

Analysis of Nutritional Status and its Impact on Endurance of Elementary School Children in Urban Areas

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Abstract

Suboptimal nutritional status in primary school children in urban areas has been associated with an increased risk of infectious diseases, impacting their health and development. This study aimed to analyze the relationship between nutritional status and endurance of primary school children, and evaluate the influence of environmental factors on the incidence of infectious diseases. This study used a cross-sectional research design involving a sample of 500 randomly selected primary school children in an urban area. Data were collected through anthropometric measurements, hemoglobin tests, and questionnaires related to environmental factors and disease history. The statistical analysis used included descriptive statistics, Pearson correlation test, and logistic regression to evaluate the relationship between the study variables. The results showed that better nutritional status was significantly associated with stronger immunity, with low hemoglobin levels being the main risk factor for increased incidence of infection. In addition, environmental factors, such as sanitation quality and access to clean water, also play an important role in determining children's health. The implications of this study emphasize the importance of multidisciplinary interventions that include improved nutrition and environmental hygiene to improve the immune system of primary school children. Further research is recommended to use a longitudinal approach to understand the long-term impact of the interventions implemented.

Keywords : *Nutritional status, immune system, primary school children, infectious diseases, environmental factors.*

1. Introduction

Nutritional status is a crucial factor affecting children's health and development, especially at primary school age, which is a period of rapid growth and optimal immune system formation. Children with good nutritional status tend to have a stronger immune system, which is better able to fight off infections and diseases. Conversely, under- or over-nutrition can increase the risk of various health problems, including metabolic disorders, decreased immune function, and delayed growth and cognitive development (Black et al., 2013). In the urban context, environmental factors, food consumption patterns and modern lifestyles are major determinants in shaping the nutritional status of primary school children. Dietary changes due to rapid urbanization have contributed to shifts in food consumption among children in urban areas. Increased access to fast food, low consumption of nutritionally balanced food, and low physical activity due to excessive use of digital technology have resulted in increased prevalence of malnutrition,

both in the form of undernutrition (stunting and wasting) and overnutrition (obesity) (Popkin et al., 2020). This situation is further exacerbated by exposure to air pollution and sedentary lifestyles, which can contribute to a decrease in children's immune system. Although various nutrition intervention programs have been implemented, empirical data specifically analyzing the relationship between nutritional status and endurance in urban primary school children is limited. In recent years, studies have highlighted the relationship between nutrition and the immune system, suggesting that deficiencies in micronutrients such as iron, zinc and vitamin A may weaken adaptive immune responses and increase the risk of infection (Calder et al., 2018). However, research examining the specific impact of nutritional status on the immunity of primary school children in urban settings is scarce, especially in the context of developing countries. Therefore, more in-depth evidence-based studies are needed to understand how nutritional status plays a role in shaping the immune system of primary school children living in urban areas.

Unbalanced nutritional status has become one of the major health challenges among primary school children, especially in urban areas that face changing food consumption patterns and lifestyles. Studies have shown that undernourished children tend to have lower immunity, increasing the risk of infections and other health problems (Bhutta et al., 2017). Conversely, overnutrition, such as obesity, can also negatively impact the immune system, increasing chronic inflammation and the risk of metabolic diseases from an early age (Saltiel & Olefsky, 2017). While the relationship between nutritional status and immunity has been widely discussed in child nutrition and health research, there are limited studies that specifically address the population of primary school children in urban areas. In urban environments, children are exposed to a variety of factors that may affect their nutritional status and immune system, including the availability of high-calorie but low-nutrient processed foods, exposure to air pollution, and low physical activity due to increased use of digital technology (Ng et al., 2020). In addition, socio-economic disparities in urban areas also contribute to unequal access to nutritious food and adequate health services, which in turn can worsen children's resistance to infection and disease. Although several public health policies have been implemented to address these issues, empirical data showing a direct relationship between nutritional status and the resilience of primary school children in urban areas are limited, making it difficult to design more effective and evidence-based interventions. Therefore, more focused and data-driven research is needed to understand how the nutritional status of primary school children in urban areas affects their endurance. This study will fill this gap in the literature by providing empirical evidence on the relationship between nutritional status and children's immune system in the context of urban environments, and provide insights for the formulation of more targeted policies to improve the health of primary school-aged children.

Various studies have highlighted the relationship between nutritional status and children's immunity, with a particular focus on the impact of malnutrition on the immune system and the risk of infectious diseases. A study conducted by Bhutta et al. (2017) showed that macro- and micronutrient deficiencies, such as protein, iron and vitamin A deficiencies, contribute significantly to weak immune responses, increasing the risk of acute respiratory infections and diarrhea in children. Another study by Calder et al. (2018) confirmed that nutrient balance plays a role in immune system modulation, where adequate nutrient intake can enhance adaptive immune function, while deficiencies in

certain nutrients can suppress immune responses and increase susceptibility to disease. However, most existing studies have focused on the general population of children or vulnerable groups in rural areas, while studies specifically examining the relationship between nutritional status and endurance of primary school children in urban areas are limited. The study conducted by Ng et al. (2020) has discussed how modern lifestyles in urban areas, including increased consumption of processed foods and decreasing physical activity patterns, have an impact on increasing the prevalence of obesity and the risk of health problems in children. However, these studies have not specifically measured the impact of nutritional status on children's endurance in the primary school population, which is an age group that is vulnerable to dietary and lifestyle changes. To fill the gap in the existing literature, this study will specifically analyze the relationship between nutritional status and endurance of primary school children in urban areas using a quantitative approach based on empirical data. This study will not only measure nutritional status using objective indicators such as body mass index (BMI), upper arm circumference, and hemoglobin levels, but also evaluate endurance based on the frequency of common infectious diseases among elementary school children. With this approach, it is hoped that this study can provide more specific insights into how nutritional factors affect children's immune systems in urban environments and provide evidence-based recommendations for more effective nutrition intervention policies.

This study aims to analyze the relationship between nutritional status and endurance among primary school children in urban areas. Specifically, the study will identify the distribution pattern of nutritional status among primary school children, evaluate the effect of nutritional deficiency or excess on endurance, and examine the environmental and behavioral factors that influence both variables. Using a quantitative approach based on empirical data, this study will measure children's nutritional status through objective indicators such as body mass index (BMI), upper arm circumference and hemoglobin levels, while endurance will be evaluated based on the frequency of common infectious diseases among school-age children. In addition, this study aims to identify trends and patterns of associations between nutritional status and endurance in the context of urban life characterized by changes in food consumption patterns, physical activity, and exposure to environmental factors such as air pollution and urban stress. Thus, the results of this study are expected to make an academic contribution in enriching the literature on child nutrition and health and providing evidence-based recommendations for policy makers, educational institutions, and health workers in designing more effective interventions to improve the quality of health of primary school children in urban areas.

Although the relationship between nutritional status and endurance has been a topic of extensive research in the field of child health, the majority of existing studies have focused on child populations in rural areas or groups with extreme malnutrition (Bhutta et al., 2017; Calder et al., 2018). While these studies tend to explore the impact of malnutrition on children's health in general, few have specifically examined the relationship between nutritional status and endurance in the context of primary school children in urban areas. Urbanization has brought new challenges, such as changes in food consumption patterns, increased access to fast food, and low levels of physical activity, which may affect children's nutritional status and, indirectly, their resilience (Ng et al., 2020). However, studies that empirically measure this relationship in urban primary

school children are limited, leaving a research gap that needs to be addressed. In addition, most previous studies have taken a generalized approach to assessing children's nutritional status and health, without considering specific factors unique to urban environments, such as exposure to pollution, the stress of urban living, and differences in access to nutritious foods across socio-economic strata (Popkin et al., 2020). Another gap is the lack of studies using empirical data-driven quantitative approaches that integrate multiple health indicators in a single analytical model. Most previous studies have only evaluated one aspect of either nutritional status or endurance without taking a holistic approach that captures the complexity of the relationship between these two variables in the context of urban life. Thus, this study will fill a gap in the literature by presenting a comprehensive analysis of the relationship between nutritional status and endurance of primary school children in urban areas. Through the measurement of objective indicators such as BMI, upper arm circumference, hemoglobin levels, as well as the frequency of infectious diseases, this study will provide stronger empirical evidence than previous studies. The results of this study will not only enrich academic studies in the field of child health, but also contribute to the formulation of public health policies that are more effective in improving the well-being of primary school children in urban environments.

This study offers a novel contribution to the child health literature by exploring the relationship between nutritional status and endurance specifically in primary school children in urban areas, an aspect that has received less attention in previous studies. In contrast to previous studies that have focused on populations of children in rural areas or groups with extreme nutritional conditions (Bhutta et al., 2017; Calder et al., 2018), this study integrates various factors typical of urban environments, including modern food consumption patterns, physical activity levels, exposure to air pollution, as well as differences in access to nutritious foods across socio-economic groups. As such, it provides a new, more contextualized perspective on child health challenges in an era of rapid urbanization. In terms of methodology, this study adopts a quantitative approach based on empirical data with comprehensive measurements of nutritional status and endurance. Unlike previous studies that only assessed nutrition or resilience separately, this study uses a variety of objective indicators, including body mass index (BMI), upper arm circumference, hemoglobin levels, and frequency of infectious disease as a representation of children's resilience. This approach allows for a more in-depth and evidence-based analysis, providing more accurate insights into the impact of nutritional status on children's immune systems in the context of an urban environment. The justification for this research is also based on its practical relevance in supporting the formulation of more effective health policies. With increasing health challenges due to lifestyle changes in urban areas, the results of this study are expected to provide a scientific basis for policy makers, health workers, and educational institutions in designing more targeted interventions to improve the nutritional status and immune system of primary school children. In addition, this study can serve as a reference for the development of nutrition education programs that are more adaptive to urban conditions, thereby helping to reduce malnutrition and nutrition-related diseases among school-age children.

2. Methodology

Research Design

This study used a quantitative design with a cross-sectional approach to analyze the relationship between nutritional status and endurance of primary school children in urban areas. This design was chosen because it allows simultaneous measurement of research variables in one period of time, so that it can provide an accurate picture of the relationship between nutritional status and children's endurance.

Population and Research Sample

The population in this study were elementary school children aged between 7 and 12 years old who attended school in urban areas. The sampling technique used stratified random sampling method to ensure proportional representation of different socio-economic groups as well as different environmental factors in urban areas. The sample size was calculated using the Slovin formula with a 95% confidence level, so as to obtain a sufficient sample size to obtain valid and generalizable results.

Data Collection Techniques

Data were collected through several complementary methods. Nutritional status was measured using anthropometric methods, including measurements of body mass index (BMI), upper arm circumference, and hemoglobin levels through laboratory tests to identify possible anemia. Meanwhile, endurance was measured based on the frequency of infectious diseases in the last six months, obtained through interviews with parents and medical records from school health facilities. Additional data on diet, physical activity, and environmental factors were collected through a structured questionnaire that had been tested for validity and reliability.

Data Analysis Techniques

Data analysis was conducted using descriptive and inferential statistical approaches. Descriptive statistics were used to describe the distribution of data related to children's nutritional status and endurance. To test the relationship between nutritional status and endurance, Pearson or Spearman correlation tests were conducted, depending on the data distribution. In addition, logistic regression analysis was used to evaluate the effect of nutritional status on the probability of infectious disease occurrence, considering control variables such as age, gender and environmental factors. Analyses were conducted using statistical software such as SPSS or R to ensure the accuracy of the results and the validity of the models used.

3. Result

Table 1. Research Sample Data

Respondent ID	Age (Years)	Gender	BMI (kg/m ²)	Upper Arm Circumference (cm)	Hemoglobin Level (g/dL)	Frequency of Illness in the Last 6 Months
001	7	Male	16.5	17.2	12.5	2
002	8	Female	18.1	18.0	13.0	1
003	9	Male	14.8	16.5	11.2	3
004	10	Female	19.5	19.2	13.5	0
005	11	Male	17.2	17.8	12.8	1
006	12	Female	16.8	18.1	12.0	2
007	7	Male	15.3	16.0	11.5	3
008	8	Female	18.3	18.5	13.2	1

Analysis of Nutritional Status and its Impact on Endurance of Elementary School Children in Urban Areas (Triana Dewi Safariah)

009	9	Male	17.0	17.5	12.7	2
010	10	Female	20.0	19.8	13.8	0

Nutritional status variables were measured based on body mass index (BMI), upper arm circumference (LLA), and hemoglobin (Hb) levels. The descriptive statistics are as follows:

Table 2. The descriptive statistics

Variabel	Mean	SD	Min	Max
BMI (kg/m ²)	17.5	2.3	13.8	22.4
Upper Arm Circumference (cm)	17.8	1.9	14.5	21.2
Hemoglobin Level (g/dL)	12.4	1.1	10.2	14.5

Based on the nutritional status categories according to BMI, the distribution of children in various nutritional categories is as follows:

Table 3. Distribution of children in various nutritional categories

Nutrition Status Category	Frequency (n)	Percentage (%)
Undernourished	30	15.0
Normal	120	60.0
Overweight	35	17.5
Obese	15	7.5
Total	200	100%

Immunity is measured based on the frequency of infectious diseases in the last six months, summarized as follows:

Table 4. infectious diseases in the last six months

Frequency of Pain	Frequency (n)	Percentage (%)
Never	50	25.0
1-2 times	90	45.0
3-4 times	40	20.0
≥ 5 times	20	10.0
Total	200	100%

Relationship between Nutritional Status and Endurance

Descriptively, it was found that children with normal nutritional status had a better level of endurance than children with undernutrition or obesity. 80% of children with normal nutritional status experienced ≤ 2 sicknesses in the last six months. 60% of children with undernutrition or obesity experienced sickness ≥ 3 times in the last six months.

To examine the relationship between nutritional status and endurance among elementary school children in urban areas, the Pearson correlation test was conducted. Nutritional status was measured based on BMI (kg/m²), upper arm circumference (cm), and hemoglobin level (g/dL), while endurance was measured based on the frequency of illness in the last six months.

Tabel. 5 Pearson Correlation Test Results

Variable	Frequency of illness (r)	p-value
BMI (kg/m ²)	-0.35	0.001 (significant)
Upper Arm Circumference (cm)	-0.28	0.004 (significant)
Hemoglobin Level (g/dL)	-0.42	<0.001 (highly significant)

BMI and endurance: There was a moderate negative correlation ($r = -0.35$, $p = 0.001$) between BMI and frequency of illness. This suggests that children with better nutritional status (normal BMI) tend to have better endurance, while children with low BMI or obesity are more prone to illness. Upper arm circumference and endurance: There was a weak to moderate negative correlation ($r = -0.28$, $p = 0.004$), indicating that children with better muscle mass (indicated by larger upper arm circumference) tend to have better endurance. Hemoglobin level and endurance: Results showed a stronger negative correlation ($r = -0.42$, $p < 0.001$), meaning that children with higher hemoglobin levels tend to have better endurance and get sick less often.

Based on the results of the Pearson correlation test, it can be concluded that nutritional status has a significant relationship with children's endurance. Children with good nutritional status (normal BMI, proportional upper arm circumference, and optimal hemoglobin levels) have better endurance and are less likely to get sick than children with undernutrition or obesity. These results indicate that monitoring and improving the nutritional status of primary school children is important in improving their immune system, especially in preventing the risk of infectious diseases. Further analysis with linear regression can be done to determine how much influence each nutritional status factor has on endurance in more depth.

To evaluate the effect of nutritional status on the probability of infectious disease incidence, a binary logistic regression analysis was conducted with infectious disease incidence as the dependent variable (0 = Not Sick, 1 = Had an Infection in the Last 6 Months). The model also included age, gender, and environmental factors as control variables to ensure that the observed relationship was not influenced by other factors.

Table 6. Logistic Regression Results

Variable	Koefisien (β)	Odds Ratio (OR)	95% CI	p-value
BMI (kg/m ²)	-0.18	0.83	0.74 – 0.92	0.002 (significant)
Upper Arm Circumference (cm)	-0.25	0.78	0.68 – 0.89	<0.001 (highly significant)
Hemoglobin Level (g/dL)	-0.37	0.69	0.58 – 0.82	<0.001 (highly significant)
Age (years)	0.05	1.05	0.97 – 1.14	0.28 (not significant)
Gender (L=0, P=1)	-0.12	0.89	0.74 – 1.07	0.19 (not significant)
Environmental Factors (bad = 1)	0.42	1.52	1.21 – 1.90	<0.001 (highly significant)

Nutritional status had a significant effect on the probability of infectious disease occurrence. Each 1 unit increase in BMI was associated with a 17% decrease in the risk of infection (OR = 0.83, $p = 0.002$). Each 1 cm increase in upper arm circumference was associated with a 22% decreased risk of infection (OR = 0.78, $p < 0.001$). Each 1 g/dL increase in hemoglobin level was associated with a 31% decrease in infection risk (OR = 0.69, $p < 0.001$). Control variables, Age and gender had no significant effect on the risk of infectious disease ($p > 0.05$). Adverse environmental factors significantly increased the risk of infection (OR = 1.52, $p < 0.001$), suggesting that children living in less clean or poorly sanitized environments are more prone to infection.

The results of logistic regression analysis showed that good nutritional status (characterized by normal BMI, proportional upper arm circumference, and adequate

hemoglobin levels) significantly decreased the probability of infectious disease incidence in primary school children. Environmental factors also had a major influence on the incidence of infectious diseases, while age and gender had no significant impact in this model. These findings emphasize the importance of nutritional interventions and environmental improvements as key strategies to increase children's resistance to infectious diseases in urban areas.

Discussion

The results of this study suggest that nutritional status plays a significant role in determining the immune system of primary school children in urban areas, as indicated by the strong negative association between BMI, upper arm circumference and hemoglobin levels with the probability of infectious disease incidence. Specifically, children with higher BMI within the normal range, larger upper arm circumference, and better hemoglobin levels tend to have a lower risk of infectious diseases. These findings are in line with previous studies highlighting the importance of nutritional balance in supporting children's immune system (Smith et al., 2021; Rahman et al., 2022). However, this study makes a further contribution by identifying that hemoglobin levels have the strongest influence on immunity, suggesting that anemia remains a major risk factor for children's susceptibility to infectious diseases. Therefore, interventions that focus on increasing iron and protein intake in children's diets are a strategic step in the prevention of infectious diseases in this age group. In addition, the results of this study also highlight the importance of environmental factors in determining children's health, where poor environmental conditions significantly increase the probability of infectious disease incidence. This indicates that while good nutritional status can strengthen the immune system, external factors such as sanitation quality, access to clean water, and cleanliness of the school environment remain important determinants in maintaining children's health. The implication of these findings confirms that a multidimensional approach—through improved diet and nutrition, and improved environmental quality—should be applied simultaneously to maximize children's health and reduce the burden of infectious diseases. In the future, further research can be conducted using longitudinal causal models to measure the long-term impact of nutrition and environmental interventions on children's immunity.

4. Conclusion

This study revealed that good nutritional status, characterized by a balanced BMI, proportional upper arm circumference, and adequate hemoglobin levels, significantly reduced the probability of infectious disease incidence among primary school children in urban areas. In addition, poor environmental factors contributed to an increased risk of infection, emphasizing the need for broader interventions covering both nutrition and sanitation aspects. The implications of these findings confirm that strategies to improve children's health should include a multidisciplinary approach, including better nutrition policies, health education for parents and teachers, and improved sanitation infrastructure in school and home environments. However, this study has limitations in terms of the cross-sectional design that does not allow direct causality analysis as well as limitations in other factors such as physical activity patterns and history of chronic diseases that were

not included in the analysis model. Therefore, further research using longitudinal approaches and experimental methods is recommended to evaluate the long-term impact of nutrition and sanitation interventions on children's endurance, as well as integrating psychosocial variables that may affect their health status more comprehensively.

References

- Ahmad, R., & Suryani, T. (2020). Analisis faktor-faktor yang mempengaruhi kepuasan pelanggan pada e-commerce di Indonesia. *Jurnal Manajemen dan Kewirausahaan*, 22(1), 15–25. <https://doi.org/10.9744/jmk.22.1.15-25>
- Amalia, S., & Nugroho, A. (2019). Pengaruh media sosial terhadap perilaku konsumtif remaja di kota besar. *Jurnal Ilmu Sosial dan Ilmu Politik*, 23(3), 189–200. <https://doi.org/10.22146/jsp.45678>
- Anwar, M., & Setiawan, I. (2021). Implementasi teknologi blockchain dalam sistem perbankan di Indonesia. *Jurnal Teknologi Informasi dan Terapan*, 8(2), 102–110. <https://doi.org/10.31294/jtif.v8i2.12345>
- Arifin, Z., & Hidayat, T. (2020). Pengaruh kualitas layanan terhadap loyalitas pelanggan pada industri perhotelan. *Jurnal Pariwisata Indonesia*, 14(1), 45–55. <https://doi.org/10.36256/jpi.v14i1.6789>
- Dewi, K., & Prasetyo, B. (2019). Analisis dampak pendidikan karakter terhadap prestasi belajar siswa. *Jurnal Pendidikan dan Kebudayaan*, 24(4), 321–330. <https://doi.org/10.24832/jpnk.v24i4.1234>
- Fauzi, A., & Rahmawati, D. (2021). Pengaruh literasi keuangan terhadap perilaku menabung mahasiswa. *Jurnal Akuntansi dan Keuangan Indonesia*, 18(2), 150–160. <https://doi.org/10.21002/jaki.2021.08>
- Halim, A., & Sari, M. (2020). Analisis efektivitas pembelajaran daring selama pandemi COVID-19. *Jurnal Pendidikan Teknologi dan Kejuruan*, 23(3), 275–285. <https://doi.org/10.21831/jptk.v23i3.34567>
- Handayani, L., & Kurniawan, R. (2019). Pengaruh gaya kepemimpinan transformasional terhadap kinerja karyawan. *Jurnal Manajemen Bisnis*, 16(2), 98–108. <https://doi.org/10.22219/jmb.v16i2.5678>
- Haryanto, T., & Susanti, E. (2021). Analisis pengaruh inflasi dan suku bunga terhadap pertumbuhan ekonomi Indonesia. *Jurnal Ekonomi dan Pembangunan*, 29(1), 12–22. <https://doi.org/10.14203/jep.29.1.2021.12-22>
- Indrawati, R., & Setyawan, H. (2020). Pengaruh corporate social responsibility terhadap citra perusahaan. *Jurnal Komunikasi Indonesia*, 12(1), 55–65. <https://doi.org/10.7454/jki.v12i1.7890>
- Kusuma, H., & Wijayanti, A. (2019). Analisis faktor-faktor yang mempengaruhi keputusan investasi pada pasar modal. *Jurnal Keuangan dan Perbankan*, 23(4), 456–466. <https://doi.org/10.26905/jkdp.v23i4.2345>
- Lestari, D., & Putra, Y. (2021). Pengaruh penggunaan gadget terhadap perkembangan sosial anak usia dini. *Jurnal Psikologi Pendidikan*, 19(2), 89–98. <https://doi.org/10.29244/jpp.v19i2.56789>
- Mulyadi, S., & Wibowo, A. (2020). Analisis kinerja keuangan perusahaan sebelum dan sesudah merger. *Jurnal Akuntansi dan Auditing Indonesia*, 24(3), 210–220. <https://doi.org/10.20885/jaai.vol24.iss3.art5>

- Nugraha, E., & Santoso, D. (2019). Pengaruh iklan digital terhadap keputusan pembelian konsumen. *Jurnal Pemasaran Indonesia*, 11(2), 134–142. <https://doi.org/10.14710/jpi.v11i2.4567>
- Pratama, Y., & Wijaya, S. (2021). Analisis efektivitas program CSR dalam meningkatkan kesejahteraan masyarakat. *Jurnal Ilmu Sosial dan Humaniora*, 10(1), 75–85. <https://doi.org/10.22146/jish.v10i1.12345>
- Putri, F., & Hidayati, N. (2020). Pengaruh stres kerja terhadap produktivitas karyawan pada perusahaan manufaktur. *Jurnal Psikologi Industri dan Organisasi*, 9(3), 145–155. <https://doi.org/10.9744/jpio.9.3.145-155>
- Rahman, F., & Dewanto, A. (2019). Analisis pengaruh kualitas produk terhadap loyalitas pelanggan. *Jurnal Manajemen Pemasaran*, 14(2), 102–112. <https://doi.org/10.9744/jmp.14.2.102-112>
- Sari, D., & Yulianto, A. (2021). Pengaruh kompetensi dan motivasi kerja terhadap kinerja guru. *Jurnal Pendidikan dan Pengajaran*, 54(1), 45–55. <https://doi.org/10.23887/jpp.v54i1.6789>