The Association Between Nutritional Status and Physical Fitness of 1st Mulyosari Elementary School Students

Ni Made Ida Damma Anggraeni[1*], Khairun Nisa Berawi[2], Dyah Wulan Sumekar Rengganis Wardani[3], Agustyas Tjiptaningrum[4]

Universitas Lampung, Lampung, Indonesia[1,2,3,4]

khairun.nisa@fk.unila.ac.id[2]

Abstract

Purpose: Adequate nutritional intake is essential during the school-age period to support growth and development. In addition to fulfilling energy requirements, nutrient-rich foods contribute to the proper development of body tissues. When the diet lacks sufficient essential nutrients, and this condition persists over time, the growth of muscles and bones may be impaired, ultimately influencing an individual's level of physical fitness.

Methodology/approach: This study utilized a cross-sectional design with the chi-square test. A total of 95 respondents satisfied the established inclusion and exclusion criteria.

Results: Of the respondents, 24 (25.3%) were classified as obese based on Body Mass Index (BMI), 46 (48.4%) had normal BMI, and 25 (26.3%) had underweight BMI. Regarding physical fitness, 20 (21.1%) respondents were categorized as having poor fitness, 20 (21.1 %) had moderate fitness, and 55 (57.9%) demonstrated good physical fitness. The analysis yielded a p-value of $p < 0.001$, which is $p < 0.050$.

Conclusions: This study found a relationship between nutritional status and physical fitness among elementary school students.

Limitations: This study had limitations owing to its relatively small sample size and the use of a cross-sectional design, which does not allow us to determine causal links between nutritional status and physical fitness.

Contributions: This study offers valuable insights into the relationship between nutritional status and physical fitness. The findings may facilitate the early identification of nutrition-related fitness problems and serve as supporting evidence for school-based and health program interventions.

Keywords: *Elementary School Children, Nutritional Status, Physical Fitness*

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1. Introduction

Nutritional status is an important variable in the development of high-quality Human Resources (HR). Nutritional deficiencies in children not only reduce physical activity capacity but also limit social and educational participation, thereby reducing community development resources. Chronic malnutrition can affect the growth of toddlers, impair the immune system, and increase the risk of infectious diseases and death in toddlers (Sutrisno & Tamim, 2023). The Human Development Index (HDI) is one variable that can be used to compare HR quality. Southeast Asian regions, such as Singapore, Brunei Darussalam, Malaysia, and Thailand, have higher HDI values than Indonesia, which ranked 107th out of 189 countries in 2020.

The HDI is determined by education, health, and the economy. Education and health issues are interrelated because an effective education process requires students to have good nutritional status and physical condition (Trasia, 2024; Ulaiya, Nurdin, Fitria, & Dinen, 2024). Physical fitness refers to the ability of the body to perform activities without fatigue and have adequate reserves to face unexpected situations while actively relaxing. Malnourished children are less physically active, which negatively impacts their health and education, especially their academic performance. Children who are short and thin are more likely to be delayed, weak in class, and to skip school. In Indonesia, 20.5% and 15.1% of children aged 6–12 years are classified as short and/or very short, respectively.

Using BMI/U as an indicator, the prevalence of thin and severely thin children is 7.6% and 4.6%, respectively. Nutritional problems can be caused by a deficiency of nutrients in the past or present (Fauzan, Nurmalasari, & Anggunan, 2021; Riska, Latifah, & Istiany, 2023; Sutrisno & Tamim, 2023). Nutritious food must be consumed at school age to encourage growth and development. The body that receives adequate nutrition over time will experience a slowdown in bone and muscle growth, which will impact physical fitness. Every day, children with inadequate nutrition will quickly feel tired and tend to be unmotivated, disrupting teaching and learning activities at school and lowering their academic performance.

In addition, owing to less-than-ideal brain development, children 's thinking abilities decrease (Fathonah & Sarwi, 2020). Proper nutrition is crucial for promoting healthy growth in children. The goal of consuming healthy and balanced food is to improve HR quality. Physical fitness and nutrition are indicators of the long-term nutritional status of elementary school children, which can range from malnutrition to overnutrition. In terms of body metabolism, nutrients such as carbohydrates, proteins, and other substances, especially iron, calcium, and vitamins, contribute to physical fitness and concentration capacity and are directly related to learning success. It is hoped that healthy eating habits will affect academic performance.

School-age children (aged 7–12 years) require more energy because of their high levels of physical activity, such as playing, exercising, and helping their parents. The energy needs of children aged 10–12 years are higher than those of children aged 7–9 years because of their accelerated growth, especially in height. School-age children are considered a vulnerable population in terms of nutrition because of their rapid growth, which demands many nutrients. Although there are still many cases of inadequate nutrition in school-age children, such as underweight, iron-deficiency anemia, vitamin C deficiency, and iodine deficiency, their nutritional status is generally better than that of toddlers (in certain areas). This group emphasizes that children in this age range struggle to eat enough and regularly because of malnutrition (Irnani & Sinaga, 2017).

Nutritional status data (height-for-age) of school-age children in Lampung Province show that 5.2% of children are very short, 16.2% are short, and 78.8% are of normal height. In East Lampung Regency, 12.2% of children have small bodies, while 7.5% have average height. There are several elementary schools at the village level. Elementary schools are located in various areas, including urban, rural, and hilly regions, including in Mulyosari District, which is part of East Lampung Regency. Based on the previous explanation, the researcher intends to further explore the relationship between students' nutritional status and physical fitness levels during the 2021/2022 academic year at SDN 1 Mulyosari, located in Pasir Sakti District, East Lampung Regency. Nutritional status is significantly influenced by environmental health conditions, wherein repeated parasitic infections due to poor sanitation can disrupt nutrient absorption and contribute to nutritional status disorders, especially in endemic areas (Trasia, 2024).

Although the impact of malnutrition on toddler health has been extensively studied, empirical evidence in the school-age population, particularly studies that directly assess the relationship between nutritional status and physical fitness as predictors of learning readiness, is still limited, local in nature, and has not explored geographically heterogeneous areas, such as East Lampung Regency (Norris et al., 2022). This gap in the literature underscores the need for more specific

research in elementary school settings with mixed geographical characteristics (urban, rural, and hilly). Furthermore, most previous studies have assessed nutrition and fitness separately; research integrating both as indicators of long-term human resource readiness in the context of primary education is still rare in Indonesia (Ortega, Ruiz, Castillo, & Sjöström, 2008).

Based on this, the present study brings novelty by assessing the relationship between height-for-age-based nutritional status and physical fitness in elementary school students, in schools with diverse geographical conditions, and contributing data for the 2021/2022 academic year at SDN 1 Mulyosari, Pasir Sakti District, East Lampung Regency. This focus is relevant because children aged 7–12 have high energy needs due to the intensity of physical activity and the acceleration of musculoskeletal growth, which impacts motor and cognitive performance (Norris et al., 2022; Ortega et al., 2008; Schwarzenberg et al., 2018). The findings of this study are expected to strengthen local scientific evidence as a basis for school-based nutrition-fitness interventions aimed at improving human resource quality starting from primary education.

2. Literature Review and Hypothesis/es Development

Children require special attention from their parents to achieve optimal growth and development. Children have distinct characteristics: they are always active, dynamic, enthusiastic, and curious about what they see, hear, and feel (Ginanjar, 2023). The World Health Organization (WHO) defines physical activity as bodily movements that involve muscle action and require energy expenditure. Physical activity is significant movement generated by muscles and bones, essentially requiring the use of body energy. A lack of physical activity can increase the risk of chronic diseases and even death. Physical movement involves bodily actions that result in tangible changes through muscle contractions and can be performed during rest, after school, at night, or on weekends (Dungga, 2020; Murbawani & Firiana, 2017).

Nutritional status plays a crucial role in achieving optimal physical fitness. This condition reflects the state of the body, which is influenced by food intake and how the body utilizes nutrients, thereby impacting physical growth and motor abilities. Furthermore, nutritional status indirectly determines the level of physical activity performed by students. When nutritional status is good, the body has sufficient energy to exercise without excessive fatigue and can perform other activities effectively. Thus, good nutritional status significantly influences the achievement of optimal physical fitness. It is important to note that nutritional status is not only determined by body weight and energy balance but also relates to body composition and clinical health (Gibney, Lanham-New, Hill, Gallagher, & Vorster, 2019).

Nutritional status plays an important role in determining the level of fitness in elementary school children. Children with good nutritional status usually have more energy, muscle strength, and endurance, allowing them to engage in physical activities and exercise more effectively. In contrast, poor nutritional status can reduce physical ability, cause quicker fatigue, and hinder motor development. Moreover, excessive nutritional status can also affect agility and endurance. Therefore, there is a strong relationship between nutritional status and fitness. Physical activity, especially during free time, helps increase daily energy expenditure according to individual fitness levels and provides benefits for physical fitness.

Other studies have revealed that the nutritional status of adolescents is also related to physical fitness. Energy balance occurs when energy intake matches energy expenditure. Hence, physical activity, nutritional status, and physical fitness are essential aspects that require further study (Caldwell et al., 2017; Casu, Gillespie, & Nisbett, 2020). In addition to dietary intake, recent research has emphasized that the physical fitness of school-age children is also influenced by non-dietary factors, such as sedentary behavior duration, sleep quality, and the activity environment at school. Children with a sitting time of >3 h/day have lower cardiorespiratory fitness performance despite having normal nutritional status, indicating that good nutrition is not necessarily protective without adequate physical activity (Prince et al., 2024).

School-based programs that combine nutrition education and structured physical activity 3–5 times a week have been shown to significantly improve VO2 max, muscle strength, and executive cognitive function compared to single interventions. In Southeast Asia, longitudinal studies have also reported that children with stunting tend to have lower motor fitness scores and aerobic capacity, which impacts sports participation, self-confidence, and academic performance (Ernawati, Syauqy, Arifin, Soekatri, & Sandjaja, 2021; Johanis, Budi, & Wibowo, 2025). These findings strengthen the urgency for research that examines the relationship between nutritional status and physical fitness in the elementary school population in Indonesia, particularly in areas with varying access to physical activity and dietary patterns, as both contribute directly to the readiness for developing high-quality Human Resources from early education (Johanis et al., 2025).

The following hypotheses were proposed in this study:

H₀: There is no significant relationship between nutritional status (height-for-age) and physical fitness levels among students of SDN 1 Mulyosari in the 2021/2022 academic year.

H₁: There is a significant relationship between nutritional status (height-for-age) and physical fitness levels among students at SDN 1 Mulyosari in the 2021/2022 academic year

3. Methodology

This analytical observational study was specifically designed to observe and analyze certain health conditions in relevant subject groups using a systematic approach based on empirical data. As the primary focus of this study was to identify the existence of a single causal relationship between the observed factors, a cross-sectional design was chosen as the most appropriate method, given its ability to capture a snapshot of conditions at a specific point in time without requiring a lengthy longitudinal intervention. The study used a probability sampling technique with Simple Random Sampling (SRS) because all members of the population (125 students in grades V–VI) had an equal chance of being selected.

The study was conducted intensively over three months, from May to July 2022, with the main location at SDN 1 Mulyosari in Pasir Sakti District, East Lampung Regency, a rural area that is representative for such studies because of its accessibility and demographic characteristics. The study population consisted of 125 students from grades V and VI at the school, selected because their age falls within a critical stage of physical development, in which factors such as nutrition and physical fitness can be observed. The sample was determined using Slovin's formula, which reliably calculates sample size from a finite population, resulting in 95 randomly selected and representative respondents, ensuring an adequate statistical confidence level.

The inclusion criteria were strictly applied to ensure data quality, including children aged 10 to 12 years who voluntarily agreed to participate in the entire research process, including measurements and questionnaire completion, after obtaining parental or guardian consent. Conversely, the exclusion criteria included children with a history of congenital diseases or chronic conditions that could affect measurement outcomes, such as endocrine or cardiovascular disorders, as well as children who were absent for more than seven days in a semester due to illness, to avoid bias from prolonged absenteeism. The independent variable in this study was defined as the nutritional status of the subjects, measured using standard anthropometric indicators such as Body Mass Index for age, while the dependent variable was the level of physical fitness, evaluated using scientifically validated physical tests such as the shuttle run or sit-up test.

The confounding factors controlled in this study included daily physical activity, sedentary behavior duration (screen time), eating habits, and sleep duration (Donnelly et al., 2016). Data were collected through a structured questionnaire completed by parents or guardians and verified by the researcher. The main relationship analysis used correlation testing, whereas the effects of confounders were tested using partial correlation or multivariate linear/logistic regression if the assumptions were met (Chaput et al., 2020).

4. Results and Discussions

Table 1. Characteristics of Body Mass Index (BMI)

BMI	F	%
Obesity	24	25.3
Normal	46	48.4
Underweight	25	26.3
Total	95	100.0

Table 1 shows the distribution of respondents' nutritional status based on Body Mass Index (BMI) by age, revealing significant variation among the 95 samples studied. The data reveal that 24 respondents (25.3 %) were in the obese category, indicating a relatively high proportion and a potential concern in the context of children's health in the elementary school setting in the area. Meanwhile, the majority of respondents (46 individuals, or 48.4 %) were in the normal BMI category, reflecting an ideal and balanced nutritional status according to anthropometric standards for ages 10–12 years. Additionally, 25 respondents (26.3%) were classified as underweight, indicating a risk of malnutrition or being underweight that cannot be overlooked, especially in relation to physical development and overall physical fitness. This distribution illustrates the heterogeneity of nutritional status in the study population, with no respondents falling into the very underweight or very obese categories, thereby strengthening the relevance of analyzing the relationship with the physical fitness variable.

Table 2. Level of physical fitness

Physical Fitness	F	%
Less	20	21.1
Moderate	20	21.1
Good	55	57.9
Total	95	100.0

Table 2 presents the distribution of respondents' physical fitness levels in detail, illustrating the variation in physical abilities among the 95 samples of children aged 10–12 years at SDN 1 Mulyosari. The results show that 20 respondents (21.1 %) fall into the low fitness category, indicating a physical condition below the minimum standard and potentially affecting daily activities as well as long-term health risks, such as cardiopulmonary weakness. Meanwhile, the same proportion (20 respondents or 21.1 %) are classified as having moderate fitness, reflecting adequate physical ability but not yet optimal, often related to inconsistent physical activity patterns or supporting nutritional factors. Most respondents (55 individuals or 57.9 %) are categorized as having good fitness, indicating excellent physical fitness levels that support the holistic development of children, in line with standard test criteria, such as shuttle run or sit-and-reach. This distribution highlights the dominance of good fitness in the study population, despite the presence of a minority group with lower levels that should be the focus of preventive interventions, particularly in relation to nutritional status (see Table 1).

Table 3. The relationship between nutritional status and physical fitness levels

BMI	Physical Fitness			P-Value
	Less	Moderate	Good	
Obesity	0 (0.0%)	10 (41.7%)	14 (58.3%)	< 0.001
Normal	2 (4.3%)	10 (21.7%)	34 (73.9%)	
Underweight	18 (72%)	0 (0.0%)	7 (28%)	
Total	20 (21%)	20 (21.1%)	55 (57.9%)	

Table 3 presents the cross-distribution between nutritional status based on Body Mass Index (BMI) and the respondents' physical fitness levels in depth, providing a bivariate relationship overview for the 95 samples of elementary school children at SDN 1 Mulyosari. Specifically, most respondents

with low or poor fitness levels had poor nutritional status, with 72%, indicating that being underweight or malnourished tends to contribute significantly to a decline in physical abilities, possibly due to deficiencies in essential nutrients that affect energy and muscle development. Furthermore, in the moderate physical fitness group, the majority of respondents were found to be in the obese category (41.7 %), highlighting the paradox that being overweight can hinder physical performance despite abundant calories, often due to relatively low muscle mass and mobility issues.

Respondents with good physical fitness predominantly fell within the normal nutritional status category (73.9 %), reinforcing the hypothesis that an ideal nutritional balance supports optimal cardiorespiratory capacity, strength, and endurance during this critical growth phase. The chi-square test results showed a p-value < 0.050 (ranging from 0.000 to 0.050), which was statistically significant, indicating a causal relationship between BMI and physical fitness. Therefore, it can be concluded that children's physical fitness tends to be better when their nutritional status is within the normal range, providing strong grounds for recommending nutritional interventions at the school level.

Physical fitness reflects an individual's ability to perform activities or tasks without excessive fatigue, allowing the body to still reserve energy to complete other tasks or handle additional stress. By definition, physical fitness is an individual's physical capacity to carry out their activities (Rasyid, Nuraisyah, Azis, Junaidi, & Supriyanto, 2025). The fitness level of students affects their ability to participate in various activities, both inside and outside of school, highlighting the importance of maintaining good physical fitness in everyday life. For elementary school students, physical fitness indicates a person's ability to perform tasks efficiently without significant fatigue, which is related to various components of physical fitness (Riadi & Satria, 2024)

Physical health is essential for students' learning activities at school, particularly so that they can engage in lessons without experiencing fatigue. If a child is not in a healthy physical condition, it will hinder their learning process and reduce their concentration on the lessons being taught. According to Riadi and Satria (2024), children with low physical fitness tend to feel weak and become fatigued more quickly during activities (Nuryadi, Negara, Juliantine, Slamet, & Gumilar, 2018).

Most respondents with low physical fitness had poor nutritional status (72 %). Additionally, respondents with moderate fitness were dominated by those who were obese (41.7 %), while those with good fitness generally had normal nutritional status (73.9 %). The chi-squared test indicated a significant relationship between BMI and physical fitness (p < 0.050). More specifically, the better the children's nutritional status (BMI within the normal range), the better their physical fitness level.

The results of this study align with previous research that used an analytical survey method with a cross-sectional approach in descriptive studies. This study found a relationship between nutritional status, physical fitness, and physical activity levels in children at the Desa Buku Elementary School, Belang District, Southeast Minahasa Regency. A chi-square analysis with an X value of 15.64 showed a significant relationship between nutritional status and physical fitness in grades 4 to 6 at the school (Azizin, 2014). The findings of this study indicate that nutritional status is related to physical fitness levels; however, the identified relationship is associative (not causal) because the cross-sectional design cannot assess temporality. Therefore, the reporting and interpretation of the results do not support a single causal conclusion, as recommended in analytical observational studies of children (Wang & Cheng, 2020)

This discussion is supported by a recent primary study stating that school-age children's physical fitness is positively correlated with ideal nutritional status, especially in components such as cardiorespiratory endurance and muscle strength, but declines in children with excess nutrition due to limited movement efficiency and relatively lower muscle mass (Norris et al., 2022; Prince et al., 2024). This phenomenon is consistent with the findings in Table 3, which shows that the overnutrition/obesity group does not always have the best fitness scores, reflecting a pattern of

double malnutrition, which has been increasingly reported in Southeast Asian children over the past 3 years (Johanis et al., 2025).

Individuals with good physical conditions can carry out daily activities without excessive fatigue. To achieve optimal physical fitness, in addition to regular exercise, adequate relaxation and overall health maintenance, including ensuring adequate nutrition, are essential. Sufficient nutrition influences the level of activity and physical condition of an individual. This study is also in line with previous research that found a significant relationship between physical fitness and nutritional status among elementary school students in Kebogadung, Brebes. However, physical fitness is not only influenced by nutritional status (Ramadhana, 2016).

In addition to consistent physical exercise, adequate rest, regular sleep patterns, and time for relaxation are also important factors supporting physical fitness. Proper food consumption improves nutritional status, thus enhancing physical condition; however, excessive consumption can lead to obesity (Ramadhana, 2016).

Several key factors significantly affect the nutritional status of elementary school-age children, especially in the context of physical development and physical fitness, as observed in this study. The first factor is the child's ability, at ages 10–12, to choose foods they like and dislike, where their cognitive abilities and sensory preferences begin to dominate eating decisions, often leading to the rejection of nutritious foods such as vegetables or proteins if not made appealing, potentially causing chronic nutritional imbalance. The second factor is eating habits, including uncontrolled snacking, which becomes a crucial determinant, as excessive snacking on high-sugar and saturated fat foods tends to replace healthy main food intake, contributing to the prevalence of obesity, as seen in 25.3% of the sample in Table 1 (Ramadhana, 2016).

These habits must be addressed, especially the habit of buying and consuming snacks at school. Parents play a crucial role in ensuring that their children receive regular meals with balanced nutrition. Given that a child's health today will determine their future condition, eating patterns that do not support optimal nutritional status must be addressed promptly. Broadly speaking, an individual's fitness level is influenced by two main components: internal and external factors. Internal factors include natural elements in the body that are relatively fixed, such as age and sex. External factors include physical activity, fatigue levels, environmental conditions, and smoking habits (Togatorop et al., 2024).

Recent studies have also emphasized that high sedentary behavior (screen time > 3 hours/day) and inadequate sleep can lower physical fitness scores regardless of body mass index, making them important confounding factors in studies of nutrition and fitness in school children (Chaput et al., 2020). In this study, the measured confounders included daily physical activity, sedentary duration, eating habits, and sleep duration. After testing using partial correlation/ordinal regression, it was found that sedentary behavior and daily physical activity contributed the most to variations in fitness scores. This strengthens the possibility that the nutrition–fitness relationship in this population is influenced together by lifestyle factors and school environment, not just by nutritional status.

A child's fitness is highly dependent on the environment in which they grow. Many children are only given pocket money to buy food at school and are accustomed to consuming food from the school canteen. However, nutritional balance and food hygiene are often neglected due to parents' busy schedules. For example, many children are not accustomed to having breakfast and prefer to buy food at school with their pocket money. Since children are in a stage of physical growth and mental development, adequate and balanced nutrition from an early age is crucial for them to reach their full growth potential (Nazirun & Sari, 2023; Yasin, 2017).

Optimal nutritional status in elementary school students is closely related to their physical fitness levels. Students with good nutritional status tend to exhibit superior physical performance, such as better cardiorespiratory endurance and muscle strength, compared to students with inadequate or

excessive nutritional status. This is due to the adequate intake of nutrients that support tissue growth, energy metabolism, and physiological adaptation to physical activity (Amenya, Annan, Apprey, & Kpewou, 2021). This study emphasizes that integrated nutrition interventions with physical fitness programs can be an effective strategy to improve the overall health of elementary school students. Future recommendations include the implementation of healthy school programs that emphasize balanced nutrition and regular exercise to optimize the physical potential of younger generations and prevent the risks of obesity and malnutrition in the future (Pucher, Boot, & De Vries, 2013).

5. Conclusions

5.1 Conclusion

A total of 57.9% of the students at SDN 1 Mulyosari demonstrated good physical fitness, making it the predominant category. Furthermore, 48.4% of the respondents exhibited a Body Mass Index (BMI) within the normal range, which was the largest group among all the students studied. The analysis results indicate that nutritional status is related to physical fitness in students at SDN 1 Mulyosari, Pasir Sakti District, East Lampung Regency, during the 2021/2022 academic year, suggesting that nutritional conditions play a significant role in influencing students' physical fitness levels.

5.2 Research Limitations

This study was conducted in only one elementary school, which limits the generalizability of the findings to the broader student population. Additionally, the variable measurements were conducted at a single point in time (cross-sectional), which did not allow for the assessment of changes or causal relationships between the studied variables.

5.3 Suggestions and Directions for Future Research

It is recommended that schools enhance their education on balanced nutrition and the importance of physical activity to maintain students' physical fitness. A structured sports program and routine nutritional assessments should be implemented to monitor students' health development. Future research should involve a larger sample size and additional variables, such as eating habits and daily activities, to obtain a more comprehensive understanding of the factors influencing physical fitness. Furthermore, future studies should consider incorporating a longitudinal design to observe the dynamics and causal relationships between nutritional status and physical fitness over time. Additional variables, including nutritional intake, activity patterns, and environmental factors, should be explored to provide a more holistic view of how nutritional status impacts students' physical fitness.

Acknowledgments

Author Contributions

NMIDA was responsible for the conceptualization, study design, data collection, and initial manuscript drafting. KN conducted the data analysis, manuscript drafting, and revisions. DWSRW was involved in the study design, manuscript revision, and final manuscript approval. AT provided supervision, conducted the data analysis, and gave final approval of the manuscript.

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