

## Strategies to increase physical activity in elementary school children in the digital age to support a healthy lifestyle

Estrategias para aumentar la actividad física de los niños de primaria en la era digital para favorecer un estilo de vida saludable

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**Abstract.** This study used the systematic literature review to review strategies to increase physical activity in elementary school children in the digital era to support a healthy lifestyle. Data were obtained from articles searched through Google Scholar. The search was conducted in September 2024 using the keywords: "Physical Activity Promotion" AND "Elementary School" AND "Healthy Lifestyle". During the search, inclusion and exclusion criteria were applied. For example, the search focused on articles published in Scopus-indexed journals between 2019 and 2024. From this initial search, 551 articles were found. Furthermore, they were screened again in several stages, and 16 articles that fit the theme and met the inclusion requirements were yielded. During the article selection, this study followed the PRISMA guidelines. The findings of this study confirmed the importance of appropriate strategies to increase the physical activity of elementary school students in the digital era to support a healthy lifestyle. The use of technology in the form of fitness apps, exergames, and wearable devices was proven effective in motivating children to be physically active. These technologies not only serve as support tools but also as powerful motivators that offer tracking and feedback that can encourage children to engage in physical activity more actively. In addition, more interactive approaches in schools, such as the Sport Education Model (SEM) and Teaching Personal and Social Responsibility (TPSR), have shown significant increases in student participation, resulting in a sustainable impact on daily physical activity habits. This study also reported that family support was very important in increasing children's physical activity. By engaging the whole family in physical activities, whether through shared outdoor activities or fitness apps, an environment that supports a healthy lifestyle is created. In addition, training teachers to utilize technology in physical learning can strengthen the implementation of strategies in schools, creating a more supportive and enjoyable environment for students.

**Keywords:** Strategy, Physical Activity, Students, Elementary School, in the Digital Age, Healthy Lifestyle

**Resumen.** Este estudio utilizó la revisión sistemática de la literatura para revisar las estrategias para aumentar la actividad física en los niños de primaria en la era digital para apoyar un estilo de vida saludable. Los datos se obtuvieron de artículos buscados a través de Google Scholar. La búsqueda se realizó en septiembre de 2024 utilizando las palabras clave: «Physical Activity Promotion» AND «Elementary School» AND «Healthy Lifestyle». Durante la búsqueda, se aplicaron criterios de inclusión y exclusión. Por ejemplo, la búsqueda se centró en artículos publicados en revistas indexadas en Scopus entre 2019 y 2024. A partir de esta búsqueda inicial, se encontraron 551 artículos. Además, se revisaron de nuevo en varias etapas y se obtuvieron 16 artículos que se ajustaban al tema y cumplían los requisitos de inclusión. Durante la selección de artículos, este estudio siguió las directrices PRISMA. Los resultados de este estudio confirmaron la importancia de las estrategias apropiadas para aumentar la actividad física de los alumnos de primaria en la era digital para apoyar un estilo de vida saludable. El uso de la tecnología en forma de aplicaciones de fitness, exergames y dispositivos wearables resultó eficaz para motivar a los niños a realizar actividad física. Estas tecnologías no sólo sirven como herramientas de apoyo, sino también como poderosos motivadores que ofrecen seguimiento y retroalimentación que pueden animar a los niños a participar en la actividad física de manera más activa. Además, los enfoques más interactivos en las escuelas, como el Modelo de Educación Deportiva (SEM) y la Enseñanza de la Responsabilidad Personal y Social (TPSR), han mostrado aumentos significativos en la participación de los estudiantes, lo que resulta en un impacto sostenible en los hábitos diarios de actividad física. Este estudio también informó de que el apoyo familiar era muy importante para aumentar la actividad física de los niños. Al involucrar a toda la familia en actividades físicas, ya sea a través de actividades compartidas al aire libre o aplicaciones de fitness, se crea un entorno que apoya un estilo de vida saludable. Además, formar a los profesores para que utilicen la tecnología en el aprendizaje físico puede reforzar la aplicación de estrategias en las escuelas, creando un entorno más propicio y agradable para los alumnos.

**Palabras clave:** Estrategia, actividad física, estudiantes, escuela primaria, en la era digital, estilo de vida saludable.

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### Introduction

Physical activity is very important in supporting children's health and development, especially for those of primary school age. Research shows regular physical activity can improve children's physical, mental, and social health. The positive impact of physical activity on children is extensive. Physically, it can improve muscle strength, endurance, and cardiovascular health. In addition, physical activity also

contributes to weight control and prevention of obesity, which is an increasing health problem among children. Hasan et al. (2020) showed that good physical activity habits from an early age can have a positive impact on children's physical development. In mental development, it has been shown to reduce symptoms of anxiety and depression, as well as improve children's mood and psychological well-being (Jauhari et al., 2019). From a social perspective, physical activity also serves as a means to improve

children's social interaction and communication skills. Through sports and games, children learn to cooperate, share, and build relationships with their peers. This is crucial for their social development, as positive social interactions can boost self-confidence and adaptability in social settings. Earlier studies emphasized that games involving physical activity can help children develop their gross motor skills, contributing to social development (Ramdani & Azizah, 2019). Thus, Rosiana et al. (2023) emphasized that integrating physical activity into daily life is crucial for children.

However, in recent years, there has been a global trend showing a decline in physical activity levels among children, especially in today's digital age. The use of electronic devices such as smartphones, tablets, and video games has changed the way children interact and play. Research shows that time spent on sedentary activities, such as watching TV or playing video games, has increased significantly, while time for physical activity has decreased (Suryoadji & Nugraha, 2021). This is a serious concern because excessive sedentary activities can lead to a variety of health problems, including obesity and mental health disorders (Rosadi et al., 2022).

One of the efforts to overcome this problem is to use a health promotion approach by increasing knowledge and the ability to apply physical sports activities among children. The activities should prioritize the use of technology that is commonly used by elementary school children every day. According to previous research, the use of technology among elementary school children helps them understand and apply simple physical activities at school, playgrounds, or at home, especially if accompanied by interesting and varied features (Bopp & Stelfson, 2020). The gadget is one form of technological advancement that is predominantly utilized by elementary school children. When used properly, it will have more positive benefits for health, growth, and development. It will encourage physical activities and change the way children use their time more actively so that they are not addicted to games (Statti & Torres, 2020).

Indeed, the digital age has created new challenges for parents and educators in encouraging children to stay physically active. According to Rusli et al. (2021), the high use of gadgets and social media among children contributes to their low physical activity levels. Children who spend more time in front of screens are less likely to participate in physical activities (Rusli et al., 2021). In addition, Suryani et al. (2017) showed that many children engage in physical activity less than once a week, indicating the need for interventions to raise awareness of the importance of physical activity. In this context, it is important for parents, educators, and communities to work together to create an environment that supports children's physical activity. This can be achieved by providing adequate sports facilities, introducing physical activity programs in schools, and encouraging children to engage in active outdoor play. According to Triardhana et al. (2022), a good understanding of nutrition

and physical activity among teachers can also improve children's fitness (Triardhana et al., 2022). Thus, collaboration between families, schools, and communities is essential to address the issue of decreased physical activity among children. Regular physical activity not only supports children's physical, mental, and social development but also helps prevent future health problems.

As argued earlier, physical activity is an essential component of children's development, especially in today's digital age, where a significant decline in children's physical activity levels leads to various health issues. Increased screen time has been shown to correlate with decreased physical activity and increased consumption of high-calorie foods, which eventually lead to an increased prevalence of obesity in children (Thakur et al., 2022). In addition, sedentary behaviors such as playing video games and watching television contribute to the risk of obesity and other health problems (Rocka et al., 2022). The impact of obesity is not only physical but also psychological, including depression and anxiety (Zheng et al., 2022). Moreover, it can inhibit fine and gross motor development, which affects social interaction and daily skills (Santri & Anggita, 2023). Lack of physical activity also worsens mental health, as children who move less tend to experience more stress, anxiety, and difficulty concentrating (O'Loughlin et al., 2013; Zheng et al., 2022).

One major challenge in promoting physical activity in children is the presence of digital technology. Technology has been long incriminated to reduce children's time to move physically (Suryani et al., 2017) and increase parents' difficulties in limiting screen time (Aseptianova et al., 2022). Schools also experience challenges in providing adequate facilities and time for physical activity (Santri & Anggita, 2023). Thus, efforts are needed to train teachers to integrate physical activity into learning (Triardhana et al., 2022). One of the factors that can be used to address this issue is attitude. Scholars believe that parents with positive attitudes towards physical activity tend to be more successful in encouraging their children to be active despite obstacles such as busyness and lack of knowledge (Chia et al., 2022). Collaboration between schools and parents is essential to increase children's participation in physical activity through in-school sports programs and active outdoor play (Örtegren, 2022). Overall, low physical activity among children has serious implications for physical, motor, and mental health, requiring collaborative action to create environments that support active lifestyles.

It is important to understand that children today face unique challenges brought by technological advancements, which often lead to decreased levels of physical activity. Therefore, the current research focuses not only on identifying strategies but also on implementing technology as a tool to support healthy lifestyles among children. Integrating technology into physical activity can create a more engaging and relevant approach for children, thus encouraging them to engage in more rewarding physical activities (Velarde et al., 2024). Strategies that have been

identified to increase physical activity in primary school children include a range of approaches, such as the development of supportive physical environments and the use of apps and digital devices that motivate children to move. Research shows that improvements to the out-of-school environment, such as increased play areas and the development of school gardens, can encourage children to be more active (Hyndman & Lester, 2015). In addition, the use of apps that combine games with physical activity, such as fitness challenges or location-based games, is effective in increasing children's participation in physical activity (Ridgers et al., 2010). Another important strategy is training teachers and parents to create a supportive environment for physical activity, both at school and at home (Knisel et al., 2020).

Identifying a comprehensive strategy has a significant impact on promoting sustainable programs to improve children's physical activity and health. Previous studies (Hyndman & Lester, 2015) showed that children involved in programs designed to increase physical activity had significant improvements in their physical fitness levels and mental health. Such programs have been shown to improve children's concentration and behavior, which contributes to better academic outcomes (Tyler et al., 2020). In addition, physically active children tend to have healthier diets and a lower risk of obesity and other health problems (Jannah, 2023). We believe that the findings of this study are crucial for education and health policy. They can provide a strong basis for developing policies that support increased physical activity among children, especially in the digitalization era that increasingly dominates their daily lives. By understanding effective strategies, policymakers can better design programs to support children's health (Matsuzaki et al., 2022). In addition, contributing to the existing literature on interventions focused on increasing physical activity among children is valuable, as it can help fill the knowledge gap on how technology can be used to promote active lifestyles among the younger generation (Ridgers et al., 2010). Thus, it is important to involve various stakeholders, including schools, parents, and communities to increase children's physical activity. Collaboration between various parties can create a more supportive environment for children to engage in physical activity, both inside and outside of school. This research not only provides insights into effective strategies but can also encourage collective action to improve children's health and well-being in this digital age.

Academically, research on human movement has touched on many areas. For example, some popular studies investigated the effect of physical education on learning outcomes (Martono et al., 2024; Komari et al., 2024a; Komari et al., 2024b; Septiantoko et al., 2024; Suyato et al., 2024; Widiyanto et al., 2024; Putro et al., 2024; Harmanto et al., 2024; Zulfahri et al., 2024; Susanto et al., 2024), motor development (Susanto et al., 2024; Susanto et al., 2024). Other studies examined specific areas of PE or sports, such as health and fitness sports (Widiyanto et al., 2024a; Widiyanto et al., 2024b; Syaokani et al., 2024;

Pranoto, et al., 2024; Astuti et al., 2024; Wayoi et al., 2024; Akhmad et al., 2024), law and sports (Ardiyanto et al., 2024; HB et al., 2024a; HB et al., 2024b), sports communication (Charlina et al., 2024), active lifestyle with exercise (Tafuri et al., 2024a), interval training and physiological (Latino et al., 2024a), circuit training programme (Tafuri et al., 2024b; Tafuri et al., 2024c; Latino et al., 2024b; Latino et al., 2024c; Adirahma et al., 2024), injury risk on sports (Anam et al., 2024a; Fahrosi et al., 2024), endurance training and physiological (Latino et al., 2024c), therapeutic sports (Zanada et al., 2024), movement skills (Susanto et al., 2023; Anam et al., 2024b; Pranoto et al., 2024), and sports training and performance (Kurniawan et al., 2024; Susanto et al., 2024), curriculum and management of physical education learning (Mardiyah et al., 2024a; Yani et al., 2024; Mardiyah et al., 2024b), and the management of sports education and archery (Hamsyah et al., 2024; Mulyanti et al., 2024; Setyawan et al., 2023a; Setyawan et al., 2023b; Setyawan et al., 2024a; Setyawan et al., 2024b; Destriani et al., 2024), students' motor skills (Sayekti et al., 2024).

Despite the myriad research, there is a lack of scholarly research yang berfokus on the strategies to increase physical activity in elementary school children in the digital era to support a healthy lifestyle. The dearth of studies on this topic can impede understanding and scientific development in the field. Hence, it is imperative to research this issue by thoroughly reviewing existing literature studies. Therefore, it aims to investigate strategies to increase physical activity in elementary school children in the digital era to support healthy lifestyles, identify appropriate strategies to increase physical activity in elementary school students in the digital era, and explore the impact of implementing these strategies on increasing children's physical activity and health.

## Materials & Methods

This study employed a systematic literature review method by identifying, evaluating, and interpreting all relevant research results. It was conducted with a comprehensive strategy by searching articles in research journal databases. The search was conducted in September 2024 using the keywords: "Physical Activity Promotion" AND "Elementary School" AND "Healthy Lifestyle". During the search, several inclusion and exclusion criteria were applied. For example, the articles must be published in Scopus-indexed journals. In addition, the publication period was limited between 2019 and 2024. Based on this timeframe, 551 articles were found from various international journal indexing databases, including Scopus and other database sources. Then, these articles went through several stages of the screening process, and 16 articles that fit the theme and met the inclusion requirements were selected. The complete list of inclusion and exclusion criteria are shown in Table 1 below:

Table 1.

**Inclusion and exclusion criteria**

Criterion	Inclusion	Exclusion
Period	Journals published in 2019-2024	Journals published outside 2019-2024
Indexed	Scopus-indexed international journal	Non-Scopus-indexed international journal
Access	Open access	Close access (Subscription)
Language	English language journal	Non-English language journal
Article Type	Original research article	Review article, conference proceeding, book, book chapter, book series, editorial, etc.
Full Text	Articles fulfill the scope/topic of research	Articles do not fit the scope/topic of the research
Topic of Discussion	The article's content is relevant to the theme of strategies to increase physical activity in elementary school children in the digital era to support a healthy lifestyle.	The article's content is not relevant to the theme of strategies to increase physical activity in elementary school children in the digital era to support a healthy lifestyle.

During the article selection, this study followed the "Preferred Reporting Items for Systematic Reviews and Meta-Analyses" (PRISMA) guidelines. These guidelines are expected to produce systematic literature review reports that are more transparent, complete, and accurate, thus facilitating evidence-based decision-making (Page et al., 2021). This systematic literature review gathered all available scientific evidence according to the inclusion and exclusion criteria (Martín-Moya et al., 2021). The process of the article selection under the PRISMA method is shown in Figure 1.

**Results**

The following section provides an overview of the results from the literature review on strategies aimed at promoting physical activity among primary school children in the digital era. These strategies are vital in fostering a healthy lifestyle and addressing the challenges posed by increasing screen time and sedentary behavior in children. The detailed results are shown in Table 2.

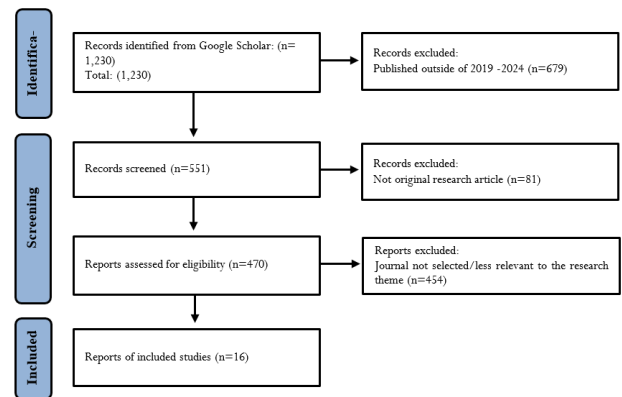


Figure 1. PRISMA flowchart of the article selection process

Table 2. Literature Review Results

Author	Study objectives	Study Design*	Main Findings
(Franceschi et al., 2021)	The goal of the study was to implement an integrated educational program aimed at preventing and managing overweight and obesity among children from migrant backgrounds or low socioeconomic status (SES) in northern Italy.	RCT	The intervention led to a significant increase in student's knowledge regarding healthy nutrition and physical activity. There was a 35% increase in knowledge about the daily consumption of vegetables and fruits and a 63% improvement in understanding the importance of physical activity. Additionally, students showed improved dietary behaviors, with a 14% increase in fruit and vegetable consumption among the clinical group.
(Oliveira et al., 2022)	The study aimed to assess the impact of interdisciplinary educational interventions on the knowledge and behaviors of elementary students related to nutrition, eating habits, and physical activity.	RCT	The intervention effectively increased students' understanding of nutrition and the importance of physical activity. The students demonstrated improved knowledge and reported healthier eating and activity behaviors post-intervention. The study highlights the positive outcomes of embedding nutritional and physical education within the school curriculum.
(Bartelink et al., 2019b)	This study evaluated the long-term effects of the Healthy Primary School of the Future (HPSF) initiative on children's dietary and physical activity behaviors.	RCT	The results showed favorable intervention effects in the schools that fully implemented the program. Children in the intervention group significantly increased their consumption of healthy foods like fruits and vegetables, and their physical activity levels improved. However, these changes were more significant in schools that focused on both nutrition and physical activity compared to those that focused solely on one aspect.
(Pulido-Gil et al., 2022)	The purpose of this study was to assess the effectiveness of a Physically Active Learning (PAL) program in improving primary school students' physical activity levels, physical fitness, well-being, and academic performance.	RCT	The PAL program resulted in a significant increase in physical activity during school hours and improved several physical fitness indicators, such as endurance and lower-limb strength. Students also reported improved relationships with their teachers and an increased interest in the subject. Additionally, the program did not negatively affect academic performance, and students' perceived health status improved in the experimental group.
(Jiménez-Parra	The purpose of this research was to develop and evaluate	RCT	The findings highlighted that combining TPSR and AB in the classroom promotes

et al., 2022)	the educational program "ACTIVE VALUES," designed to promote healthy lifestyles and reduce sedentary behaviors among students.		physical activity, social responsibility, and behavioral improvements among students. While TPSR enhances social and emotional skills, AB contributes to improving physical fitness and reducing sedentary behaviors. The integration of both strategies addresses educational and health-related goals simultaneously, filling research gaps found when these methods are applied in isolation.
(Maglie et al., 2022)	The study aimed to evaluate the effects of a structured physical activity intervention on the physical fitness and lifestyle habits of schoolchildren.	RCT	Results demonstrated significant improvements in fitness measures, such as the vertical jump and rope jump performance in the intervention group. Additionally, the study found a reduction in sedentary behaviors such as video games and screen time, accompanied by increased physical activity and healthier lifestyle habits, particularly among boys.
(Filho et al., 2019)	This study examined the effectiveness of a multicomponent intervention designed to improve the lifestyle behaviors of Brazilian adolescents in low Human Development Index (HDI) areas.	RCT	The findings revealed improvements in several key areas, including increased physical activity levels, enhanced social interactions, and better adherence to a healthy diet. The adolescents showed positive behavioral changes, such as reduced consumption of unhealthy snacks and a greater preference for physical activities, indicating the success of the intervention in fostering healthier lifestyle habits.
(van den Berg et al., 2020)	The goal of this research was to assess the impact of the Texas GROW! EAT! GO! (TGEG) program, which integrates gardening and physical activity interventions on children's eating behaviors and physical activity levels in low-income Title 1 schools.	RCT	The study found significant improvements in children's vegetable preferences, vegetable tasting, and nutrition knowledge due to the gardening intervention. Additionally, the physical activity component helped improve the children's Body Mass Index (BMI) percentile. However, the study noted that parental involvement in the home-based component was limited, which may have constrained the intervention's overall effectiveness.
(Vega-Ramírez, 2024)	The purpose of this research was to investigate the effects of a school-based intervention program focused on physical activity and healthy eating on the overall well-being of primary school students.	RCT	The findings revealed that students who participated in the physical activity and healthy eating program experienced significant improvements in their physical fitness, self-esteem, and social interactions. The study showed that these positive outcomes were more pronounced in students who were overweight or exhibited low physical activity levels at the outset, highlighting the effectiveness of a structured intervention in promoting healthy habits and well-being among children.
(Liao et al., 2023)	This study aimed to evaluate the effectiveness of the Sport Education Model (SEM) in promoting healthy lifestyle behaviors among university students.	RCT	The results indicated that students exposed to the SEM reported higher levels of physical activity, better dietary choices, and improved self-regulation in maintaining healthy lifestyle habits. The study concluded that the SEM is a promising educational tool for fostering long-term health-related behaviors in university students.
(Jiménez-Parra & Valero-Valenzuela, 2023)	The objective of this research was to analyze the impact of an interdisciplinary educational program on physical activity levels and fitness outcomes in school children.	RCT	The findings demonstrated that students participating in the interdisciplinary program exhibited significant improvements in both their physical fitness and overall physical activity levels. The program was particularly effective in engaging students who were previously less active, leading to enhanced participation and better fitness outcomes across the entire student population.
(Morano et al., 2020)	This study aimed to assess the efficacy of a school-based multicomponent intervention designed to increase physical activity levels and improve actual and perceived physical competence among overweight and obese children aged 10-12.	RCT	The results showed that children who participated in the 7-month intervention program experienced significant improvements in their physical activity levels, perceived physical ability, and performance in physical tasks, such as throwing and jumping. The intervention group outperformed the control group, demonstrating that a comprehensive approach to physical education can effectively enhance physical competence and health in overweight and obese children.
(Bartelink et al., 2019)	The study aimed to investigate the effects of the Healthy Primary School of the Future (HPSF) on children's physical activity (PA) and dietary behaviors, both at school and at home.	RCT	The study found that the full HPSF led to positive improvements in children's PA and dietary behaviors at school without compensatory negative effects at home, while the partial HPSF showed compensatory decreases in PA at home. Additionally, socioeconomic status significantly moderated the effects, with children from lower SES backgrounds exhibiting less favorable outcomes at home, which may exacerbate health inequalities.
(Jiménez-Parra et al., 2022)	The main goal of this study was to examine the impact of a hybrid educational program that combined active breaks (AB) with the Teaching Personal and Social Responsibility (TPSR) model on the behavior of primary school students.	RCT	The study concluded that the hybrid program led to significant improvements in student behavior, promoting autonomy and responsibility while also increasing their engagement in physical activity. Teachers reported enhanced satisfaction with their teaching experience, noting that the methodology introduced novel strategies and increased student motivation. However, the research also highlighted challenges, such as the small sample size and the need for longitudinal studies to validate the findings.
(Bartelink et al., 2019a)	This study aimed to evaluate the long-term impact of the Healthy Primary School of the Future (HPSF) initiative on the body mass index (BMI) z-scores of young children, focusing on whether such school-based interventions could provide an effective strategy for addressing the childhood obesity epidemic.	RCT	The findings revealed that the HPSF had a significant positive effect on lowering children's BMI z-scores over a two-year follow-up period. Both the full and partial implementations of the program contributed to healthier BMI outcomes, but the full HPSF yielded more pronounced effects. These results suggest that comprehensive school interventions can help mitigate childhood obesity.
(Willeboordse et al., 2022)	The study aimed to examine the long-term effects of the Healthy Primary School of the Future (HPSF) program on children's body mass index (BMI), waist circumference (WC), and physical activity (PA) levels over a four-year period.	RCT	The results showed that both full and partial HPSF interventions effectively stabilized children's BMI and WC over the four-year period, with greater exposure leading to increased effect sizes. However, while PA and dietary behaviors improved initially, these improvements did not persist in the long term, indicating the need for continuous reinforcement of healthy behaviors to achieve sustained change.

\* Study Design: RCT (Randomised Controlled Trial)

## Discussion

The purpose of this systematic literature review was to investigate strategies for promoting physical activity among

primary school children in the digital era to support a healthy lifestyle. The review sought to identify effective strategies to increase physical activity in elementary school students and to explore the impact of these strategies on increasing physical activity and children's health.

Given on the importance of promoting physical activity in the digital era, various technological approaches have emerged as effective strategies to engage children and adolescents. Fitness apps, technology-based active games (exergames), and wearable devices are some examples of technologies that can increase individuals' participation in physical activity. Fitness apps, for example, are effective in motivating users to increase their physical activity through goal setting, progress tracking, and reminders to get moving (Widiyatmoko & Hadi, 2018). In addition, technology-based active games, such as exergames, combine game elements with physical activity, thus creating a fun and interactive experience that can appeal to different age groups, especially children and adolescents (Ginanjari et al., 2020). Further, wearable devices, such as smartwatches and fitness trackers, also play an important role in monitoring users' physical activity and health. With the ability to track steps, heart rate, and calories burned, these devices provide immediate feedback that can encourage users to be more active (Adhianto & Arief, 2023). Research shows that wearable devices can increase individuals' awareness of their physical activity levels and encourage positive behavior change (Adhianto & Arief, 2023).

In addition to the technological strategies discussed, recent research highlights the effectiveness of interdisciplinary programs in enhancing physical fitness among students. The findings of the reviewed articles demonstrated that students participating in the interdisciplinary program exhibited significant improvements in their physical fitness and overall physical activity levels. The program was particularly effective in engaging students who were previously less active, leading to enhanced participation and better fitness outcomes across the entire student population (Jiménez-Parra & Valero-Valenzuela, 2023). In this context, technology serves not only as a tool but also as a motivator that can increase individual engagement in physical activity.

Another important finding of the reviewed articles was the development of more interactive and fun school-based intervention programs. One example was implementing sports that incorporated technology and physical games, which could create a more engaging environment for students. Approaches such as Sports Education in physical education have been shown to be effective in increasing student participation and engagement (Ginanjari et al., 2020). In addition, research shows that these interventions contribute to the reduction of sedentary behaviors, such as video games and screen time, and increase physical activity and healthy living habits, especially among boys (Maglie et al., 2022). The development of physical literacy is also important in educating students about the benefits of physical activity. It can increase their understanding and awareness

of physical activity (Rosiana et al., 2023). The results of other studies have shown that intervention programs that focus on physical activity and healthy eating contribute to improvements in physical fitness, self-esteem, and social interactions, especially in students who are overweight or have low prior physical activity. Hence, it confirms the effectiveness of structured interventions in promoting healthy habits (Vega-Ramírez, 2024). Overall, structured, interactive, and technology-based interventions in schools have been shown to be effective in encouraging student participation and improving their physical health.

The effectiveness of utilizing physical activity literacy technology requires an approach from the family, including fathers, mothers, older siblings and/or other family members who help children absorb technology (Eather et al., 2022). The present study also noted family-based approaches as an important factor in encouraging physical activity. Scholars believe that joint family activities involving digital devices or fitness apps can strengthen bonds between family members while increasing their physical activity levels. Family support has been shown to contribute significantly to an individual's motivation to participate in physical activity (Sabrina & Iryanti, 2023). Involvement of all family members in physical activities such as walking, cycling, or playing active games can create an environment that supports a healthy and active lifestyle (Sabrina & Iryanti, 2023). In addition, research has gained promising improvements such as higher levels of physical activity, better social interactions, and adherence to a healthy diet. Positive behavioral changes, especially among adolescents, such as reduced consumption of unhealthy snacks and increased preference for physical activity, demonstrate the success of family interventions in promoting healthy living habits (Filho et al., 2019).

However, during the COVID-19 pandemic, there has been a decrease in physical activity across different age groups, including children and adolescents (Amir et al., 2022; Aritonang et al., 2022; Lontoh & Limanan, 2022). Such conditions emphasize the importance of appropriate intervention. For example, research showed that a 7-month intervention program resulted in significant improvements in physical activity levels, perceived physical competence, and performance in physical tasks such as throwing and jumping, especially in overweight and obese children. In Morano et al.'s research, the intervention group showed better results than the control group (Morano et al., 2020). Programs that combine technology and physical activity, such as virtual exercise classes or online fitness challenges, can also be an effective solution to maintain physical activity during social distancing (Amir et al., 2022; Lontoh & Limanan, 2022), as technology can maintain individual connectivity and motivation even under restrictive conditions. Overall, the synthesis of these studies suggests that approaches involving family and technology can significantly increase participation in physical activity, especially in situations of pandemic and social restrictions.

Within the broader field, it is important to consider the

social and environmental factors that influence physical activity. Research shows that a supportive environment, such as access to open spaces and sports facilities, can increase an individual's level of physical activity (Adhianto & Arief, 2023; Widiyatmoko & Hadi, 2018). In addition, public policies that support infrastructure for physical activity, such as bicycle lanes and parks, can also contribute to increased community participation in physical activity (Adhianto & Arief, 2023; Widiyatmoko & Hadi, 2018). Therefore, collaboration between various stakeholders, including the government, schools, and families, is essential to create an environment that supports physical activity. The use of technology in supporting physical activity, the development of interactive school-based intervention programs, and family-based approaches are important steps in increasing individuals' participation in physical activity. By utilizing technology and creating a supportive environment, people can be encouraged to be more active and healthy and reduce the risk of sedentary lifestyle-related diseases.

### ***Identifying the Right Strategy to Increase Elementary Students' Physical Activity in the Digital Age***

In today's digital age, a key challenge in increasing physical activity among elementary school students is reducing sedentary behaviors caused by the increased use of technology. The literature reviewed in this study suggests that effective solutions require a holistic and adaptive approach. The integration of nutrition and physical activity education in the school curriculum has been shown to be a highly effective strategy. Studies (Franceschi et al., 2021; Oliveira et al., 2022) emphasize that school-based programs that include both aspects can improve students' health knowledge and behavior. In addition, Bartelink et al. (2019b) concluded that programs that combine nutrition education and physical activity have a more significant impact than those that focus on only one aspect.

Social responsibility-based teaching methods, such as Teaching Personal and Social Responsibility (TPSR), are also an effective solution in promoting students' physical activity and social skills. Jiménez-Parra et al. (2022) showed that this approach not only improves physical fitness but also reduces sedentary behavior. Similarly, the integration of technological methods through models such as the Sport Education Model (SEM) identified by Liao et al. (2023) showed that SEM helps students improve sustainable physical activity habits. This suggests that the effective use of technology can be an integral part of strategies to increase students' physical activity. In addition, programs such as Physical Activity Level (PAL), which focuses on increasing physical activity during school hours, have also positively impacted students' physical fitness (Pulido-Gil et al., 2022).

In addition, school garden-based interventions, as revealed by van den Berg et al. (2020), showed significant health benefits, including improvements in students' body mass index. These strategies reinforce the importance of a multidimensional approach that includes physical health,

nutrition, and more creative utilization of the school environment to promote physical activity.

In the digital age, wearable technology, such as fitness trackers, can also be an important component in increasing children's physical activity. These devices have been widely used and investigated (Creaser et al., 2021, Danković et al., 2023; Wang et al., 2022). The scholars reported that these devices can increase students' awareness of their physical activity levels and provide motivation through immediate feedback. In addition, the data collected from these wearable devices can be used to design more targeted and evidence-based interventions (Sousa et al., 2023; Triantafyllidis et al., 2021). The use of gamification in fitness applications has also been shown to be effective in increasing student engagement in physical activity, as game elements can increase motivation and enjoyment in exercise (Danković et al., 2023; González-González et al., 2018).

Family support also plays an important role in the success of these programs. For example, Creaser et al. (2021) showed that programs that engage families in physical activity, such as app-based fitness challenges, not only increase children's physical activity but also strengthen family relationships through healthy activities together. Therefore, involving parents in technology-based intervention programs can provide additional motivation for students to stay physically active. Apart from students, teachers also play an important role in implementing this strategy. Wort et al. (2021) showed that teachers trained in the use of wearable technology and fitness apps greatly influence students to be active. Therefore, proper training for teachers is necessary to create a learning environment that supports students' increased physical activity. In addition to the physical benefits, it is also important to consider students' mental health in this strategy. Kang et al. (2023) confirmed that physical activity can provide great benefits to children's mental health and emotional well-being. Positive social interactions during physical activity, such as in team games involving technology, can improve students' experiences and overall health outcomes (González-González et al., 2018); (Danković et al., 2023). Therefore, periodic evaluation and adjustment of the program is essential to maintain the effectiveness of the strategies implemented. Data collection from wearable devices allows schools to understand students' physical activity patterns and adjust programs to better suit their needs (Sousa et al., 2023; Triantafyllidis et al., 2021). Thus, the combination of technology, family engagement, teacher training, and attention to mental health is key in identifying appropriate strategies to increase the physical activity of elementary school students in the digital age.

### ***Impact of Implementing Appropriate Strategies on Improving Children's Physical Activity and Health***

It has been argued that increased physical activity among elementary school children directly reduces the risk of obesity. Studies (Hasan et al., 2020; Suryoadji & Nugraha,

2021) emphasize that children who engage in regular physical activity show a lower risk of obesity. Interventions that include nutrition education are also very important, as healthy eating and active lifestyles have been shown to improve children's nutritional status (Nugraha et al., 2021). Strategies that focus on these two aspects strengthen health outcomes, both in terms of weight loss and increased knowledge and healthy behaviors. In addition, the implementation of technology to encourage children's physical activity, such as fitness apps and wearable devices, has shown promising results in increasing children's motivation to move more actively (Purwanto & Baan, 2022; Suryoadji & Nugraha, 2021). The use of these technologies provides immediate feedback and allows children to set goals, creating a more interactive and engaging learning experience. In addition, the application of gamification in physical education is effective in making learning more fun, which in turn encourages higher participation (Purwanto & Baan, 2022). Another important component is parental involvement in children's physical activity programs. Hasan et al. (2020) showed that support from parents plays a significant role in children's motivation and commitment to exercise. Family involvement in physical activities, such as cycling or going for a walk together, not only improves physical fitness but also strengthens family relationships. Therefore, integrating parents' roles in school programs could be one of the keys to achieving more effective and sustainable results.

Physical activity in children has a significant impact on mental health, reducing the symptoms of depression and anxiety. The research argued that it could help children manage stress, boost mood, and improve sleep (Suryoadji & Nugraha, 2021). This is in line with findings that emphasize the importance of physical activity in maintaining children's mental well-being, especially in the digital age, where children spend more time in front of a screen (Purwanto & Baan, 2022). An environment that supports physical activity, both at school and at home, is essential for maintaining children's mental health. Low physical activity can lead to mental health problems such as stress and anxiety, whereas physically active children tend to have better mental health (Bachtiar et al., 2023). In the digital age, increased sedentary behavior can negatively impact mental health, especially with longer sitting habits during the COVID-19 pandemic, leading to increased symptoms of anxiety and depression (Bellanisa et al., 2023). Although some studies did not find a significant relationship between physical activity and anxiety in adolescents (Wewengkang et al., 2023), physical activity is still considered an effective coping mechanism to improve mood. Social support from parents and teachers is essential to motivate children to participate in physical activity. Parental involvement in children's physical activity not only improves physical health but also mental well-being (Fadhilah et al., 2021). Schools also have an important role in providing engaging and interactive physical education programs, which can increase children's participation in physical activity and help them manage stress (Gumilang et al., 2023). Overall, a supportive environment for physical activity at home and

school, as well as social engagement from parents and teachers, are crucial factors in maintaining children's mental well-being in this digital era.

In education, the importance of integrating physical activity into the school curriculum cannot be overlooked. Quality physical education has been shown to encourage children to be more physically active and have better physical fitness (Hasan et al., 2020). This is in line with research by Pulido-Gil et al. (2022), which showed that physical activity-based programs, such as PAL, can improve fitness without compromising academic performance. Incorporating physical activity in the curriculum and providing sufficient resources and time for physical education are essential to encourage children's participation in engaging and enjoyable physical activity. However, the challenge is the sustainability of such programs, especially those involving technology and parental involvement. Willeboordse et al. (2022) suggest that programs that are not well integrated or do not involve out-of-school components may not have a significant long-term impact. Furthermore, more comprehensive strategies, such as the Health Promoting School Framework (HPSF), which involve the entire school community and families, may result in more significant and sustainable impacts, such as reduced BMI scores and increased healthy behaviors at school (Bartelink et al., 2019a). Therefore, the implementation of strategies to improve children's physical activity and health requires a comprehensive and sustainable approach involving quality physical education, relevant technology, and parental involvement. These strategies not only improve children's physical health, but also their mental health and social well-being.

## Conclusion

In conclusion, this study emphasizes the importance of appropriate strategies to increase the physical activity of elementary school students in the digital era to support a healthy lifestyle. The use of technology in the form of fitness apps, exergames, and wearables has been shown to be effective in motivating children to be physically active. These technologies not only serve as support tools but also as powerful motivators that offer tracking and feedback, encouraging children to engage in physical activity more actively. More interactive approaches in schools, such as the Sport Education Model (SEM) and Teaching Personal and Social Responsibility (TPSR), have shown significant increases in student participation, resulting in a sustainable impact on daily physical activity habits. Family support also plays a very important role in increasing children's physical activity. By engaging the whole family in physical activities, whether through shared outdoor activities or fitness apps, an environment that supports a healthy lifestyle is created. In addition, training teachers to utilize technology in physical learning can strengthen the implementation of strategies in schools, creating a more supportive and enjoyable environment for students.

Implementing the right strategies has been shown to



have a significant impact on improving children's physical and mental health. In addition, increased physical activity is directly linked to a reduced risk of obesity and other health problems. More regular physical activity can also reduce symptoms of anxiety and stress, which is important for children's emotional well-being in this digital age. Thus, a comprehensive strategy involving technology, interactive physical education, and support from families is key to improving children's overall health. The implications of these findings suggest that collaboration between schools, families, and communities is essential to creating a supportive environment for increasing children's physical activity. Technology-based programs and engaging physical education need to be developed to accommodate the needs of the digital age while encouraging healthier lifestyles for children.

### Conflicts of interest

The authors declare no conflicts of interest.

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