQ		Moderate IQ	
	n	%	n	%
Male	22	42	6	33
Female	28	58	12	67
Grade 7	19	38	3	17
Grade 8	31	62	15	83
13 years old	19	38	7	39
14 years old	19	38	8	44
15 years old	12	24	3	17
Total	**50**	**100**	**18**	**100**

Table 3 shows the frequency distribution of IQ scores among students at SMPN 2 Sumber in February 2025, categorized by gender, grade, and age. In terms of gender, the majority of female students have low IQ scores (58%), while a smaller percentage of male students fall into this category (42%). Among male students, 33% have moderate IQ, while a higher proportion of female students (67%) fall into the moderate IQ category. Regarding grade, in Grade 7, 38% of students have low IQ, and only 17% have moderate IQ. In Grade 8, the percentage of students with moderate IQ rises significantly to 83%, while 62% of students in this grade have low IQ. Looking at age, the 13-year-old and 14-year-old age groups show similar distributions, with 38% of students in both groups having low IQ and the remaining percentages having moderate IQ. Among the 15-year-olds, a lower percentage (24%) have low IQ, with only 17% having moderate IQ. Overall, the majority of students in the sample have low IQ, particularly among females and students in Grade 8, with a notable percentage also falling within the moderate IQ range.

The distribution of nutritional status among students at SMPN 2 Sumber in February 2025 shows that the majority of students are underweight, accounting for 61.8% or 42 students. Students with normal nutritional status account for 33.8% (23 students), while students with obesity only account for 3.9% (3 students).

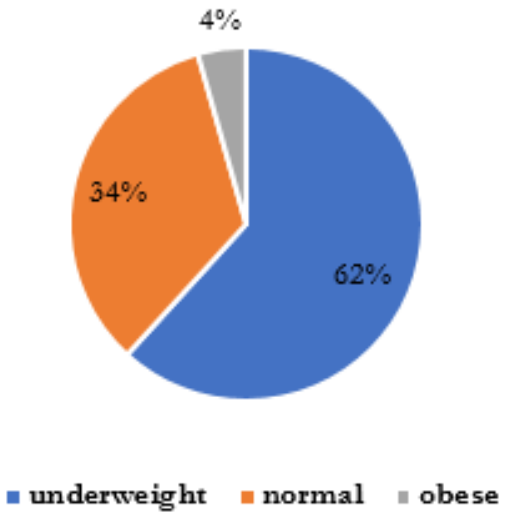

Figure 2. Distribution of Students Based on Nutritional Status at SMPN 2 Sumber in February 2025

Based on Figure 3, the number of respondents from SMPN 2 Sumber was 68 students. The majority of them had low IQ, namely 73.5%. Meanwhile, students with average IQ were 26.5%.

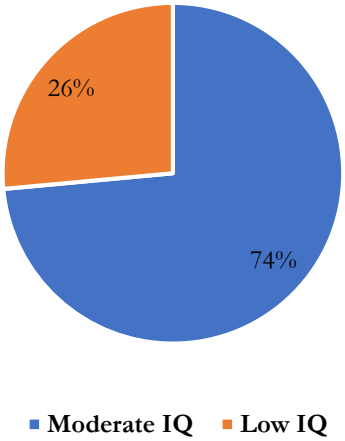

Figure 3. Distribution of Students Based on Nutritional Status at SMPN 2 Sumber in February 2025.

The bar chart below illustrates the distribution of nutritional status based on IQ among students at SMPN 2 Sumber. The majority of students with low IQ (38 students) are underweight, while only 4 students with moderate IQ fall into this category. In the normal nutritional status category, there are 11 students with low IQ and 12 students with moderate IQ, indicating a more balanced distribution between the two IQ groups. As for obesity, there is only 1 student with a low IQ and 2 students with a moderate IQ, indicating a very low prevalence of obesity in both IQ groups. Overall, students with low IQ are more likely to have underweight status, while students with moderate IQ are more evenly distributed between normal and obese nutritional status. Figure 4 shows that students at SMPN 2 Sumber mostly have an underweight nutritional status among students with low IQ, namely 38 students with a percentage of 76%. Meanwhile, in the moderate IQ group, the majority of respondents have a normal nutritional status with a percentage of 67%.

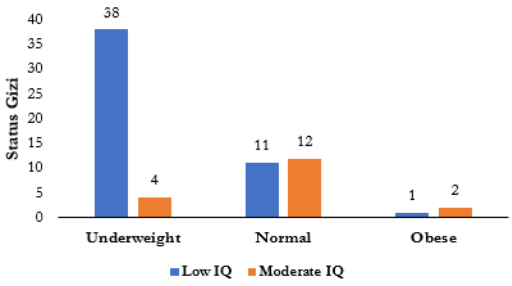

Figure 4. Bar Chart of the Relationship between Nutritional Status and IQ among students at SMPN 2 Sumber in February 2025

Table 4. Distribution of IQ by nutritional status among students at SMPN 2 Sumber in February 2025

	IQ			
	Low IQ		Moderate IQ	
	n	%	n	%
Normal Nutritional Status	11	22	12	67

Abnormal Nutritional Status	39	78	6	33
Total	**50**	**100**	**18**	**100**

Based on Table 4, it was found that students at SMPN 2 Sumber with low IQ had abnormal nutritional status (underweight and obese) by 78%. Meanwhile, students with average IQ had normal nutritional status by 67%.

Table 5. Independent Samples T test

Test	Value	P-Value	Conclusion
t-test for Equality of Means	t = -4.676	0.000	There is a significant difference between the two groups.

Based on statistical tests conducted on nutritional status and IQ using an independent T-test, which aimed to determine the relationship between the two variables. Prior to that, the analysis requirements test was conducted using a normality test to determine the suitability of using the independent T-test, and the data obtained was normally distributed. Then, from the results of the independent T-test of two independent samples, a p-value of $0.000 < 0.05$ was obtained, so it can be concluded that the intellectual intelligence variable is related to the nutritional status variable. Thus, the first hypothesis, H1, is accepted and H0 is rejected.

4.2. Discussion

Based on the results of a study conducted at SMPN 2 Sumber, Probolinggo Regency, the nutritional status and IQ of students aged 13-15 years showed several important findings that need to be discussed. Most of the respondents were 14 years old, and the results of the BMI (Body Mass Index) examination on 68 students showed that 42 students (61.8%) were underweight, 23 students (33.8%) had normal BMI, and 3 students (3.9%) were in the overweight and obese category. Underweight status was more prevalent among female students, indicating that inadequate nutrient intake affects a significant portion of the students. This aligns with previous research by Pangow et al. (2020), which found that 57% of adolescents were underweight. This nutritional deficiency is often caused by unhealthy eating patterns, such as restrictive diets to avoid weight gain, particularly among adolescent girls. In this case, it is important to pay attention to proper eating patterns to support the physical and mental development of students [27].

Poor nutritional status in adolescents can lead to more serious health problems, such as anemia and growth disorders. Adolescent girls, in particular, require more attention in maintaining good nutritional status because insufficient iron intake can increase the risk of anemia, which can impact productivity and long-term health. In addition, data from Riskesdas 2010 also shows that teenage pregnancy can pose high health risks, such as preeclampsia and low birth weight. Therefore, it is important to ensure that adolescents have good nutritional status to support their future health [28].

In terms of IQ, research shows that 73.5% of students at SMPN 2 Sumber have low IQ, while 26.5% have moderate IQ. Most students with low IQ are aged 13 and 14, with the

majority being female. This study is in line with research by Malelak et al. (2022), which indicated that most adolescents have low IQ [29]. However, this study is not entirely consistent with other studies stating that adolescent age does not influence IQ levels. Factors such as environment, education, and cognitive stimulation play a more significant role in IQ development. Additionally, nutritional factors, particularly during the growth period, have a significant impact on adolescents' cognitive abilities. Poor nutrition can hinder brain development, which in turn affects IQ scores.

The results of this study indicate a significant relationship between nutritional status and IQ, which was tested using the T-Test method. Of the 68 respondents, 39 students with low IQ (<100) also had poor nutritional status (underweight). This shows that the better the nutritional status, the better the students' IQ, while poor nutritional status is associated with low IQ. This study is in line with the findings of Ardi et al. (2021), which showed that poor nutritional status can affect cognitive abilities and brain function in general. Malnutrition, especially protein malnutrition, can cause disturbances in brain maturation, which impacts students' IQ and academic performance [30]. Therefore, it is very important to ensure adequate nutrition during adolescence so that their intellectual development can proceed optimally.

However, despite the significant relationship between nutritional status and IQ in this study, research by Mahyiddin et al. (2019) states that intellectual intelligence is not only influenced by nutritional status but also by genetic and environmental factors. This study also shows that external factors, such as students' motivation and understanding of IQ tests, can influence the results obtained [26].

Being underweight or obese can disrupt children's growth and development, which in turn affects their brain function and IQ. Students with normal nutritional status tend to have higher IQ scores than those with poor nutritional status. This is in line with research showing that children with more normal body weight tend to have better IQ scores. This condition emphasizes that healthy nutritional status is important for supporting children's physical and mental development.

Finally, this study has several limitations, such as not all students brought informed consent forms signed by their parents, so some students could not be included in the study sample. In addition, although this study focused on nutritional status, many other factors can influence IQ, such as the environment, genetics, and parents' economic status, which could not be fully analyzed in this study. Nevertheless, this study provides important insights into the relationship between nutritional status and IQ, as well as the importance of maintaining a balanced diet during adolescence.

5. Conclusions

Based on the findings of this study, it can be concluded that there is a significant relationship between nutritional status and intellectual intelligence (IQ) among students at SMPN 2 Sumber, Kabupaten Probolinggo. The majority of students were found to have underweight status, with 61.8% of 14-year-old students in this category. Furthermore, 90% of the students with underweight status had low IQ, indicating that poor nutritional status is linked to lower cognitive abilities. Statistical analysis using the independent T-test revealed a significant correlation between nutritional status and IQ, with a p-value of 0.007, supporting the hypothesis that better nutritional status leads to higher IQ levels. These findings align with previous research that emphasizes the role of nutrition in cognitive development, underscoring the need for interventions to improve nutritional intake in order to enhance academic performance and intellectual growth among school-aged children.

The implications of these findings contribute to the broader understanding of how proper nutrition is critical for cognitive development during adolescence. This study highlights the importance of providing children with adequate nutrition, particularly in their formative years, to ensure optimal brain development and academic success. Although the study provides valuable insights, it has limitations, including its cross-sectional design and reliance on self-reported data, which may introduce bias. Future research should explore longitudinal studies with objective measures of both nutritional intake and IQ to better understand the causal relationship between these variables.

In terms of recommendations, this research suggests that future studies should investigate the long-term effects of nutritional interventions on IQ development, employing experimental designs to determine causality. For parents, it is crucial to be proactive in ensuring that their children receive a balanced diet rich in essential nutrients, as proper nutrition directly impacts cognitive development. Healthcare providers should take a more active role in monitoring children's nutritional status and educating families on the importance of good nutrition for brain health. Finally, schools should support programs that provide healthy meals and nutritional education to students, thereby fostering an environment that encourages both physical and intellectual growth. Overall, this study emphasizes that improving nutritional status can significantly enhance cognitive abilities and academic performance, contributing to better outcomes for students.

Author Contributions: Conceptualization: T.A.P. and S.U.; Methodology: T.A.P.; Software: T.A.P.; Validation: T.A.P., S.U., and M.M.M.; Formal analysis: T.A.P.; Investigation: T.A.P.; Resources: T.A.P.; Data curation: T.A.P.; Writing—original draft preparation: T.A.P.; Writing—review and editing: S.U. and M.M.M.; Visualization: T.A.P.; Supervision: S.U.; Project administration: S.U.; Funding acquisition: M.M.M.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy and ethical restrictions involving underage respondents.

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Conflicts of Interest: The authors declare no conflict of interest.

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