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Physical education learning outcomes: Does it have a correlation with nutritional status, physical activity, and students' cognitive function?

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ABSTRACT

The process of learning physical education in schools is influenced by nutrition, physical activity, and students' cognitive functions. The purpose of this study was to find out how students' nutritional status, physical activity, and cognitive function relate to their performance in physical education classes at school. This type of research is called correlational research. 98,289 junior high school students in Bandung, West Java Province, became the study population. Simple random sampling strategy for sampling 1870 students into the research sample. This study uses primary data provided from students' assessments of nutritional condition, physical activity, and cognitive function and secondary data provided from physical education teachers. The data collection method was in the form of a questionnaire to measure cognitive function, physical activity, and nutritional status, as well as student test scores from teachers to measure learning outcomes. Correlation analysis and multiple regression, as well as the F test, were used as data analysis methods in this study. Data analysis through computerized procedures using the SPSS application The tests needed are the normality test and the linearity test before testing the hypothesis. The findings demonstrate a significant correlation between learning outcomes and nutritional status, physical activity, and cognitive function. However, it is important to note that the research scope was limited to the field of physical education and the selected research subjects. Nonetheless, these results contribute to existing knowledge and can serve as a guide for future studies, particularly in the domain of physical education, aiming to optimise learning outcomes.

Keywords: Physical education; learning outcomes; nutritional status; physical activity; cognitive function

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Authors' Contribution: a – Study Design; b – Data Collection; c – Statistical Analysis; d – Manuscript Preparation; e – Funds Collection

INTRODUCTION

Physical education can be used in schools to enhance the human resources there (Krijgsman et al., 2021). In addition to utilizing the facilities and infrastructure already in place and having teachers available, improving effective learning outcomes in schools necessitates providing kids with adequate nutritional conditions or a healthy nutritional status that will encourage them to want to learn (Coimbra et al., 2021; Mwivanda & Kingi, 2019; Wallhead et al., 2021). A balanced diet, or one in which the amount of energy and nutrients consumed matches both what the body requires and what is expelled by the body, is necessary to maintain excellent physical health in order to study physical education in school (Verburgh et al., 2016). Children who participate in physical

education at school must eat healthfully (Wallhead et al., 2021). Children should eat calorie-dense foods like carbs, lipids, and proteins before going to school. The balance of these nutrients must be carefully monitored since if it is off, it may result in incorrect nutrition. The body requires dietary consumption and nutritional status as sources of nutrients (Belogianni et al., 2019). Energy intake and expenditure must balance for nutrition to exist (Maffetone & Laursen, 2017; Weng et al., 2018). Nutritional status serves as a measure of the body's state and its utilisation of nutrients (Ali, 2021).

Nutritional status of individuals is influenced by a range of factors, including consumption habits, food intake, psychology, education, and individual income (de Brauw et al., 2015). Extensive research has demonstrated the significant impact of nutritional status on intelligence levels and students' capacity to understand lessons (Soriano et al., 2018). Students in good nutritional health are more likely to absorb lessons effectively and achieve optimal learning outcomes compared to those with poor or excessive nutritional health, who may struggle in both areas (Petrizzo et al., 2021; Wong, 2020). Given the crucial developmental stage of junior high school students, health issues, including nutrition, are of utmost importance (Haynes et al., 2021). Understanding the nutritional value of the food children consume daily is critical as it serves as the foundation for their overall well-being (Azman & Zakaria, 2019; Rahman et al., 2014). Insufficient food intake puts children at risk of undernourishment, which can have detrimental effects on their regular physiological processes (Qureshy et al., 2013). Therefore, knowledge of the nutrients found in food and their sources is essential for promoting children's growth and cognitive development. Additionally, the nutritional status of children serves as an indicator of the effectiveness of multi-sectoral development, including education.

On the other hand, learning activities in physical education in schools can also be impacted by physical exercise and cognitive function. School age might foretell a person's future behavior, including their health (Coimbra et al., 2021; Lavelle et al., 2020; Tariku et al., 2019). Moderate exercise, particularly outdoor activities, has been found to improve mood, alleviate loneliness and stress, enhance sleep quality, and protect against depression. However, excessive exercise may have adverse effects on cognitive function, diminishing the benefits of physical education in school (Aarsland et al., 2020; Clifford et al., 2019; Silva & Arida, 2015). While the association between physical exercise and cognitive function in relation to physical education learning outcomes has been extensively studied, there is limited research specifically focusing on the cognitive function of middle school students in Bandung City, particularly in the context of the "new normal".

Given that the school entry phase is considered an ideal time to develop healthy lifestyle habits, it is essential to understand these factors from a young age to ensure long-term preparedness (Cale & Harris, 2022; Shi et al., 2014). Although research on the relationship between diet, exercise, and academic performance has been conducted (Chu et al., 2016; Raine et al., 2017; Schnider et al., 2021), there is currently a gap in the understanding of cognitive function among middle school students in Bandung City, especially in light of the new normal era particularly in light of the new normal era (Abbott et al., 2022). Exploring the cognitive function and its association with nutritional status, physical activity, and physical education learning outcomes among these students will provide valuable insights and contribute to addressing the research gap in the field (Clifford et al., 2019; Morais et al., 2018).

METHOD

The link between the variables is investigated in this study using a correlational analytic design. Cross-sectional research, which involves measuring or observing simultaneously, is the method used in this study. The months of March through June 2022 were used for this study. The city of Bandung served as the site of this study. 98,289 junior high school pupils in Bandung were the population used in this study. Just 1870 students made up the sample in this study because of time restrictions; the researchers thus used simple random sampling. A questionnaire was the research's main tool. A closed questionnaire is one that has already been answered, leaving the respondent with only a few options. This type of questionnaire was employed in this study. A student survey served as the research tool for physical activity (the PAQ-C questionnaire). food intake, with requirements determined by body mass index (BMI). Academic success is measured by grades or other numerical representations of what students learn in formal educational institutions (Huijgen et al., 2015; Li et al., 2019; Schnider et al., 2021). Using the Concentration Grid Test to measure cognitive function (CGT). Correlation and multiple regression analysis along with the F test were employed as the data analysis methods in this investigation. Perform the required tests, namely the normalcy test and the linearity test, before testing the hypothesis. Four connected or correlated variables—nutritional status, physical activity, cognitive function, and learning outcomes from physical education—were the subject of the analysis.

RESULTS AND DISCUSSION

The findings of a study with a total of 1870 participants, conducted on junior high school students in the city of Bandung, will be discussed in this section. From March 2022 through June 2022, research was conducted. The study's findings are as follows:

Table 1. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Y	.305	1870	.0900	.781	1870	.080
X1	.099	1870	.200*	.983	1870	.978
X2	.222	1870	.178	.906	1870	.258
X3	.272	1870	.053	.802	1870	.051

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

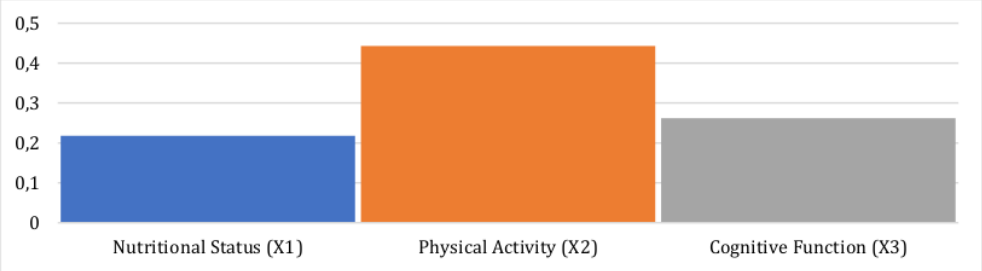
Significance value (p) on the Shapiro-Wilk (table 1) test learning outcomes (Y) are 0.080 (p > 0.05), nutritional status (X1) is 0.978, physical activity (X2) is 0.258, and cognitive function (X3) is 0.05, so based on the normality test, the Shapiro-Wilk data is normally distributed.

Table 2. Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.528	1.544		.342	.744		
Nutritional Status (X1)	.127	.150	.281	.844	.431	.218	4.581
Physical Activity (X2)	.146	.192	.178	.760	.476	.443	2.258
Cognitive Function (X3)	.552	.315	.533	1.755	.130	.262	3.812

a. Dependent Variable: Learning outcomes (Y)

It is known that the tolerance value for the nutritional status variable (X1) is 0.218, physical activity (X2) is 0.443, and cognitive function (X3) is 0.262, all of which are larger than 0.10, based on the output table 2 (coefficients) in the "collinearity statistics" section. Variables (X1), (X2), and (X3) all have VIF values of 4.581, 2.258, and 3.812, respectively. The regression model does not exhibit any signs of multicollinearity, according to the reasoning behind the multicollinearity test's decision-making. For more details, tolerance value can be seen in the image below:



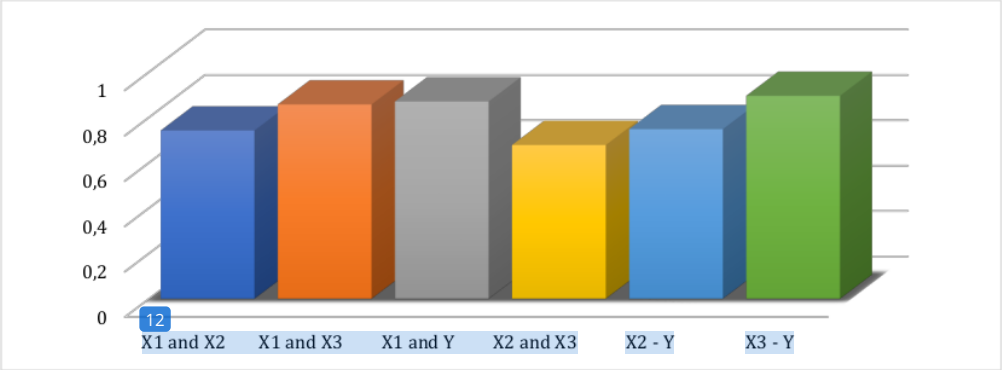
Graph 1. Coefficients Value

Table 3. Correlations

		Nutritional Status (X1)	Physical Activity (X2)	Cognitive Function (X3)	Learning Outcomes (Y)
Nutritional Status (X1)	Pearson Correlation	1	.742*	.857**	.870**
	Sig. (2-tailed)		.014	.002	.001
	N	1870	1870	1870	1870
Physical Activity (X2)	Pearson Correlation	.742*	1	.678*	.748*
	Sig. (2-tailed)	.014		.031	.013
	N	1870	1870	1870	1870
Cognitive Function (X3)	Pearson Correlation	.857**	.678*	1	.895**
	Sig. (2-tailed)	.002	.031		.000
	N	1870	1870	1870	1870
Learning Outcomes (Y)	Pearson Correlation	.870**	.748*	.895**	1
	Sig. (2-tailed)	.001	.013	.000	
	N	1870	1870	1870	1870

*. Correlation is significant at the 0.05 level (2-tailed).

In the output table 3, it can be seen that the correlation between nutritional status (X1) and physical activity (X2) yields a score of 0.742, the correlation between nutritional status (X1) and cognitive function (X3) yields a score of 0.857, the correlation between nutritional status (X1) and learning outcomes (Y) yields a score of 0.870, the correlation between physical activity (X2) and learning outcomes (Y) yields a number of 0.748, and the correlation between cognitive function (X3) and learning outcomes (Y) is 0.895. For more details, correlation score can be seen in the image below:



Graph 2. Correlation Score

Table 4. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.725[a]	.525	.782	.32642	.855	11.765	561	1122	.006

Predictors: (Constant), Cognitive function (X3), Physical activity (X2), Nutritional status (X1)

Based on Table 4 (summary model), it is known that the magnitude of the relationship between nutritional status (X1), physical activity (X2), and cognitive function (X3) on learning outcomes (Y), which is calculated by the correlation coefficient, is 0.725, which shows a strong significant influence. While the simultaneous contribution of nutritional status variables (X1), physical activity (X2), and cognitive function (X3) to learning outcomes (Y) is 52.5%, 47.5% is determined by other variables. Furthermore, the value of sig. F change 0.006 0.05 means nutritional status (X1), physical activity (X2), and cognitive function (X3) are simultaneously and significantly related to the learning outcomes of junior high school students in Bandung, West Java Province. According to the researchers, who based their findings on the questionnaires that respondents filled out, practically all respondents engaged in less physical activity, such as daily morning walks, despite the fact that regular exercise can help to maintain healthy blood flow and deliver nutrients to the brain. Nearly half of the respondents (or 77.81%) had cognitive function less than 1455, and others had moderate cognitive function in as many as 415 respondents (19.68%), according to the findings of the study on cognitive function. The findings revealed that nearly all junior high school students in Bandung City, West Java Province, claimed to have lost cognitive function. Researchers found that many survey respondents stated that their cognitive function was deteriorating as a result of a lack of physical activity based on the findings of the questionnaires they had completed. Meanwhile, it can be inferred that nutritional status also significantly affects learning outcomes given that the correlation coefficient rxy is higher than rtable at a significance level of 0.05. On the other hand, high levels of routine and physical activity are correlated with high cognitive function ratings. On the other hand, students who exercise at low to moderate levels perform less cognitively.

Relevant research conducted by Carrasco et al. (2020) and Gendron et al. (2020) explains that activity can improve a person's executive function, attention, speed of thinking, working memory, and long- and short-term memory. Furthermore, regular routines and exercise can lower the chances of cognitive impairment (Aarsland et al., 2020). According to Meijer et al. (2020), both strong cognitive function and cognitive decline are connected with sustained and robust levels of physical activity. When a

person looks three years younger than their actual age, physical activity has been proven to be beneficial and 20% less physical activity can lower the risk of cognitive impairment (BenOunis et al., 2013). In general, cognitive performance will deteriorate as we age. A family history of conditions like Parkinson's, heart disease, stroke, and diabetes, as well as one's level of education, a brain injury, environmental pollutants, a lack of exercise, and conditions like these that are chronic can all be risk factors for cognitive decline (Silva & Arida, 2015). Researchers and decision-makers are focusing on the prospect that children's academic performance, learning, and cognitive function can be enhanced by physical activity and fitness in light of the findings. A three-step search process was used to locate studies that used physical activity or fitness measures to assess the degree of connection with or impact on a) academic achievement and b) cognitive performance. 18 papers in total—11 correlational studies, 6 quasi-experimental studies, and 1 randomised control trial—were used in the data extraction process. No study met the requirements for evaluating the link between physical activity and cognitive performance. The interventions did corroborate the positive correlations between physical activity, fitness, academic success, and various cognitive function components. Nutrition, according to Mbhatsani et al. (2017), is the process of food that is regularly ingested by organisms through the process of food metabolism and the removal of chemicals that are not necessary for maintaining life, growing, maintaining normal organ function, and producing energy. We require energy to complete daily tasks, which comes from the food we eat. According to de Brauw et al. (2015), 60–70% of the body's overall energy needs is used by the body to maintain its fundamental processes, also known as the basic operations of basal metabolism. This indicates that the body needs little energy when completely resting but not when sleeping. Other activities like walking, working, eating, and researching, however, demand more energy. The study's findings can be compared between underweight and overweight nutritional status, with overweight having a stronger impact on students' ability to learn. It is indisputable, nonetheless, that consuming too much food can have an impact on one's body weight and nutritional status. Therefore, if eating too much will interfere with focus when learning and may result in excessive tiredness. In addition to external nutritional elements, two internal and external factors also have an impact on learning success and learning attainment.

The results of this study are consistent with the findings of previous studies that have been mentioned, namely research by Ma et al. (2021), Su et al. (2014), and Wallhead et al. (2021). The fact that IQ, motivation, environment, family, school, and community are aspects that can improve learning achievement. Based on the relevant studies above, it is clear that there is a positive correlation between physical activity, nutritional status, and cognitive function and student learning outcomes. Students' cognitive function, nutritional status, learning outcomes, and physical activity are interrelated. Scores for cognitive function increased with physical activity, as did the other variables. The findings of this study can be considered for further research by studying other characteristics such as gender, social economy, family factors, and etc.

CONCLUSION

Based on the results of research on the relationship between nutritional status, physical activity, cognitive performance, and student learning outcomes, it can be stated that there is a significant relationship between junior high school students in Bandung City, West Java Province. It is suggested for future researchers to compare the differences in the relationship between nutritional status, physical activity, cognitive performance, and student learning outcomes in rural and urban areas. Furthermore,

despite the fact that the research findings indicated a relationship between learning outcomes, nutritional status, physical activity, and cognitive function, the scope of the research was limited by the research subjects and the fact that it only looked at the field of physical education. The results obtained are anticipated to serve as a guide for future learning, particularly in the field of physical education, to maximize learning outcomes.

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CONFLICT OF INTEREST

The authors state no conflict of interest.

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