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Effects of physical fitness, parenting style, and secondhand smoke exposure predict physical education learning outcomes

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ABSTRACT

This study aimed to investigate the effects of physical fitness, parenting style, and secondhand smoke exposure on Physical Education learning outcomes and to examine the mediating role of secondhand smoke exposure. A quantitative correlational design was employed involving 38 fifth- and sixth-grade students from Kuranji Elementary School Number 32nd, Padang City, selected through total sampling. Data were collected using the Indonesian Student Fitness Test (TKSI), parenting style and secondhand smoke exposure questionnaires, and Physical Education academic records. Data were analyzed using path analysis with IBM SPSS Statistics 27. Physical fitness had a positive and significant effect on Physical Education learning outcomes ($\beta = 0.427$; $p < 0.001$), while parenting style ($\beta = -0.379$; $p = 0.001$) and secondhand smoke exposure ($\beta = -0.344$; $p = 0.001$) also showed significant effects. The model explained 68.2% of the variance in Physical Education learning outcomes. Physical Education learning outcomes are influenced not only by students' physical fitness but also by family environmental factors, particularly parenting practices and reduced exposure to secondhand smoke.

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Introduction

Physical Education is a core subject that plays a strategic role in supporting students' holistic development (Amalia & Angga, 2021; Padli et al., 2022; Sujarwo & Widayat, 2020). Through well-structured physical activities, Physical Education aims not only to improve physical fitness and fundamental movement skills but also to promote cognitive, affective, social, and character development (Budiono, Yahya, Siyono, Pratiwi, & Ginting, 2023; Noer, Mustopa, & Ramly, 2023). In line with the implementation of the Merdeka Curriculum, Physical Education instruction in elementary schools is designed to foster physically active and healthy students, enhance physical literacy, and encourage the adoption of healthy lifestyles in daily life (Mustafa & Dwiyo, 2020). Therefore, the success of Physical Education learning should not be assessed solely based on students' physical performance but should also be reflected in their learning outcomes, which demonstrate comprehensive mastery of the expected competencies.

However, Physical Education learning outcomes among elementary school students continue to exhibit considerable variation. Previous studies have shown that these outcomes are influenced by the interaction of multiple factors originating from both individual and environmental contexts. Internal factors, particularly physical fitness, contribute to students' ability to actively and effectively participate in learning activities. Meanwhile, external factors, including the family environment and environmental health conditions, also play an important role in shaping the quality of students' learning experiences.

Physical fitness is one of the key determinants of success in learning. Students with higher levels of physical fitness generally demonstrate better endurance, coordination, and concentration, enabling them to participate more actively and effectively in learning activities. Conversely, poor physical fitness may lead to early fatigue, reduced classroom participation, and lower learning achievement. Research by (Ruiz-ariza, Grao-cruces, Eduardo, Loureiro, & Martínez-lópez, 2016), reported that physical fitness is positively associated with concentration and academic performance, while (Waruwu, Pertiwi, Sadar, Sugiarto, & Caniago, 2025), found that regular physical activity enhances cognitive function and promotes greater engagement in the learning process. These findings suggest that physical fitness contributes not only to physiological well-being but also to academic success.

In addition to physical fitness, the family environment plays a crucial role in shaping students' learning behaviors. Parenting style influences the development of discipline, motivation, healthy lifestyle habits, and support for children's learning activities (Hidayat et al., 2023; Kimiecik & Horn, 2012). Responsive parenting accompanied by appropriate supervision has been shown to promote children's independence, responsibility, and academic achievement, whereas ineffective parenting practices are associated with lower learning motivation and weaker self-regulation (Boakye, 2021). Therefore, success in Physical Education learning is determined not only by school-based instructional activities but also by the quality of parenting and family support experienced by students.

Another environmental health issue that has received limited attention in Physical Education research is children's exposure to second hand smoke. Indonesia continues to experience a high prevalence of secondhand smoke exposure in households, placing many school-aged children at risk of becoming passive smokers. Exposure to second hand smoke has been associated with impaired lung function, respiratory disorders, reduced cardiorespiratory fitness, and diminished capacity to engage in physical activity. These adverse health effects may limit students' participation in Physical Education classes and ultimately affect their learning outcomes. Although the health consequences of secondhand smoke exposure have been widely documented, its relationship with Physical Education learning outcomes remains underexplored in Physical Education research.

Previous studies have generally examined physical fitness, parenting style, and secondhand smoke exposure as separate determinants. Research on physical fitness has primarily focused on physical performance and academic achievement, whereas studies on parenting have emphasized children's psychosocial development and learning motivation. Likewise, investigations of secondhand smoke exposure have largely been conducted within the field of public health, focusing on respiratory health and child development. To date, few studies have integrated these three factors into a single analytical model to explain variations in Physical Education learning outcomes among elementary school students. Yet, learning outcomes are shaped by the interaction of students' physical condition, family environment, and the health environment in which they live.

Preliminary observations at Kuranji Elementary School Number 23, Padang City, Indonesia, revealed that some students were less active during Physical Education classes, experienced fatigue more quickly during physical activities, and achieved suboptimal learning outcomes. Physical Education teachers also reported variations in parental support for students' learning and health-related behaviors. In addition, several students were found to live in households where smoking indoors was common, increasing their exposure to secondhand smoke. These findings suggest that poor Physical Education learning outcomes may not be attributed solely to physical fitness but may also be influenced by family-related and environmental health factors. Therefore, this study aimed to examine the effects of physical fitness, parenting style, and secondhand smoke exposure on Physical Education learning outcomes among elementary school students. The novelty of this study lies in the development of an integrated analytical model that simultaneously examines physiological factors (physical fitness), family psychosocial factors (parenting style), and environmental health risk factors (secondhand smoke exposure) in explaining Physical Education learning outcomes. This multidimensional approach is expected to provide a more comprehensive understanding of the determinants of Physical Education learning outcomes and to serve as a basis for developing intervention strategies involving schools, families, and communities to improve the quality of Physical Education in elementary schools.

Method

This study employed a quantitative correlational design using path analysis to examine the direct and indirect effects of physical fitness, parenting style, and secondhand smoke exposure on Physical Education learning outcomes. The exogenous variables were physical fitness (X_1) and parenting style (X_2), the mediating variable was second hand smoke exposure (M), and the endogenous variable was Physical Education learning outcomes (Y). The study was conducted at Kuranji Elementary School Number 32nd, Padang City, Indonesia. The population consisted of 132 students, while the sample included 38 fifth- and sixth-grade students (Phase C)

selected through total sampling. Phase C students were chosen because they possess more advanced cognitive, affective, and psychomotor development, enabling them to provide data relevant to the study objectives.

Physical fitness was assessed using the Indonesian Student Fitness Test (TKSI). Parenting style was measured using a questionnaire adapted from the Parenting Styles and Dimensions Questionnaire (PSDQ), whereas second hand smoke exposure was assessed using a questionnaire developed based on the World Health Organization (WHO) indicators for passive smoke exposure. Physical Education learning outcomes were obtained from students' semester grades for the 2025/2026 academic year. All instruments demonstrated acceptable validity and reliability before data analysis. Descriptive statistics were used to summarize the data, followed by assumption tests, including normality, linearity, and multicollinearity. Hypotheses were tested using path analysis in IBM SPSS Statistics version 27 with a significance level of 0.05.

Results and Discussions

Physical Fitness Characteristics

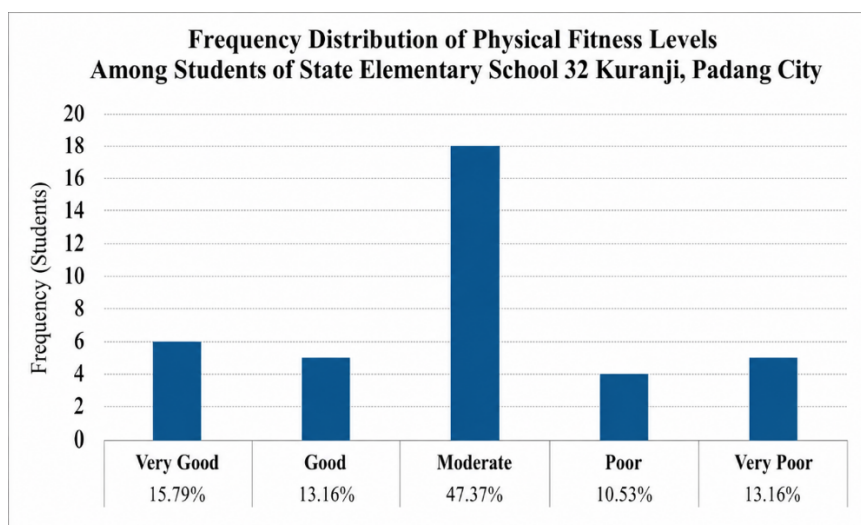


Figure 1. Distribution of Physical Fitness Levels

As shown in Figure 1, most students demonstrated a moderate level of physical fitness, accounting for 18 students (47.37%). Meanwhile, 9 students (23.69%) were classified as having low or very low physical fitness, whereas 11 students (28.95%) were categorized as having high or very high physical fitness. These findings indicate that the overall physical fitness level of the students was moderate, suggesting the need for regular physical activity and well-designed Physical Education instruction to further improve students' physical fitness.

Parenting Style Characteristics

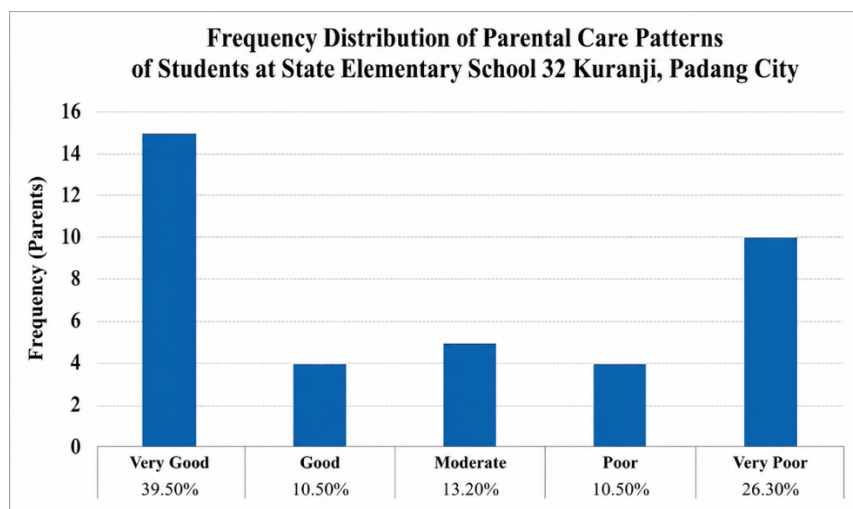


Figure 2. Distribution of Parenting Style Levels

As shown in Figure 2, most students were classified as having a very high level of positive parenting, comprising 15 students (39.5%). In contrast, 10 students (26.3%) were classified in the very low category. These findings suggest that, overall, parents have adopted positive parenting practices. However, a substantial proportion of students still require greater parental support to foster a family environment that is conducive to their development and learning.

Secondhand Smoke Exposure

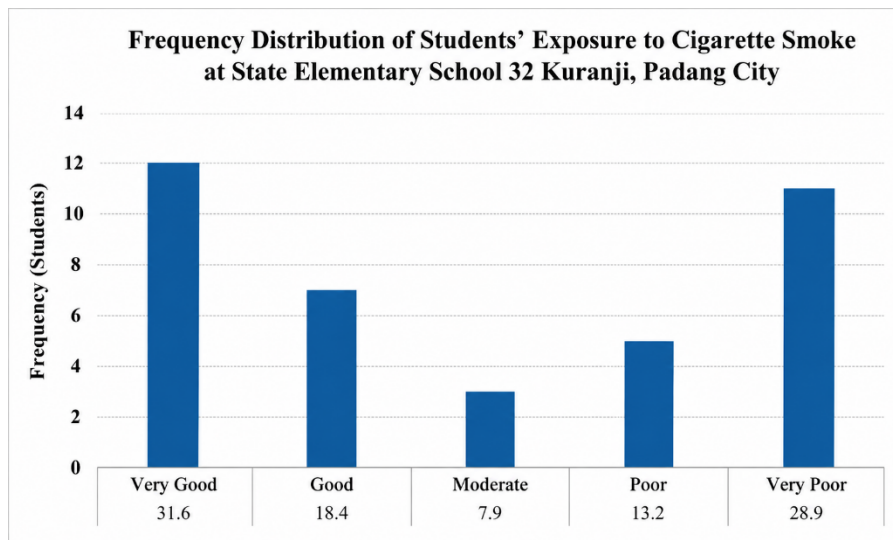


Figure 3. Distribution of Secondhand Smoke Exposure Levels

As shown in Figure 3, most students were classified in the very high category, representing 12 students (31.6%), while 11 students (28.9%) were classified in the very low category. Overall, these findings indicate that students' secondhand smoke exposure was generally at a favorable level according to the study indicators. Nevertheless, a considerable proportion of students remained exposed to relatively high levels of secondhand smoke. This highlights the important role of families and the surrounding environment in creating smoke-free environments that support children's health and learning.

Physical Education Learning Outcomes

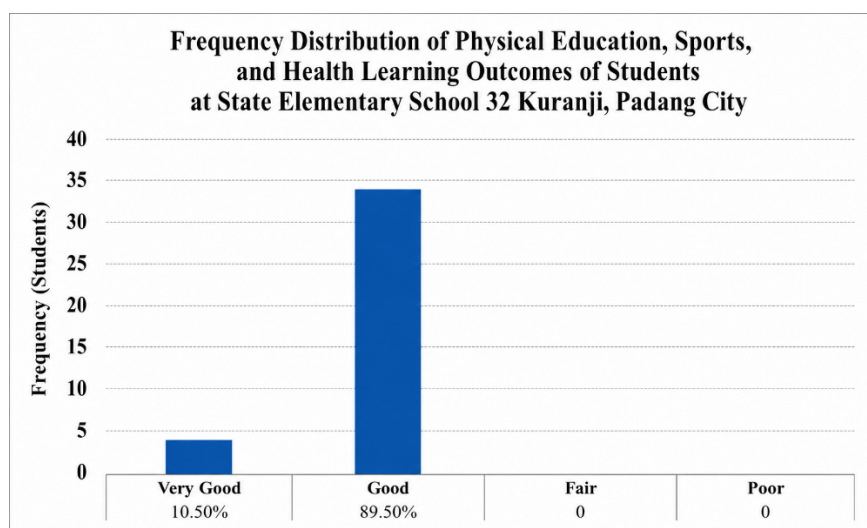


Figure 4. Distribution of Physical Education Learning Outcomes

As presented in Table 4, most students achieved a grade of B (Good) in Physical Education, accounting for 34 students (89.5%), while 4 students (10.5%) achieved a grade of A (Excellent). No students obtained grades C (Fair) or D (Poor). These findings indicate that students generally demonstrated good Physical Education learning outcomes, suggesting that the expected learning competencies were successfully achieved.

Results of Path Analysis**Table 1.** Summary of the Regression Analysis Results for Structural Model III

Variable	Beta (β)	t _{counts}	p-value	R _{Square}	Description
Physical Fitness to Physical Education Learning Outcomes	0,427	3,969	<0,001	0,682	Significant
Parenting Style to Physical Education Learning Outcomes	-0,379	-3,583	0,001		Significant
Secondhand Smoke Exposure to Physical Education Learning Outcomes	-0,344	-3,456	0,001		Significant

Based on the results of the Structure III analysis, the coefficient of determination (R^2) was 0.682, indicating that physical fitness, parenting style, and exposure to secondhand smoke collectively explained 68.2% of the variance in Physical Education learning outcomes, while the remaining 31.8% was attributable to other factors not included in the model. The path analysis revealed that physical fitness had a positive and significant effect on Physical Education learning outcomes ($\beta = 0.427$; $t = 3.969$; $p < 0.001$). In contrast, parenting style ($\beta = -0.379$; $t = -3.583$; $p = 0.001$) and secondhand smoke exposure ($\beta = -0.344$; $t = -3.456$; $p = 0.001$) showed significant negative effects on Physical Education learning outcomes. The negative coefficient for parenting style should be interpreted in accordance with the scoring direction of the instrument used, whereas the negative coefficient for secondhand smoke exposure indicates that higher levels of exposure were associated with lower Physical Education learning outcomes. Overall, the findings demonstrate that physical fitness, parenting style, and secondhand smoke exposure are significant predictors of Physical Education learning outcomes among students.

Direct and Indirect Effects Among Variables**Table 2.** Summary of Direct and Indirect Effects Among the Study Variables

Effect Path	Direct	Indirect	Total Effect
Physical Fitness to Physical Education Learning Outcomes	0,427	-0,138	0,289
Parenting Style to Physical Education Learning Outcomes	-0,379	-0,328	-0,707
Secondhand Smoke Exposure to Physical Education Learning Outcomes	-0,344		-0,344

The path analysis indicated that physical fitness had a direct effect of 0.427 on physical education learning outcomes and an indirect effect of -0.138 through secondhand smoke exposure, resulting in a total effect of 0.289. this finding suggests that the influence of physical fitness on physical education learning outcomes was predominantly direct rather than mediated by secondhand smoke exposure. in contrast, parenting style had a direct effect of -0.379 and an indirect effect of -0.328 through secondhand smoke exposure, yielding a total effect of -0.707 . these results indicate that secondhand smoke exposure mediated the relationship between parenting style and physical education learning outcomes. meanwhile, secondhand smoke exposure exerted only a direct effect on physical education learning outcomes (-0.344), as it functioned as the mediating variable in the path model.

Effect of Physical Fitness on Physical Education Learning Outcomes

The results showed that physical fitness had a positive and significant effect on physical education learning outcomes ($\beta = 0.427$, $p < 0.001$). this finding indicates that students with higher levels of physical fitness tended to achieve better physical education learning outcomes. physical fitness provides an essential foundation for students to actively participate in learning activities, sustain physical endurance throughout lessons, and perform practical tasks more effectively. These findings are consistent with motor development theory, which emphasizes that physical fitness serves as a fundamental basis for acquiring motor skills and promoting active participation in Physical Education (Gallahue, 1983; Salehi, Sheikh, & Talebrokni, 2017; Veiskarami & Roozbahani, 2020). From a physiological perspective, regular physical activity enhances cardiovascular function, increases oxygen delivery to the brain, and stimulates the production of brain-derived neurotrophic factor (BDNF), which plays a crucial role in improving concentration, memory, and learning processes (Caldwell et al., 2020; Ying, Zhongling, & Zhaowei, 2022).

These findings are consistent with previous studies by (Xin et al., 2020) and (Weir, Pringle, & Roscoe, 2024), which reported that students with higher levels of physical fitness tend to demonstrate better cognitive

performance and academic achievement. In the present study, physical fitness not only enhanced students' physical capacity but also promoted greater engagement in physical education learning activities. Furthermore, physical fitness remained a significant predictor of physical education learning outcomes even after controlling for parenting style and secondhand smoke exposure in the path analysis model. These findings highlight the importance of improving students' physical fitness as a key strategy for optimizing learning outcomes in Physical Education

Effect of Parenting Style on Physical Education Learning Outcomes

The results indicated that parenting style had a significant effect on Physical Education learning outcomes ($\beta = -0.379$, $p = 0.001$). Although the path coefficient was negative, this direction reflects the partial effect after controlling for physical fitness and secondhand smoke exposure in the path analysis model. Therefore, the negative coefficient should not be interpreted as indicating that better parenting leads to lower physical education learning outcomes; rather, it represents the simultaneous relationships among the variables included in the model. This finding is consistent with the theories of Baumrind (1991) in the research (Ishlah, Hilmi, & Himmah, 2024), which emphasize that parenting style plays a crucial role in shaping children's motivation, discipline, responsibility, and healthy lifestyle habits. Through supervision, emotional support, and the promotion of healthy behaviors, parents create a family environment that supports both academic and non-academic development, including success in physical education learning.

These findings are also consistent with previous studies by (Dorsch, Thrower, & Lowe, 2020; Kong & Yasmin, 2022), which reported that parental involvement contributes positively to students' learning motivation, academic achievement, and social development. In the present study, the relationship between parenting style and physical education learning outcomes was partially mediated by secondhand smoke exposure, suggesting that part of the influence of parenting operates through the creation of a healthier home environment. This finding highlights that improving physical education learning outcomes depends not only on school-based instruction but also on positive parenting practices, support for regular physical activity, and a smoke-free home environment. Therefore, effective collaboration between schools and families is essential for optimizing students' physical education learning outcomes.

Effect of Secondhand Smoke Exposure on Physical Education Learning Outcomes

The results showed that secondhand smoke exposure had a significant negative effect on Physical Education learning outcomes ($\beta = -0.344$, $p = 0.001$). This finding indicates that higher levels of secondhand smoke exposure were associated with lower physical education learning outcomes. Therefore, secondhand smoke exposure represents an environmental risk factor that may hinder students' achievement in physical education. This finding is consistent with previous evidence indicating that exposure to secondhand smoke impairs respiratory function, reduces lung capacity, and limits oxygen delivery to body tissues, thereby negatively affecting physical performance and learning ability (World Health Organisation, 2017). Moreover, the toxic substances contained in tobacco smoke may impair cognitive function, concentration, and endurance during learning activities.

These findings are in line with studies by (Braun, Klingelhöfer, Oremek, Quarcoo, & Groneberg, 2020; Öberg, Jaakkola, Woodward, Peruga, & Prüss-üstün, 2010), which reported that children exposed to secondhand smoke are at greater risk of developing health problems, cognitive impairment, and lower academic achievement than those raised in smoke-free environments. In the present study, secondhand smoke exposure remained a significant negative predictor of physical education learning outcomes even after controlling for physical fitness and parenting style in the path analysis model. These results emphasize the importance of maintaining a smoke-free home environment to support children's health and academic success. Therefore, stronger collaboration between schools and parents is essential to increase awareness of the harmful effects of secondhand smoke and to promote healthier environments that enhance students' physical education learning outcomes.

Effect of Physical Fitness on Parenting Style

The results showed that physical fitness had a significant effect on parenting style in the path analysis model ($\beta = -0.401$, $p = 0.013$). Although the path coefficient was negative, this finding should not be interpreted as indicating that improved physical fitness leads to poorer parenting. Rather, the coefficient represents a partial relationship estimated after simultaneously accounting for the relationships among all variables in the path model. Theoretically, children's physical fitness is influenced by multiple factors, including family support through regular physical activity, healthy lifestyle practices, and parental involvement in child development (Purnomo et al., 2024). Similarly, (Felber Charbonneau & Camiré, 2020), emphasized that parental involvement plays a crucial role in fostering active lifestyles that promote children's physical fitness.

In the present study, this relationship should be interpreted as an empirical association within the path analysis model rather than as direct evidence of causality. The observed coefficient may have been influenced by the relatively homogeneous sample and by other unmeasured factors, such as parental education, socioeconomic status, and neighborhood environment. Therefore, the findings should be interpreted with caution. Nevertheless, the results suggest an interrelationship between students' physical fitness and the family environment within the overall analytical framework. Future studies are encouraged to adopt more comprehensive conceptual models by incorporating additional family-related variables to better explain the mechanisms underlying this relationship.

Indirect Effect of Physical Fitness on Physical Education Learning Outcomes Through Secondhand Smoke Exposure

The path analysis revealed that physical fitness had an indirect effect on Physical Education learning outcomes through secondhand smoke exposure, with an effect size of -0.138 . This value was obtained by multiplying the path coefficient from physical fitness to secondhand smoke exposure ($\beta = 0.400$) by the path coefficient from secondhand smoke exposure to physical education learning outcomes ($\beta = -0.344$). Because both pathways were statistically significant ($p < 0.05$), the fifth hypothesis was supported. These findings indicate that the relationship between physical fitness and physical education learning outcomes is not only direct but also partially mediated by the family environment, as reflected in students' exposure to secondhand smoke. Specifically, secondhand smoke exposure reduces the positive contribution of physical fitness to learning outcomes when students are exposed to tobacco smoke at home.

These findings are consistent with the (World Health Organisation, 2017), which emphasizes that a healthy family environment is essential for supporting children's physical development, health, and learning. Exposure to secondhand smoke has been shown to impair respiratory function, reduce aerobic capacity, and diminish concentration and participation in learning activities, particularly in physical education, where active physical engagement is required. Similarly, (Öberg et al., 2010), reported that children raised in smoke-free environments generally demonstrate better health and academic performance. However, the indirect effect (-0.138) was substantially smaller than the direct effect of physical fitness on physical education learning outcomes ($\beta = 0.427$), indicating that physical fitness remains the primary determinant of learning outcomes, while secondhand smoke exposure acts as a mediating factor that weakens this positive relationship. These findings suggest that improving physical education learning outcomes requires not only enhancing students' physical fitness but also promoting smoke-free home environments.

Indirect Effect of Parenting Style on Physical Education Learning Outcomes Through Secondhand Smoke Exposure

The results showed that parenting style had a significant indirect effect on Physical Education learning outcomes through secondhand smoke exposure, with an indirect effect coefficient of -0.328 . This value was obtained by multiplying the path coefficient from parenting style to secondhand smoke exposure ($\beta = 0.954$) by the path coefficient from secondhand smoke exposure to physical education learning outcomes ($\beta = -0.344$). Since both pathways were statistically significant ($p < 0.05$), the sixth hypothesis was supported. These findings indicate that secondhand smoke exposure serves as a mediating mechanism linking parenting style to physical education learning outcomes. Parenting practices influence not only children's motivation and learning habits but also the quality of the home environment. Consequently, exposure to tobacco smoke within the household may diminish the positive influence of parenting style on students' learning outcomes.

These findings are consistent with (Invernizzi et al., 2021), who emphasized that parental involvement plays a crucial role in children's academic development and overall health. Similarly, (Braun et al., 2020), reported that a smoke-free home environment contributes to better physical health, improved concentration, and greater readiness for learning. Accordingly, secondhand smoke exposure can be viewed as an environmental factor that mediates the relationship between parenting style and physical education learning outcomes. The relatively large indirect effect (-0.328) suggests that the quality of the family environment makes a substantial contribution to this relationship. These findings highlight that improving physical education learning outcomes requires not only positive parenting practices but also a strong family commitment to maintaining a smoke-free home environment, thereby supporting students' physical development and learning performance.

Conclusions

This study demonstrates that Physical Education learning outcomes among students at SD Negeri 32 Kuranji Padang City are influenced by the interaction of both internal and external factors. Physical fitness was found to have a positive and significant effect on physical education learning outcomes, while parenting style and secondhand smoke exposure also showed significant effects within the path analysis model. In addition to their

direct effects, secondhand smoke exposure served as a mediating variable linking both physical fitness and parenting style to physical education learning outcomes. These findings indicate that improving physical education learning outcomes depends not only on students' physical fitness but also on the quality of the family environment, particularly positive parenting practices and maintaining a smoke-free home.

The findings have important practical implications for improving the quality of physical education instruction through collaboration among teachers, schools, and parents. Teachers should design structured physical activity programs to enhance students' physical fitness, while schools should provide adequate sports facilities and promote healthy, smoke-free environments. Parents are encouraged to adopt positive parenting practices, promote healthy lifestyles, and minimize children's exposure to secondhand smoke to support both health and academic achievement. This study is limited by its relatively small sample size and its focus on a single elementary school, which may limit the generalizability of the findings. Future research should involve larger and more diverse samples, employ longitudinal or experimental designs, and incorporate additional variables, such as nutritional status, daily physical activity, learning motivation, psychological factors, and the school environment, to provide a more comprehensive understanding of the determinants of physical education learning outcomes.

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