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Original Article

THE RELATIONSHIP BETWEEN PHYSICAL FITNESS, PERCEIVED PHYSICAL COMPETENCE, AND ACADEMIC ACHIEVEMENT AMONG INDONESIAN ELEMENTARY SCHOOL CHILDREN

A RELAÇÃO ENTRE APTIDÃO FÍSICA, COMPETÊNCIA FÍSICA PERCEBIDA E DESEMPENHO ACADÊMICO ENTRE CRIANÇAS DO ENSINO FUNDAMENTAL DA INDONÉSIA

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RESUMO
As crescentes taxas de obesidade infantil e problemas de saúde relacionados ao estilo de vida no Sudeste Asiático, incluindo a Indonésia, exigem intervenções educacionais e de saúde inovadoras. Apesar das recomendações da OMS para atividade física em crianças, a Indonésia está enfrentando uma crescente inatividade física e ênfase reduzida na educação física nas escolas. Este estudo examina as relações entre aptidão física, desempenho acadêmico e competência física percebida entre crianças do ensino fundamental da Indonésia para explorar potenciais benefícios educacionais. Uma avaliação de aptidão foi conduzida com 82 crianças da quarta série de Bali, incluindo avaliações de aptidão, competência física percebida e desempenho acadêmico. Os resultados revelam uma correlação positiva entre as pontuações gerais de aptidão e desempenho acadêmico. Componentes como força muscular e aptidão cardiorrespiratória foram associados a melhor desempenho acadêmico. Além disso, o "sentimento de controle" na competência percebida foi positivamente correlacionado com o indonésio e a matemática. Essas descobertas indicam que promover a aptidão por meio de intervenções educacionais pode abordar questões de saúde e acadêmicas. Enfatizar a educação física que aprimora a competência física percebida das crianças, particularmente seu sentimento de controle, pode apoiar o desenvolvimento cognitivo e acadêmico, oferecendo uma abordagem integrada para melhorar os resultados educacionais e de saúde nas escolas indonésias. Pesquisas adicionais são recomendadas para esclarecer relações causais e desenvolver evidências longitudinais para essas iniciativas.
Palavras-chave:Aptidão física, Desempenho acadêmico, Competência física percebida, Escolas de ensino fundamental.

ABSTRACT
Rising rates of childhood obesity and lifestyle-related health issues in Southeast Asia, including Indonesia, call for innovative health and educational interventions. Despite WHO recommendations for physical activity in children, Indonesia is facing increasing physical inactivity and reduced emphasis on physical education in schools. This study examines the relationships among physical fitness, academic achievement, and perceived physical competence among Indonesian elementary school children to explore potential educational benefits. A fitness assessment was conducted with 82 fourth-grade children from Bali, including assessments of fitness, perceived physical competence, and academic achievement. Results reveal a positive correlation between overall fitness scores and academic achievement. Components such as muscle strength and cardiorespiratory fitness were associated with improved academic achievement. Additionally, the "feeling of control" in perceived competence was positively correlated with Indonesian and mathematics. These findings indicate that fostering fitness through educational interventions can address both health and academic issues. Emphasizing physical education that enhances children's perceived physical competence, particularly their feeling of control, may support cognitive and academic development, offering an integrated approach to improving health and educational outcomes in Indonesian schools. Further research is recommended to clarify causal relationships and develop longitudinal evidence for these initiatives.
Keywords: Physical fitness, Academic achievement, Perceived physical competence, Elementary schools.

Introduction

Health problems caused by lifestyle habits, such as childhood obesity, have become crucial public health issues. In Southeast Asia, the proportion of obese and overweight children has been increasing from around 2000 to the present.[1] According to data published by the World Health Organization(WHO),[2] the proportion of obese and overweight children in Indonesia tripled between 2000 and 2016, from 5.5% to 15.4%. In addition, according to the Global Burden of Disease Study published by the Institute for Health Metrics and Evaluation,[3] the five

top causes of death in Indonesia in 2000 were stroke, ischemic heart disease, tuberculosis, diarrheal diseases, and neonatal disorders, three of which are related to infections and nutrition. In 2019, however, stroke, ischemic heart disease, cirrhosis, tuberculosis, and chronic obstructive pulmonary disease were the five top causes of death, four of which were non-communicable diseases, so-called lifestyle-related diseases. As described above, lifestyle-related health is a major social issue in Indonesia.

Physical activity and exercise are effective approaches to these public health issues, and WHO[4] recommends that children and adolescents aged 5-17 years should accumulate at least 60 minutes per day of moderate-to-vigorous-intensity physical activity, on average, and incorporate vigorous-intensity aerobic activities as well as muscle and bone strengthening activities at least 3 days per week. Nevertheless, Indonesia has a trend toward physical inactivity,[5] which is gradually worsening,[6] making the promotion of physical activity and exercise one of the most urgent issues to be resolved. However, since many children have few opportunities to be aware of health risks in their daily lives, an approach that focuses on health risks may not be effective in reducing physical inactivity.

In this context, recent studies have suggested that habitual physical activity and the physical fitness that is thought to be improved by such physical activity contribute to the improvement of cognitive function and academic achievement in children.[7-10] In other words, it can be said that the development of physical fitness through the acquisition of exercise habits may play an important role in the healthy development of cognitive functions and in the improvement of academic performance. Such findings showing a link between physical education and intellectual development should be of interest to educators and parents and can have a social impact in promoting physical activity among children. It is particularly significant in Indonesia because of the result of "PISA 2022" that is a survey of academic achievement conducted OECD[11] in 2022. In this survey, Indonesia found that its academic achievements have declined to a record low.

In addition, the number of physical education classes has been decreasing in many countries and regions in recent years. Furthermore, the status of physical education has been set lower due to greater emphasis on literacy and numeracy, a non-examinable, non-academic, recreational and non-demanding subject, and low levels of awareness of its usefulness and intrinsic/extrinsic values and so on.[12] A similar trend can be observed in Indonesia. For example, Indonesian policymakers decided to drop PE from senior vocational school students' curricula in late 2018 to give 12th grade students more time to prepare for the national examination.

The decline in the value of physical education and the reduction in class time will not only let go of a strategy for approaching health issues in Indonesia but may also lose a strategy for approaching academic achievement, which is one of the major issues in school education, if the promotion of physical activity and the improvement of physical fitness are related to the improvement of cognitive ability and academic ability, as mentioned above. Clarifying the relationship between physical fitness and academic achievement means promoting physical activity through physical education classes and improving related variables, as well as exploring the possibility of improving academic achievement by improving physical fitness. It is significant to indicate a new direction for educational approaches that promote physical fitness and improve academic achievement based on school education.

Therefore, the purpose of this study was to examine the relationship between physical fitness, academic achievement, and motor competence among elementary school students to obtain basic data for conceptualizing an educational approach to improve academic achievement from physical education classes in Indonesia.

Methods

Sample

A physical fitness test was conducted in early September 2023 for 85 fourth graders (44 boys and 41 girls; 66 9-year-olds and 19 10-year-olds) from 1 elementary school located in the province of Bali, Indonesia. 3 students (3 boys and 1 girl) were absent on the day of the physical fitness test, and the final number of participants was 82 (42 boys and 40 girls; 64 9-year-olds and 18 10-year-olds). The elementary school surveyed in this study was a public elementary school located in a relatively urban area within province of Bali. Subsequently, a questionnaire survey on perceived physical competence was administered to the children who participated in the physical fitness test. This study was designed to examine the relationship between physical fitness, academic achievement, and perceived physical competence; thus, the inclusion criteria were children who participated in the physical fitness test and answered the questionnaire on perceived physical competence. Therefore, the 3 children who were absent from these tests and did not answer the questionnaire were excluded from this study. After explaining the purpose of this survey and the contents of the questionnaire to the school principal and physical education teachers, permission to participate in the survey was obtained. In addition, an explanation of the survey and a consent form were sent to the parents or guardians through school. These forms clearly stated that the survey was not a test, that it was not related to academic achievement in the school, that no disadvantages would be incurred by withdrawing from the survey in the middle of a response, that the confidentiality of individual survey results would be protected, and that the survey results would not be used for any purpose other than research purposes. As a result, 81 children (41 boys and 40 girls; 64 9-year-olds and 17 10-year-olds; mean age 9.22 years; 98.8% valid response rate) who were able to provide consent to this study from their parents or guardians were included in the analysis.

Measurement

1) Academic achievement

An elementary school surveyed in this study proved academic achievement scores. That is final exam subjects consist of Indonesian, English, and mathematics. Each subject's raw score was used for the analysis rather than grade (e.g. A, B, C)

2) Physical fitness

Physical fitness was assessed using grip strength, sit-up, sit and reach, side steps, 20-meter shuttle run, 50-meter dash, standing long jump, and ball throw.

3) Perceived physical competence

Perceived physical competence was assessed using the physical competence scale developed by Okazawa et al.[13] This scale consists of three categories: the "Perceived Physical Competence" category, consisting of several subcategories, including statements such as "I think I have excellent motor skills" and similar, and a "Feeling of Control" category, consisting of several subcategories, such as the statement "Even if I cannot do an exercise, I think I can DOIt if I practice without giving up," and an "Peer and Teacher Acceptance" factor consisting of items such as "My friends encourage and support me when I do an exercise." Subjects were asked to respond to each question item on a 5-point scale from "not at all applicable (1 point)" to "very applicable (5 points).

Statistical analysis

Independent-samples *t* tests were conducted to examine sex differences in academic achievement, physical fitness, and perceived physical competence. Because significant sex differences were observed in multiple physical fitness components (Table 1), each physical fitness component was standardized within sex (z-scores), and these standardized values were used in subsequent analyses. For the 50-meter run, because a lower time indicates better

performance, the z-score was multiplied by -1 (i.e., reverse-coded after standardization) so that higher values consistently indicated better performance. Total score of physical fitness was calculated by summing the sex-standardized z-scores across all fitness components.

Table 1. Mean and Standard Deviation for measured values

		Boys(N=41) Mean±SD	Girls(N=40) Mean±SD	t-value
Anthropometric characteristics	Height (cm)	134.39±5.97	134.23±7.52	0.11
	Weight (kg)	30.90±5.91	29.75±8.83	0.69
	Rohrer's index formula	126.74±17.73	121.49±24.03	1.12
	BMI	17.02±2.46	16.32±3.57	1.03
Academic achievement	Indonesian	84.12±4.21	84.68±3.87	-0.62
	English	84.05±2.10	83.98±1.89	0.17
	Math	83.32±4.46	83.93±3.65	0.05
Physical fitness	Grip strength (kg)	12.74±2.91	12.28±3.25	0.68
	Sit up (times)	17.29±4.37	14.78±4.34	2.46 *
	Sit and reach (cm)	29.46±7.50	27.10±5.18	1.65
	Side steps (times)	27.10±5.18	25.58±3.15	2.15 *
	20m shuttle run (times)	12.39±7.10	10.70±4.01	1.31
	50m run (second)	10.57±1.06	11.73±1.47	-4.10 ***
	Standing long jump (cm)	127.00±18.04	106.50±16.26	5.37 ***
	Ball throw (m)	12.76±3.20	8.03±1.82	8.21 ***
Physical competence	Perceived Physical Competence	16.29±2.32	16.35±2.03	-0.12
	Feeling of Control	17.28±2.79	17.71±1.83	-0.82
	Peer and Teacher Acceptance	16.83±2.14	16.68±1.95	0.34

Note: Values are mean ± SD. Parentheses indicate measurement units for anthropometric characteristics (height and weight) and physical fitness tests. Significance levels: $p < .05$; **$p < .001$.
Source: The authors.

Table 2. Correlations between academic achievement, physical fitness and perceived physical

			1		2		3		4		5		6		7		8		9		10		11		12		13		14	15
Academic achievement	1.	Indonesian	1																											
	2.	English	.345	**	1																									
	3.	Math	.922	**	.374	**	1																							
Physical fitness	4.	Grip strength	.193		.017		.087		1																					
	5.	Sit up	.180		.302	**	.228	*	.161		1																			
	6.	Sit and reach	.028		.237	*	.014		.009		-.020		1																	
	7.	Side steps	.095		.027		-.003		.238	*	.296	**	-.112		1															
	8.	20m shuttle run	.073		.224	*	.118		.050		.325	**	.090		.169		1													
	9.	50m run	.164		.187		.231	*	.176		.425	**	.140		.240	*	.393	**	1											
	10.	Standing long jump	.104		.181		.104		.292	**	.367	**	-.024		.407	**	.308	**	.592	**	1									
	11.	Ball throw	.222	*	-.054		.200		.356	**	.162		.089		.248	*	.047		.362	**	.324	**	1							
	12.	Total score of physical fitness	.236	*	.257	*	.226	*	.508	**	.604	**	.261	*	.552	**	.530	**	.740	**	.726	**	.576	**	1					
Perceived Physical competence	13.	Perceived Physical Competence	.053		.019		.045		.093		.031		-.104		.149		.063		.310	**	.186		.206		.208		1			
	14.	Feeling of Control	.329	**	.111		.269	*	.162		.068		.085		.154		.137		.285	**	.239	*	.276	*	.313	**	.389	**	1	
	15.	Peer and Teacher Acceptance	.123		.096		.171		.094		.008		.088		.063		-.100		.087		-.020		.199		.093		.202		.168	1

Note: Pearson's r values are shown (N = 81). All physical fitness variables (overall composite and components) were standardized within sex (z-scores) prior to analysis. For the 50-m sprint, the z-score was multiplied by -1 (i.e., reverse-coded after standardization) so that higher values consistently indicate better performance. *p < .05, **p < .01.
Source: The authors.

Pearson's correlation coefficients were then employed to the relationship between academic achievement, physical fitness and perceived physical competence, with acceptable significance values of $p<0.05$.

Results

Table 2 shows the results of Pearson's correlation coefficients. Total score of physical fitness was positively correlated with Indonesian ($r=.236$, $p<.05$), English ($r=.257$, $p<.05$) and mathematics ($r=.216$, $p<.05$). Regarding fitness components, Indonesian was positively correlated with ball throw ($r=.222$, $p<.05$). English was positively correlated with sit up ($r=.302$, $p<.01$), sit and reach ($r=.237$, $p<.05$), and 20-meter shuttle run ($r=.224$, $p<.05$). Mathematics was positively correlated with sit up ($r=.228$, $p<.05$) and 50m run ($r=.231$, $p<.05$). The "feeling of control" component of perceived physical competence was also positively correlated with Indonesian ($r=.329$, $p<.01$) and mathematics ($r=.269$, $p<.05$).

Discussion

This study focused on the relationship between physical fitness and academic achievement as one approach to health and academic issues in Indonesia, and examined the relationship between physical fitness and perceived physical competence and academic achievement as a basic study to promote physical activity, including related variables of it, and to improve physical fitness through physical education. The results revealed a significant positive correlation between the overall evaluation of physical fitness and academic achievement of language skills, such as Indonesian and English and Math literacy.

As mentioned above, according to the results of PISA 2022,[11] children's academic achievement in Indonesia is not only declining but also at the lowest level since the country joined this academic survey in 2001. Based on these results, Bilad et al.[14] identified the need for educational reforms such as curriculum modification, teacher education, and equal educational opportunities, especially for improving mathematics literacy and language literacy related to various subject. Since this study found a positive relationship between academic performance and physical fitness in subjects related to those literacies, it can be said that developing physical education classes in Indonesia with the intention of improving physical fitness may represent one partial and complementary approach to solving the issues related to academic achievement indicated in the PISA survey.

When considering the relationship between individual physical fitness components and academic achievement, subjects related to language skills, such as Indonesian and English, were positively correlated with several physical fitness components, including sit up, sit-and-reach, 20-meter shuttle run, and ball throw. Among these physical fitness components, the effects of cardiorespiratory fitness, as measured by the 20-meter shuttle run, on cognitive function and academic performance have been consistently observed[8,10]. Thus, the results of this study support those previous studies. Although in flexibility, as measured by sit and reach, a positive relationship with academic performance has been reported[15,16], few studies have been conducted. In this study, the associations differed across muscular fitness indicators; that is grip strength and sit up. Evidence regarding muscular strength and academic achievement has been mixed, and a previous systematic review reported inconsistent findings.[9] However, a recent systematic review and meta-analysis reported a very small positive association between muscular fitness and academic achievement,[17] although the pooled estimate integrates diverse muscular fitness tests, making it difficult to determine which specific indicators show the most consistent associations. In this study, grip strength as an indicator of maximal isometric strength

was not significantly correlated with academic achievement, whereas sit-up performance as an indicator of muscular endurance showed a positive correlation with English. Taken together, these findings suggest that muscular strength is multidimensional, and future research should examine which specific components strength are most relevant to academic outcomes. In addition, recent studies have pointed out that simple improvements in physical fitness do not lead to improvements in cognitive function and academic performance; rather, dexterity, as measured by ball throw, contributes to these improvements.[18] Therefore, further investigation is required to determine the physical fitness components closely related to academic performance among Indonesian children.

This study also found a positive correlation between "Feeling of Control" and academic achievement; Indonesian language and mathematics. The feeling of control is a central concept that motivates physical activity. In self-determination theory, one of the motivational theories proposed by Ryan and Deci,[19] competence is listed as one of the innate psychological needs that must be satisfied for a person to be motivated. In other words, increased perceived physical competence can increase motivation for physical activity, stimulate physical activity, and contribute to improved physical fitness and academic achievement. Based on the findings of this study, it may be necessary to create physical education classes in which students can experience a feeling of control over physical activity through their own efforts and practice, since a feeling of control plays an important role in improving academic achievement.

In contrast, Peer and Teacher Acceptance was not significantly associated with academic achievement. This factor may reflect perceived social support and interpersonal experiences in school contexts, which are not necessarily captured by exam scores. Rather, it may be more closely related to broader indicators of school engagement (e.g., sense of belonging, classroom participation, and motivation) than to academic achievement per se. In addition, limited variability in grades within a single school setting may have attenuated detectable correlations.

Finally, the limitations of this study and directions for future research should be noted. First, the cross-sectional design precludes causal inference, and the direction of the observed associations cannot be determined; therefore, longitudinal and/or intervention studies are needed to clarify temporal ordering and potential causal pathways. Second, academic achievement was operationalized using school exam scores from a single institution, which may be influenced by grading practices and has limited comparability across schools; future studies should incorporate more standardized achievement measures and multi-school samples to improve generalizability. Third, unmeasured confounders such as socioeconomic status, sleep, nutrition, and out-of-school learning opportunities may influence both physical fitness and academic achievement, and should be measured and controlled in future research. Finally, although we used sex-standardized z-scores derived from the raw fitness measures to reduce dependence on country-specific normative scoring systems, future research should establish Indonesian reference values and further evaluate the cultural and measurement validity of the instruments used in Indonesian settings. Despite these limitations, the present findings provide preliminary evidence that can inform the design of future longitudinal or experimental studies in Indonesian school settings.

Conclusion

This study investigated the relationship between physical fitness, perceived physical competence, and academic achievement among Indonesian elementary school children. The findings revealed a significant positive correlation between physical fitness and academic

performance. Additionally, the "feeling of control" aspect of perceived physical competence was positively correlated with academic achievement.

These results emphasize the potential of integrating well-structured physical education classes into school curricula to enhance academic achievement while addressing health challenges. In the context of declining physical education resources and academic performance in Indonesia, this approach offers a dual benefit to holistic child development. Future longitudinal studies are needed to clarify temporal ordering and potential causal pathways. In addition, replication in larger, multi-school samples using more standardized achievement measures and incorporating key confounders (e.g., socioeconomic status, sleep, and nutrition) is required.

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