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Original Article

Strong Foundations of Physical Literacy: The Role of School-Based Daily Mile Physical Activity in Elementary School Children's Success

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Abstract

Background: Reduced physical activity among students has made physical literacy a necessity for public health. Programs like the Daily Mile can help improve physical literacy in children. The purpose of the present study was to investigate the role of school-based daily physical activity in the development of physical literacy in elementary school children.
Methods: This quasi-experimental study, using a pre-test-post-test design, was conducted on 208 male students aged 8 to 10 years in the city of Nurabad (Lorestan Province, Iran) during the academic year of 2023-2024. The study participants were selected using a randomized cluster sampling method. Random assignment of individuals to the experimental (N=113) and control (N=95) groups was performed using a computer-based random number generation algorithm. The Canadian Assessment of Physical Literacy-2 (CAPL-2) test was used to evaluate physical literacy. The Daily Mile program was administered to the experimental group three times weekly for a duration of two months, whereas the control group pursued their typical activities. SPSS version 24 was employed to analyze the collected data, using one-way ANCOVA, independent t-tests, and paired t-tests.
Results: The results showed that the Daily Mile intervention significantly improved physical literacy and its constituent components. Specifically, the experimental group demonstrated a statistically significant increase in physical literacy (Mean±SD=70.74±5.22) compared with the control group (Mean±SD=58.61±6.22). Similarly, significant improvements were observed in daily physical activity (Experimental group: Mean±SD=21.05±2.77; Control group: Mean±SD=17.97±2.71), physical competence (Experimental group: Mean±SD=18.66±2.09; Control group: Mean±SD=15.55±2.12), motivation/confidence (Experimental group: Mean±SD=25.83±1.90; Control group: Mean±SD=21.69±3.20), and knowledge/understanding (Experimental group: Mean±SD=5.20±1.25; Control group: Mean±SD=3.40±1.37).
Conclusions: The findings of this study suggested that the Daily Mile intervention, when implemented in schools, can effectively improve the physical literacy of elementary school students. Therefore, integrating such activities into regular school programs is recommended. However, further nationwide research with more diverse groups is necessary to ensure the generalizability of the results.

Keywords: Physical Literacy, Exercise, Health, School-based Intervention, Children

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1. Introduction

While systematic reviews of school-based programs have demonstrated positive outcomes such as increased physical activity, reduced sedentary time (1), improved motivation (2), higher levels of moderate-to-vigorous activity (3), and better academic performance (4), these results are not always consistent. Many aspects of these interventions lack conclusive evidence or show only minor benefits (5). It appears that the diversity and complexity of interventions are among the main reasons for these mixed results (1). Furthermore, the lack of sufficient time has been reported as one of the most common barriers to implementing physical education interventions by teachers (2). To combat these issues and encourage higher physical activity levels in schoolchildren, the Daily Mile, a running/walking-based program, has been implemented (6).

Launched in 2012, the Daily Mile has experienced global expansion, with daily participation currently spanning 87 countries (7). The program involves walking, slow jogging, or running along a predetermined route for a specific distance or duration (6). Providing staff training or funding for implementation—often cited as barriers to school-based activities—is of minimal concern in this program, as it requires

minimal training and resources to be feasible (7). Research indicated that the Daily Mile has been successfully integrated and maintained within a range of primary school environments (8, 9). Based on these findings, integrating physical activity into the school curriculum can help reduce sedentary behaviors (10). Given that students spend a significant portion of their day at school, interventions carried out in the school environment using an appropriate strategy are among the most feasible ways to combat low physical activity levels (11). Moreover, using a suitable model can prevent discrepancies in physical activity goals among physical education teachers and facilitate more systematic planning for physical activity across different age groups (12, 13).

Physical literacy, a model for physical activity, has been adopted in Canada for use in school physical education programs (14). Whitehead (14) defined physical literacy as the overarching aim of quality physical education, encompassing the motivation, confidence, physical competence, knowledge, and understanding necessary for lifelong engagement in physical activity. Physical literacy is viewed as a comprehensive concept (7, 15), encompassing the knowledge, skills, understanding, and values needed to responsibly engage in purposeful physical activities and movement throughout life, irrespective of physical or mental constraints. Anticipated benefits of physical literacy include improved healthcare outcomes, enhanced physical and mental well-being, increased productivity, skill development, and greater participation in sports (16). Since physical literacy, akin to other forms of literacy, is a learned attribute, quality physical education is crucial in facilitating individual progress (13). It is believed that establishing positive physical activity habits through the Daily Mile can contribute to the development of physical literacy components (10), as participation in the Daily Mile positively impacts motor health markers (1), enhances physical fitness (17), and improves overall fitness during childhood (18). While proponents suggested numerous benefits, Thorburn (8) contended that these are primarily based on school reports and necessitate thorough research before definitive conclusions can be drawn. Given the substantial time children spend in school, this setting is deemed appropriate for implementing obesity prevention interventions and promoting overall well-being and quality of life (19). Consistent with the findings of de Jonge and colleagues (1), structural, environmental, and policy changes can positively influence children's physical activity, underscoring the importance of prioritizing children in school-based interventions. Therefore, it is essential to adopt innovative approaches to physical education that are tailored to students' needs and school resources. Therefore, the present study aimed to assess the impact of the Daily Mile, a school-based physical activity intervention, on the physical literacy of primary school children.

2. Methods

2.1. Design

This quasi-experimental study, using a pre-test-post-test design, was conducted on 208 male students. To examine the impact of the Daily Mile school-based physical activity intervention on the physical literacy of primary school children, a pre-test-post-test control group design was implemented.

2.2. Selection and Description of Participants

The study population consisted of all 8- to 10-year-old boys attending elementary schools in Nurabad city, Lorestan Province, Iran, during the academic year of 2023-2024. Due to the large population size and practical costs, a multi-stage cluster sampling method was employed.

2.3. Sample Size Determination

First, one region in Nurabad, Lorestan Province, Iran was randomly selected. Then, four public schools from this region were selected based on their willingness to participate in the study. Two schools were randomly assigned to implement the Daily Mile program (sample size: 113) and two other schools were assigned to continue with typical physical activity routines (sample size: 95). This random assignment was conducted at the school level to ensure the comparability of the groups in relevant characteristics (Figure 1). The inclusion criteria were: physical and mental health, parental consent, and self-reported absence of any illness by participants and parents. The exclusion criteria were: incomplete questionnaires and more than three missed intervention sessions.

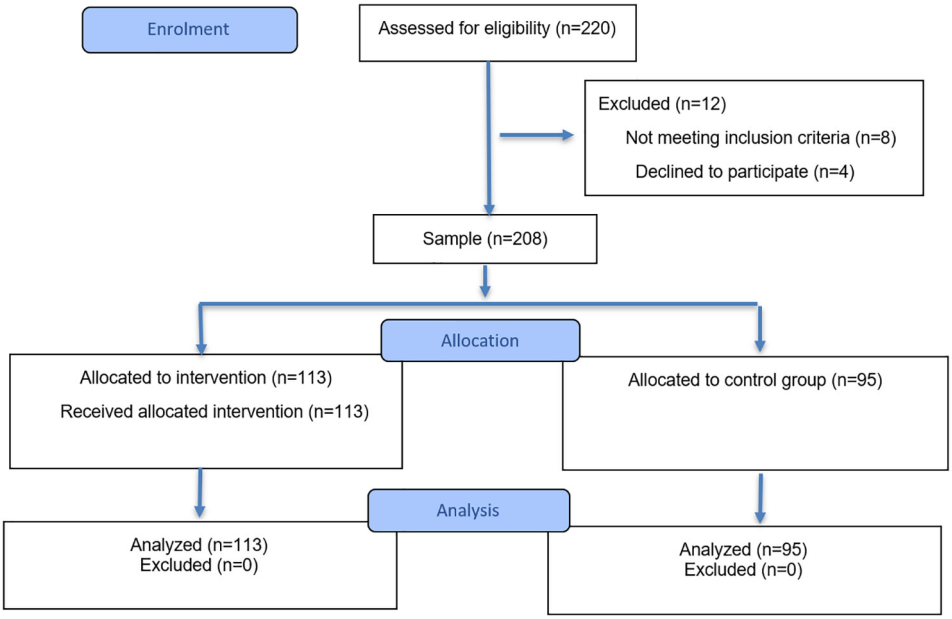

Figure 1: The figure shows the CONSORT flow diagram of the study.

2.4. Data Collection and Measurements

Physical literacy was assessed using the sub-components of the Canadian Assessment of Physical Literacy-2 (CAPL-2) model including daily physical activity, physical competence, motivation and confidence, and knowledge and understanding. All four CAPL-2 domains were evaluated following the CAPL-2 guidelines to determine the level of physical literacy. Daily physical activity was measured through two methods. First, direct measurement involved using a pedometer to track activity for one day (from waking to sleep) and then for one week. Valid pedometer records required: a) between 1,000 and 30,000 steps recorded per day, b) at least 10 hours of pedometer wear per day, and c) a minimum of three days of recorded data. Second, indirect measurement involved using a physical literacy questionnaire to assess children's perceptions of their engagement in at least 60 minutes of moderate to vigorous daily activity. The total score for this domain was 30 points, with 25 points allocated to pedometer readings and 5 points to self-reported physical activity by the child (20). The physical competence domain was evaluated using three criteria: a) The 15–20-meter Progressive Aerobic Cardiovascular Endurance Run (PACER) test to measure aerobic fitness (21); b) The Plank trunk test to assess muscle endurance (22); and c) The Canadian Agility and Movement Skill Assessment (CAMSA) (23). The total score for this domain was 30 points, with 10 points each for the PACER, Plank, and CAMSA tests. The motivation and confidence domain assessed the child's confidence in their ability and motivation to engage in physical activity. This domain comprised four components—intention, adequacy, competence, and intrinsic motivation—each scored out of 7.5, resulting in a maximum total score of 30 (23). The knowledge and understanding domain evaluated the child's knowledge of physical activity through five questions (23). This domain was scored out of 10 points, with questions 1-4 scored between 0 and 1 and question 5 scored between 0 and 6. The overall physical literacy score, incorporating all domains, was 100 points. A key feature of CAPL-2 is its provision of both quantitative and qualitative scores (23). The psychometric properties of the CAPL-2 instrument, including cognitive (motivation, self-confidence, knowledge, understanding) and physical (daily physical activity, physical competence) tests, have been evaluated in Iran. For the cognitive assessment, the content validity index (CVI) showed satisfactory item-level (I-CVI > 0.80) and scale-level (S-CVI=0.85) content validity. The content validity ratio (CVR) also demonstrated satisfactory content validity, with CVR values exceeding the critical value of 0.62 according to the Lawshe table (1975). Internal consistency was assessed using Cronbach's alpha, which was 0.87 for the entire questionnaire, indicating sufficient stability (24). In the assessment of the physical component, the

content validity index ranged from 0.80 to 1.0. The Cronbach's alpha reliability coefficient was 0.75, with test-retest reliability of 0.89 and intra-rater reliability of 0.80. These findings suggested that the CAPL-2 instrument has acceptable reliability and validity for use in Iranian populations (25).

2.5. Procedure

After selecting the target sample, the study participants completed a demographic questionnaire to gather initial information. A consent form for participation was attached to the end of the demographic questionnaire and signed by parents. All families and children were assured that there was no obligation to participate in the study. The collected data were kept confidential, and the results were published anonymously. At the outset, an orientation session was held to inform the schools about the procedure for implementing the Daily Mile intervention, and the teachers received the necessary information for carrying out the program from the researcher. Before the intervention program began, a pre-test was administered using CAPL-2, and the study participants were randomly assigned to either an experimental or a control group. The Daily Mile intervention program for the experimental group was conducted over two months, three days a week, totaling 23 sessions of 15 minutes each, in accordance with previous study (19). The program was carried out outside of regular classroom hours and in group sessions during the school day. Children left their classrooms to run or walk along a predefined route within the school grounds for 15 minutes (on average approximately 1,600 meters). During this time, children performed various jumps, hopscotch, and other fundamental movement skills, with the specific way of executing these movements left to the teacher's discretion (26). The program was based on the guidelines of the Daily Mile, and no additional instructions were included. The key aspect of the program was that participants ran or walked at a self-selected speed for 15 minutes (26). It is important to note that the researcher provided weekly program implementation guidance and feedback to the schools. Schools were encouraged to involve all students as much as possible; however, assessments were only conducted on the target sample. Finally, after the intervention, the participants completed a post-test, mirroring the pre-test, and the results were recorded. The Daily Mile intervention was implemented in two schools, while the other two schools continued their usual activities.

2.6. Data Analysis

Data were analyzed using several statistical methods. Univariate analysis of covariance (ANCOVA) was used to compare post-test scores between the two groups. Independent samples t-tests were used to compare pre-test scores of the groups, and paired samples t-tests were used to compare pre-test and post-test scores within each group. The normality of the data was assessed using the Kolmogorov-Smirnov test, while Levene's test was used to check for homogeneity of variances. All analyses were conducted using SPSS version 24, with a significance level set at 0.05

3. Results

The study participants were divided into experimental and control groups. The inclusion criteria were: physical and mental health, parental consent, and the absence of any illness. The exclusion criteria were: incomplete questionnaires and unwillingness of participants to cooperate. Demographic details of the participants are shown in Table 1. The mean age of participants in the experimental group was 8.95±0.784 years, and 9.01±0.623 years in the control group. Weight analysis revealed a mean weight of 30.88±7.23 kg in the experimental group and 31.47±8.06 kg in the control group. Mean height was 133.27±7.52 cm in the experimental group and 134.16±6.28 cm in the control group. Body Mass Index (BMI) was 17.12±3.65 in the experimental group and 17.50±4.21 in the control group. These data indicated no significant difference between the two groups regarding demographic variables.

Table 2 shows the mean and standard deviation values for each physical literacy component in the experimental and control groups, before and after the intervention. The results of within-group comparisons indicated that the experimental group showed statistically significant improvements in physical literacy and its components, including daily physical activity (pre-test: Mean±SD=17.75±2.87, post-test: Mean±SD=21.05±2.77, P=0.001), physical competence (pre-test: Mean±SD=15.12±2.75, post-test: Mean±SD=18.66±2.09, P=0.001), motivation and self-confidence (pre-test: Mean±SD=21.55±3.34, post-test: Mean±SD=25.83±1.90, P=0.001),

Table 1: Demographic characteristics of participants in the experimental and control groups

Variable	Group	Mean±Standard Deviation	t	P value
Age (Years)	Experimental	8.95±0.784	1.54	0.123
	Control	9.01±0.622		
Weight (kg)	Experimental	30.88±7.23	0.546	0.586
	Control	31.47±8.06		
Height (cm)	Experimental	133.27±7.52	0.105	0.916
	Control	134.16±6.28		
BMI	Experimental	17.12±3.65	0.218	0.781
	Control	17.50±4.21		

BMI: Body Mass Index

Table 2: Means and Standard Deviations of physical literacy scores for participants in the two groups

Variable	Group	Pre-test	Post-test	P value	P value	
		Mean±Standard Deviation	Mean±Standard Deviation	Within-Group	Between Group Pre-test	Between Group Post-test
Daily Physical Activity	Experimental	17.75±2.87	21.05±2.77	0.001*	0.919	0.001*
	Control	17.47±2.87	17.97±2.71	0.711		
Physical Competence	Experimental	15.12±2.75	18.66±2.09	0.001*	0.772	0.001*
	Control	15.18±2.75	15.55±2.12	0.237		
Motivation & Confidence	Experimental	21.55±3.34	25.83±1.90	0.001*	0.916	0.001*
	Control	20.81±3.25	21.69±3.20	0.603		
Knowledge & Understanding	Experimental	3.29±1.71	5.20±1.25	0.001*	0.764	0.001*
	Control	3.33±1.26	3.40±1.37	0.275		
Overall Physical Literacy	Experimental	57.71±4.01	70.74±5.22	0.001*	0.801	0.001*
	Control	56.79±5.33	58.61±6.22	0.298		

knowledge and understanding (pre-test: Mean±SD=3.29±1.71, post-test: Mean±SD= 5.20±1.25, P=0.001), and overall physical literacy (pre-test: Mean±SD=57.71±4.01, post-test: Mean±70.74±5.22, P=0.001), in the post-test compared with the pre-test. In contrast, the control group showed no statistically significant differences between pre-test and post-test scores in physical literacy (pre-test: Mean±SD=56.79±5.33, post-test: Mean±58.61±6.22, P=0.298) and its components, including daily physical activity (pre-test: Mean±SD=17.47±2.87, post-test: Mean± 17.97±2.71, P=0.711), physical competence (pre-test: Mean±SD=15.18±2.75, post-test: Mean±1 5.55±2.12, P=0.237), motivation and self-confidence (pre-test: Mean±SD=20.81±3.25, post-test: Mean±21.69±3.20, P=0.603), and knowledge and understanding (pre-test: Mean±SD=3.33±1.26, post-test: Mean±3.40±1.37, P=0.275).

Between group comparison of the results showed that in the pre-test phase, there were no statistically significant differences between the experimental and control groups in the components of daily physical activity (Experimental: Mean±SD=17.75±2.87, Control: Mean±SD=17.47±2.87, P=0.919), physical competence (Experimental: Mean±SD=15.12±2.75, Control: Mean±SD=15.18±2.75, P=0.772), motivation and self-confidence (Experimental: Mean±SD= 21.55±3.34, Control: Mean±SD=20.81±3.25, P=0.916), knowledge and understanding (Experimental: Mean±SD=3.29±1.71, Control: Mean±SD=3.33±1.26, P=0.764), and total physical literacy score (Experimental: Mean±SD= 57.71±4.01, Control: Mean±SD=56.79±5.33, P=0.801). However, in the post-test phase, participants in the experimental group showed better performance than the control group in the components of daily physical activity (Experimental: Mean±SD=21.05±2.77, Control: Mean±SD=17.97±2.71, P=0.001), physical competence (Experimental: Mean±SD=18.66±2.09, Control: Mean±SD=15.55±2.12, P=0.001), motivation and self-confidence (Experimental: Mean±SD= 25.83±1.90, Control: Mean±SD=21.69±3.20, P=0.001), knowledge and understanding (Experimental: Mean±SD=5.20±1.25, Control: Mean±SD=3.40±1.37, P=0.001), and total physical literacy score (Experimental: Mean±SD=70.74±5.22, Control: Mean±SD=58.61±6.22, P=0.001).

4. Discussion

The study results showed that the Daily Mile intervention significantly improved physical literacy and its constituent components. Specifically, the experimental group demonstrated a statistically significant increase in physical literacy compared with the control group. Similarly, significant improvements were observed in daily physical activity, physical competence, motivation/confidence, and knowledge/understanding. These results are supported by findings of Chesham and colleagues (19) who demonstrated the positive effects of the Daily Mile on physical fitness in Scottish children. Furthermore, Some other studies (1, 27) also reported the benefits of Daily Mile intervention, strengthening the evidence for its effectiveness.

A possible explanation for the results of this study is that school-based interventions contribute to improved physical literacy by increasing daily physical activity, reducing sedentary behavior during the school day, and enhancing physical fitness (13). Furthermore, another reason for the success of the Daily Mile intervention may be the self-selected speed of activity by the participants. Research showed that interventions that allow for self-selection of physical activity play an important role in enhancing children's autonomy (28). Therefore, self-selected speed on the Daily Mile can improve children's autonomy and, in turn, contribute to intrinsic motivation and participation in physical activity (19). In addition, the Daily Mile helps children develop a habit of regular physical activity. It also provides opportunities for children to interact socially, which contributes to improved mood, reduced stress, and the formation of new friendships. This, in turn, positively impacts their physical literacy and learning abilities (19). A Daily Mile program, by encouraging children to walk daily, consistently and regularly, increases their physical activity. This leads to improved physical fitness, muscle strength, flexibility, and cardiovascular health. Simultaneously, the diverse experiences incorporated in this program (such as exploring the school grounds, group games, and participation in various activities) help children develop motor skills, environmental awareness, decision-making abilities, and an understanding of the importance of physical activity. These experiences enhance children's physical literacy. Another possible interpretation of the findings is a theory closely related to developmental systems theory, which recognizes the interplay of biological, psychological, and environmental factors in child development as crucial determinants of motor and cognitive growth (29). A Daily Mile program, by impacting various facets of child development, including motor, social, and emotional aspects, can serve as a driving force in promoting a child's full development. Furthermore, this intervention positively influences children's perceived self-efficacy in movement and their motivation for physical activity– key factors in developing motor skills and physical literacy.

According to our results, the effect of the Daily Mile intervention on the sub-constructs of daily behavior, physical competence, motivation and self-confidence, and knowledge and understanding of the physical literacy model was significant. Our study results aligned with the Canadian physical literacy model, which posits a strong relationship between daily behavior, physical competence, and physical activity levels. The observed link between the Daily Mile and physical competence aligned with the study of Mohammadi and co-workers (30), who also found a strong relationship between physical activity and physical competence. Similarly, Anico and colleagues (26) reported positive effects of a Daily Mile program on the physical domains of physical literacy, supporting the present study findings. However, Mirali (29) reported a weaker relationship between physical activity and physical competence, which contrasts with our results. This discrepancy may be due to the age of participants, as their study focused on 10-year-olds, while our age range was 8-10 years. In a possible explanation of these results, it can be said that the Daily Mile intervention can provide an opportunity for children to freely practice their motor skills in a supportive school environment. The development of motor skills is considered vital to improving children's specific movement patterns. On the other hand, it can be said that the Daily Mile intervention, by creating a fun and engaging environment and instilling a sense of responsibility and participation in planning, as well as increasing the level of vitality, has led to the development of physical competence and daily physical activity of the participants.

This study also revealed a significant impact of the Daily Mile intervention on participants' motivation, self-confidence, knowledge, and understanding.

These findings are notable, as research in school settings has primarily focused on students' physical factors, leaving a gap in the understanding of psychological and cognitive effects (7). However, some studies reported significant improvements in motivation components (27) and self-efficacy/self-esteem (27) following the Daily Mile intervention. Furthermore, in some studies (30, 31), the relationship between physical activity and motivation and self-confidence in children was significant, consistent with the results of this study. However, in the study by Kvalø and Natlandsmyr (32), school-based physical activity had no effect on participants' motivation, which is inconsistent with the results of this study. This difference in findings could be attributed to the type of intervention used. Kvalø and Natlandsmyr (32) implemented active classroom breaks, whereas the present study used a Daily Mile program. Motivation, a crucial factor in children's physical activity behaviors, is a psychological experience characterized by enjoyment, liking, and pleasure. This motivation can be influenced by factors such as the intensity of the physical activity, the child's perception of success or failure, and their overall emotional state. Based on the results of our study and existing literature, it appears that the Daily Mile plays an important role in creating independent motivation and increasing self-confidence through social support from friends, self-selected activities, autonomy of participation, perceived benefits, and a supportive school environment. As mentioned, the Daily Mile is student-centered; class management is based on their interests and needs. A large portion of the lesson plans are implemented by the students themselves, which facilitates physical, emotional, mental, and social growth, creativity, problem-solving, and experiential learning, establishing connections between school, family, and community, self-discipline, and increasing students' knowledge and understanding of physical education activities. Overall, the research suggested that while physical literacy is a key factor in physical activity participation, its development is fostered through both structured and unstructured physical activity opportunities (14). Since active physical behavior is established early in life, education, as the most influential social and cultural institution, significantly impacts children and adolescents. Physical activity in schools and during formative years offers invaluable opportunities to learn and refine skills, fostering lifelong physical fitness and health, enhancing practical intelligence, and promoting scientific development at a national level. Therefore, there is a critical need for well-designed national programs that promote physical activity and improve physical literacy among students, as well as health literacy in the broader community. Interventions like the Daily Mile, which are child-centered and create self-selected movement opportunities, are particularly effective in enhancing the child's environment and developing physical literacy.

4.1. Limitations

Given the limitations of the present study, including the large sample size, the difficulty and time-consuming nature of implementing the stages, and the lack of cooperation from some schools, it is suggested that future studies examine the multiple factors influencing the development of physical literacy, which were not considered in this study, in order to gain a deeper insight into this area. This highlights the necessity of conducting further research on scalable, child-centered physical activity programs, such as the 'Daily Mile,' and can serve as a guide in the development of national policies and guidelines for promoting physical literacy and health in the educational system.

5. Conclusions

This study results carried significant weight for physical education, health initiatives, and educational policy-making, especially considering that sports facilities in Iranian schools are below global benchmarks, with only one-third of the globally recommended sports space per person. Moreover, the time dedicated to physical education in Iran is less than in leading countries. Incorporating the Daily Mile into school curricula, and promoting it beyond school hours could boost physical activity participation and improve children's health outcomes. This straightforward, cost-free approach not only enhances children's learning abilities and health awareness but also fosters their social skills. Given the limited research on the impact of Daily Mile on both the physical and cognitive aspects of physical literacy, more studies are needed to confirm these results. To effectively advance student's physical activity, it is recommended that all stakeholders first grasp the concept of physical literacy. Teachers, coaches, and professionals should prioritize physical literacy

as a key objective to better guide its development. In essence, research demonstrates that the Daily Mile school-based physical activity program significantly contributes to the development of physical literacy, which is foundational for future achievements in elementary school children.

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Authors' Contributions

Roohollah Mohammadi Mirzaei: Contributed substantially to the conception and design of the study, interpreted the findings; drafted the manuscript. Majid Mohammadi: Contributed substantially to the design of the study, collected and analyzed the data; reviewed the manuscript critically for important intellectual content. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work, such as the questions related to the accuracy or integrity of any part of the work

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Ethical Approval

The Ethics Review Board of Farhangian University, Tehran, Iran approved the present study with the code of IR.CFU.REC.1403.002. Also, written informed consent was obtained from the children's parents.

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