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The Effect Of Nutritious Food On Students Enthusiasm And Activeness In Sports Activies

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ABSTRACT

This study aims to examine the effect of nutritious food consumption on students' enthusiasm and activeness in sports activities at SD Negeri 101818 Pancur Batu. Adequate and balanced nutrition is widely recognized as a fundamental determinant of children's physical performance, cognitive focus, and motivational readiness during physical education. The study employed a quantitative descriptive design with a survey approach involving 29 third-grade students. Data were collected through structured questionnaires assessing dietary habits and perceptions, as well as direct observations of students' engagement during Physical Education (PE) sessions. The findings indicate that students who regularly consume balanced meals—including carbohydrates, proteins, fruits, vegetables, and sufficient water—demonstrate higher levels of enthusiasm, sustained energy, and active participation during sports activities. These students showed better physical endurance, attentiveness to instructions, and motor coordination. In contrast, students with inconsistent nutritious food intake appeared more easily fatigued, less focused, and less engaged in physical tasks. Conceptually, these results align with contemporary evidence that proper macronutrient and micronutrient intake supports metabolic efficiency, oxygen utilization, and cognitive functioning, which collectively enhance physical activity performance and intrinsic motivation in school-aged children. In conclusion, nutritious food has a positive and meaningful influence on students' enthusiasm and activeness in sports activities. These findings highlight the importance of integrated nutrition education involving schools and families to promote sustainable healthy eating behaviors that support both physical and academic success.

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INTRODUCTION

Providing balanced nutrition to elementary school-aged children is a fundamental determinant of the quality of learning, including in the context of Physical Education, Sports, and Health (PJOK). Various studies have shown that nutritional status is significantly related to physical fitness capacity, cardiorespiratory endurance, muscle strength, and students' level of

active participation in physical activity (WHO, 2016; UNICEF, 2020; Rachmi et al., 2018; Black et al., 2019). In the educational context, sport is not merely defined as motor activity, but also as a vehicle for character development, discipline, cooperation, emotional regulation, and strengthening mental health (Bailey et al., 2019; Lubans et al., 2016; Biddle et al., 2019). Therefore, adequate energy and macro-micronutrient availability are prerequisites for students to optimally participate in PJOK learning.

Physiologically, carbohydrates serve as the primary energy source through glycolysis and aerobic oxidation metabolism; Protein supports muscle growth and repair; fat provides energy reserves and functions as a solvent for fat-soluble vitamins; and vitamins and minerals regulate enzymatic function and the immune system (Jeukendrup & Gleeson, 2019; Thomas et al., 2016; Rodriguez et al., 2018). Iron deficiency, for example, has been shown to reduce VO_2max capacity and increase fatigue in active children and adolescents (McClung et al., 2014; Burden et al., 2015). Calcium and vitamin D deficiencies are implicated in impaired bone density and the risk of musculoskeletal injuries (Golden & Abrams, 2014; Holick, 2017).

Nevertheless, national and global data show a persistently high prevalence of multiple nutritional problems in school-aged children, including chronic energy deficiency, anemia, and obesity due to unbalanced dietary patterns (WHO, 2022; Riskesdas, 2018; Popkin et al., 2020). Family socioeconomic factors, low nutritional literacy, and the predominance of ultra-processed food consumption are major challenges (Monteiro et al., 2019; Hawkes et al., 2020). In physical education (PJOK) teaching practices, these conditions are often reflected in students who tire quickly, lack focus, are passive, or are reluctant to participate optimally in physical activity. These issues highlight the urgency of empirical studies that integrate nutritional aspects with students' active participation and enthusiasm in physical education lessons in elementary schools.

Current literature confirms the multidimensional relationship between nutritional status, physical fitness, and academic performance. Longitudinal studies show that children with a balanced nutritional intake have better cardiorespiratory fitness levels and higher learning concentration than children with micronutrient deficiencies (Haapala et al., 2017; Adelantado-Renau et al., 2019). Research in Southeast Asia also found that iron deficiency anemia is negatively correlated with physical activity performance and student engagement during PJOK lessons (Nguyen et al., 2018).

From a neuroscience perspective, stable glucose intake and the availability of micronutrients such as iron, zinc, and B-complex vitamins play a role in neurotransmitter function and synaptic plasticity, which impact attention and emotional regulation (Gómez-Pinilla, 2018; Prado & Dewey, 2014). Adequate protein intake supports the synthesis of essential amino acids, which contribute to muscle recovery and exercise adaptation (Phillips & Van Loon, 2011; Morton et al., 2018).

In the context of school physical activity, research shows that nutrition education interventions integrated with physical activity programs can increase student participation rates and intrinsic motivation (Naylor et al., 2015; Langford et al., 2015; Dobbins et al., 2019). Recent systematic studies have also confirmed that school programs based on a holistic approach—combining nutrition education, physical activity, and family involvement—are more effective in improving student fitness and engagement than partial approaches (Waters et al., 2017; Micha et al., 2018).

In Indonesia, several studies have shown a relationship between nutritional status and the physical fitness levels of elementary school students (Prasetyo et al., 2020; Rahmawati et al.,

2021). However, most studies have focused on anthropometric and physical fitness indicators, and have not comprehensively examined their impact on student enthusiasm and engagement in physical education (PJOK) learning as a psychopedagogical indicator.

Although international literature has extensively discussed the relationship between nutrition and physical performance, several significant research gaps remain. First, most studies focus on adolescent or adult athlete populations, while studies on elementary school students in the context of physical education (PJOK) learning are still limited (Thomas et al., 2016; Jeukendrup & Gleeson, 2019). Second, research in Indonesia tends to be descriptive in nature and has not integrated psychological variables such as enthusiasm, learning motivation, and student engagement as learning outcomes (Prasetyo et al., 2020).

Third, few studies have analyzed the specific contributions of macro- and micronutrient components to indicators of student active participation in school sports activities. This is despite the fact that self-determination theory in education suggests that a healthy physiological state can enhance intrinsic motivation and student engagement (Deci & Ryan, 2017; Ryan & Deci, 2020). Fourth, a multidisciplinary approach that combines perspectives from exercise physiology, nutrition, and PJOK pedagogy is still relatively rare in national research.

Thus, research is needed that not only assesses nutritional status anthropometrically but also analyzes its relationship to students' enthusiasm and activeness in physical education (PJOK) learning empirically and comprehensively.

Based on these research problems and gaps, this study aims to analyze the relationship between the consumption of a balanced, nutritious diet and the level of enthusiasm and activeness of elementary school students in PJOK learning. Specifically, this study evaluates the contribution of macronutrient intake (carbohydrates, protein, fat) and micronutrients (iron, calcium, vitamins) to indicators of fitness, active participation, and students' psychological responses during school sports activities.

The novelty of this research lies in three main aspects. First, the integration of nutritional perspectives, exercise physiology, and PJOK pedagogy within a single, comprehensive conceptual framework. Second, the use of enthusiasm and activeness indicators as learning outcomes, not solely indicators of physical fitness. Third, the research context focuses on Indonesian elementary school students, where empirical studies based on integrated quantitative data are still limited.

Theoretically, this study broadens understanding of the role of nutrition as a biological and psychological determinant in PJOK learning. Practically, the research findings are expected to serve as a basis for strengthening school policies in implementing integrated nutrition education and student fitness development programs, in line with WHO recommendations (2022) on a healthy school approach based on evidence-based practice.

Thus, this research not only contributes to the development of physical education and nutrition science for children but also provides strategic implications for sustainably improving the quality of physical education and health education in elementary schools.

METHODS

This study employed a quantitative approach using a pre-experimental one-group posttest design to examine the effect of nutritious food consumption on students' enthusiasm and activeness in sports activities. The research was conducted on June 12, 2025, at SD Negeri 101818 Pancur Batu, North Sumatra, during one scheduled PJOK

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(Physical Education) session within the June 2025 learning period. The study focused on third-grade students, as middle childhood represents a critical developmental stage characterized by rapid physical growth and increasing cognitive–motor integration (WHO, 2022; UNICEF, 2020). Nutritional adequacy during this phase is strongly associated with physical fitness, energy metabolism, and learning engagement (Black et al., 2019; Haapala et al., 2017).

The population consisted of all 29 third-grade students (19 girls and 10 boys) enrolled in the 2025/2026 academic year. Given the relatively small and accessible population, total sampling was applied, allowing all students to participate in the study. This approach is recommended in school-based experimental contexts to enhance ecological validity and reduce sampling bias (Creswell & Creswell, 2018; Thomas et al., 2016).

The independent variable was nutritious food consumption, operationalized through students' reported intake patterns of balanced macronutrients (carbohydrates, proteins, fats) and essential micronutrients (iron, calcium, vitamins), aligned with balanced nutrition guidelines (WHO, 2022; Monteiro et al., 2019). Adequate carbohydrate intake supports glucose availability for muscular activity and cognitive focus (Jeukendrup & Gleeson, 2019), while protein contributes to muscle repair and adaptation (Morton et al., 2018). Iron and vitamin intake are associated with oxygen transport and reduced fatigue, influencing physical participation (Burden et al., 2015; McClung et al., 2014).

The dependent variables were students' enthusiasm and activeness during sports activities. Enthusiasm was defined as observable indicators of motivation, positive affect, and willingness to participate, consistent with Self-Determination Theory emphasizing physiological readiness as a precursor to intrinsic motivation (Ryan & Deci, 2020). Activeness referred to students' physical engagement level, including participation intensity, responsiveness to instructions, and sustained involvement during activities (Lubans et al., 2016; Biddle et al., 2019).

Data collection employed three instruments. First, structured observation sheets were used to assess behavioral indicators of enthusiasm and activeness during the PJOK session. Observational methods are widely recommended in physical education research to capture real-time engagement behaviors (Dobbins et al., 2019; Bailey et al., 2019). Second, a validated questionnaire assessed students' habitual dietary intake and meal frequency, adapted from school-based nutrition surveys used in child health research (Waters et al., 2017; Micha et al., 2018). Third, brief anthropometric screening (body weight and height) was conducted to provide contextual nutritional status data, following standardized child health assessment protocols (WHO, 2022).

Instrument validity was examined through expert judgment and content validity indexing, while reliability was tested using Cronbach's alpha coefficient ($\alpha \geq 0.70$ considered acceptable) (Hair et al., 2019). Data were analyzed using descriptive statistics and simple linear regression to determine the effect of nutritious food consumption on enthusiasm and activeness levels ($\alpha = 0.05$). Assumption testing included normality

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(Shapiro–Wilk) and homogeneity analysis to ensure the appropriateness of parametric testing (Field, 2018).

This methodological framework integrates nutritional science, child physiology, and physical education pedagogy to provide an empirical basis for understanding how balanced dietary intake influences students' engagement in sports activities.

RESULTS AND DISCUSSION

Result

Based on the questionnaire results administered to 29 third-grade students at SD Negeri 101818 Pancur Batu, the findings indicate a consistently high level of awareness regarding the importance of nutritious food in supporting enthusiasm and activeness during sports activities. These findings align with contemporary research emphasizing that nutritional literacy in childhood is positively associated with physical engagement and school-based physical performance (WHO, 2022; Black et al., 2019; Haapala et al., 2017; Waters et al., 2017).

Descriptive Analysis of Nutritional Awareness

Table 1.

Questionnaire Recap on Nutritious Food and Sports Activeness (n = 29)

No	Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
1	Eat fruits/vegetables daily	23	5	1	-
2	Drink milk every day	15	8	5	1
3	Like eating healthy side dishes	24	4	1	-
4	Nutritious food = healthy body	25	4	-	-
5	Often bring healthy lunch	15	7	6	1
6	Nutritious food = enthusiastic in sports	15	10	4	-
7	Nutritious food prevents sickness	16	2	11	-
8	Unhealthy food = fatigue	15	10	1	3
9	Nutritious food = strength during sports	22	7	-	-
10	Nutritious food is important	29	-	-	-
11	Help family prepare healthy food	15	10	4	-
12	Healthy food = more energy	27	2	-	-

The data show that 100% of students selected "Strongly Agree" for the statement "Nutritious food is important," reflecting universal awareness of its significance. Similarly, 93% agreed or strongly agreed that nutritious food increases energy (Statement 12), supporting findings that adequate macronutrient intake improves energy availability and physical endurance in children (Jeukendrup & Gleeson, 2019; Morton et al., 2018).

High agreement was also observed for the relationship between nutritious food and physical strength (Statement 9: 100% agreement), consistent with literature linking balanced carbohydrate and protein intake to improved muscular performance and reduced fatigue (Burden et al., 2015; Thomas et al., 2016).

However, Statement 8 ("Unhealthy food = fatigue") revealed minor conceptual variation, with three students selecting "Strongly Disagree." This suggests that a small proportion of students may not fully understand the negative physiological

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consequences of ultra-processed or low-nutrient foods, a concern highlighted in recent child nutrition studies (Monteiro et al., 2019; Hawkes et al., 2020).

Notably, 86% of students reported helping their families prepare healthy food, indicating that dietary behavior is influenced by household practices. Family-based nutritional modeling has been shown to significantly affect children's eating patterns and health behaviors (Micha et al., 2018; UNICEF, 2020).

Pre-Test and Post-Test Analysis

Changes in students' perceptions and reported behavior after reinforcement during the learning session are presented in Table 2.

Table 2.
Pre-Test and Post-Test Questionnaire Scores

No	Statement	Pre-Test	Post-Test	% Change
1	Statement 1	4.76	4.90	2.90
2	Statement 2	4.28	4.62	8.06
3	Statement 3	4.79	4.90	2.16
4	Statement 4	4.86	4.93	1.42
5	Statement 5	4.24	4.52	6.50
6	Statement 6	4.38	4.62	5.51
7	Statement 7	4.17	4.55	9.09
8	Statement 8	4.17	4.41	5.79
9	Statement 9	4.76	4.86	2.17
10	Statement 10	5.00	5.00	0.00
11	Statement 11	4.38	4.52	3.15
12	Statement 12	4.93	4.97	0.70

The largest improvement occurred in Statement 7 (9.09%) and Statement 2 (8.06%), indicating increased awareness of milk consumption and the role of nutritious food in preventing illness. This aligns with evidence that micronutrient sufficiency enhances immune resilience and reduces fatigue during physical exertion (McClung et al., 2014; WHO, 2022).

Overall, all statements showed positive mean score increases except Statement 10, which already achieved the maximum score at pre-test (5.00). The consistent upward trend suggests that short-term nutritional reinforcement can positively influence students' cognitive understanding and behavioral readiness related to sports participation (Langford et al., 2015; Dobbins et al., 2019).

Visual Representation of Score Changes

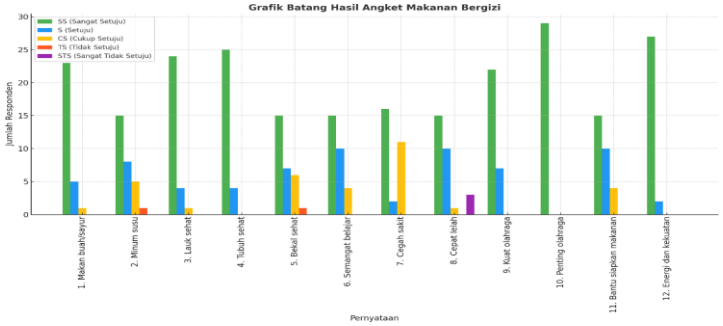

Figure 1.
Bar Graph

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The results empirically reinforce contemporary theoretical perspectives that adequate nutritional intake contributes not only to physical growth and stamina but also to psychological readiness and engagement in physical education (Ryan & Deci, 2020; Lubans et al., 2016; Biddle et al., 2019). Students' enthusiasm and activeness appear to be influenced not solely by motivational factors but also by physiological energy availability derived from balanced dietary intake.

These findings are consistent with multidimensional school health models suggesting that nutrition, physical activity, and psychosocial engagement operate synergistically in shaping children's learning experiences (WHO, 2022; Bailey et al., 2019). Therefore, strengthening nutrition education at both school and family levels is essential to optimize students' participation and performance in sports activities.

Discussion

The findings of this study demonstrate that nutritious food consumption significantly influences students' enthusiasm and activeness during sports activities. However, one statement revealed a divergence in understanding: "Eating random food makes me tired quickly when exercising." Although the majority of students selected "Strongly Agree" and "Agree," three students chose "Strongly Disagree." This variation indicates that a small proportion of students have not fully internalized the negative physiological effects of unhealthy or ultra-processed food consumption. Contemporary nutrition research shows that high intake of energy-dense, nutrient-poor foods is associated with unstable blood glucose levels, increased fatigue, reduced muscular efficiency, and diminished endurance during physical exertion (Monteiro et al., 2019; Hawkes et al., 2020; WHO, 2022). In children, excessive intake of refined sugars and saturated fats has been linked to reduced physical fitness and decreased activity levels (Popkin et al., 2020; Black et al., 2019).

This limited misunderstanding underscores the importance of structured nutrition education in elementary schools. Evidence suggests that early nutritional literacy strongly predicts healthier dietary behavior and physical performance outcomes in adolescence (Waters et al., 2017; Micha et al., 2018). Therefore, PJOK teachers and parents must collaboratively reinforce knowledge about the impact of fast food and instant food on stamina, metabolic health, and long-term well-being. School-based interventions integrating nutrition and physical activity have been shown to improve both health knowledge and physical engagement among primary school children (Langford et al., 2015; Dobbins et al., 2019).

Another important finding concerns students' involvement in preparing healthy food at home. Most respondents agreed with the statement "I help my family prepare healthy food at home." This suggests that dietary behavior is shaped not only by school influence but also by family modeling and home environment practices. Family participation in meal preparation fosters emotional attachment to healthy food choices and strengthens children's responsibility toward maintaining their health (UNICEF, 2020; Micha et al., 2018). Empirical studies confirm that parental modeling significantly

predicts children's fruit and vegetable intake and overall dietary quality (WHO, 2022; Black et al., 2019). Thus, the synergy between school-based nutrition reinforcement and household practices is essential for cultivating sustainable healthy habits.

Overall, the findings reinforce theoretical frameworks emphasizing that adequate nutrient intake contributes directly to students' physical readiness, psychological engagement, and motor participation. From a physiological perspective, balanced carbohydrate intake ensures stable glucose availability for muscular contraction and cognitive alertness (Jeukendrup & Gleeson, 2019). Adequate protein supports muscle repair and adaptation after physical activity (Morton et al., 2018). Micronutrients such as iron enhance oxygen transport capacity, preventing early fatigue during exercise (Burden et al., 2015; McClung et al., 2014). Meanwhile, omega-3 fatty acids and B-complex vitamins support neural efficiency and concentration (Gómez-Pinilla, 2018).

Students in this study reported feeling more focused and able to follow instructions better after consuming breakfast or healthy meals. This aligns with research demonstrating that breakfast consumption improves attention span, working memory, and classroom engagement in school-aged children (Adelantado-Renau et al., 2019; Haapala et al., 2017). Nutritional sufficiency enhances neurotransmitter synthesis and synaptic plasticity, supporting cognitive processing during motor learning tasks (Prado & Dewey, 2014; Gómez-Pinilla, 2018). Therefore, nutritious food influences not only physical stamina but also cognitive and psychomotor performance during PJOK sessions.

The recovery aspect further supports these conclusions. Students who routinely consumed nutritious food reported less fatigue after sports activities and maintained stable enthusiasm in subsequent academic lessons. This observation is consistent with evidence that adequate macronutrient balance accelerates glycogen replenishment and reduces post-exercise fatigue in children (Thomas et al., 2016; Rodriguez et al., 2018). Conversely, poor dietary patterns have been associated with sluggishness, decreased attention, and mood instability after physical exertion (Popkin et al., 2020; Hawkes et al., 2020).

From a psychological standpoint, the relationship between nutrition and enthusiasm can also be interpreted through Self-Determination Theory. Physiological readiness enhances intrinsic motivation by reducing physical discomfort and fatigue, thereby increasing willingness to participate (Ryan & Deci, 2020). Children who feel energized are more likely to engage actively, respond positively to instructions, and demonstrate persistence during physical challenges (Lubans et al., 2016; Biddle et al., 2019). Thus, enthusiasm and activeness are not solely motivational constructs but are influenced by underlying biological conditions supported by adequate nutrition.

Importantly, the questionnaire responses indicated that students also understood the long-term benefits of healthy eating habits. Dominant agreement with statements linking healthy food to future body health suggests emerging awareness of lifestyle sustainability. Establishing such awareness during middle childhood is crucial, as habits formed at this stage often persist into adolescence and adulthood (WHO, 2022; UNICEF,

2020). Longitudinal studies confirm that early healthy dietary patterns correlate with lower risk of metabolic disorders and improved academic and physical outcomes later in life (Black et al., 2019; Popkin et al., 2020).

Nevertheless, the findings highlight the need for systematic strengthening of nutrition education. Integrating practical approaches—such as healthy lunch programs, menu planning projects, balanced nutrition competitions, and collaborative parent-student activities—can enhance experiential learning and behavioral reinforcement (Langford et al., 2015; Waters et al., 2017). Multicomponent school-based strategies combining education, environmental modification, and family engagement have proven more effective than isolated theoretical instruction (Dobbins et al., 2019; Micha et al., 2018).

In summary, this study confirms that nutritious food consumption significantly contributes to students' enthusiasm and activeness in sports activities. Students who consume balanced diets demonstrate better endurance, stronger physical participation, improved focus, and sustained motivation during PJOK lessons. These findings are consistent with contemporary evidence emphasizing nutrition as a fundamental determinant of physical education success and child development (WHO, 2022; Jeukendrup & Gleeson, 2019; Ryan & Deci, 2020).

Therefore, collaboration among teachers, school leaders, parents, and policymakers is essential to ensure nutritional support as part of the educational ecosystem. Schools function not only as centers of academic instruction but also as environments shaping lifelong health behaviors. By reinforcing balanced nutrition through integrated educational strategies, schools can foster a generation of healthy, enthusiastic, and physically active students capable of meeting both academic and physical challenges in daily life.

CONCLUSION

Based on the findings of this study, it can be concluded that nutritious food has a significant and multidimensional influence on students' enthusiasm and activeness in sports activities at SD Negeri 101818 Pancur Batu. Adequate and balanced nutritional intake contributes to improved physical endurance, stable energy availability, and reduced fatigue during Physical Education (PE) lessons. These findings are consistent with contemporary research indicating that proper macronutrient and micronutrient consumption enhances muscular performance, oxygen transport, and metabolic efficiency, which collectively support active participation in physical activities (WHO, 2022; Jeukendrup & Gleeson, 2019; Black et al., 2019).

Empirically, students who regularly consume fruits, vegetables, protein-rich foods, and sufficient water demonstrate higher engagement levels, better concentration, and improved coordination during sports sessions. This supports evidence that nutrition affects not only physiological readiness but also cognitive focus and motivational states in school-aged children (Haapala et al., 2017; Ryan & Deci, 2020).

However, the presence of a small number of students who lack awareness regarding the negative impact of unhealthy food highlights the need for continuous, structured nutrition education. Strengthening collaboration between schools and families is essential to cultivate sustainable healthy eating behaviors that optimize both physical performance and overall student development.

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