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Children's Fundamental Movement Skills, Social Emotional Development and Physical Activity Development Based on Kids' Athletics Intervention: SEM Modelling and Analysis

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Abstract

Objectives. This study aimed to examine the developmental status of fundamental movement skills, social emotional development, and physical activity in Chinese children aged 7 to 10. Using the Kids' Athletics intervention, Structural Equation Modeling (SEM) was applied to analyze their developmental trajectories.

Materials and methods. The study was conducted between April and June 2024, and involved 305 primary school students. The Children's Fundamental Movement Skills Test, the Physical Activity Level Questionnaire for Children and Adolescents (ages 7-18), and the Student Social Emotional Competence Questionnaire were used to perform this study. SEM was applied to explore relationships among these developmental domains.

Results. In post-intervention period, significant improvements were noted in fundamental movement skills, social emotional competence, and physical activity levels (all $p < 0.05$). The experimental group outperformed the control group in most metrics, except balance beam walking and the others' perception dimension ($p < 0.05$). The structural model indicated an adequate fit, with path correlation analysis revealing a significant negative correlation between fundamental movement skills and social emotional development ($r = -0.33$, $p < 0.001$) and physical activity ($r = -0.24$, $p < 0.001$). Furthermore, social emotional development showed a positive correlation with physical activity ($r = 0.19$, $p = 0.001$) and a negative correlation with sedentary behavior ($r = -0.17$, $p = 0.005$). No significant correlations were observed between fundamental movement skills and sedentary behavior, or between different levels of physical activity.

Conclusions. The findings suggest that improved fundamental movement skills contribute to enhancing social emotional development and increasing physical activity while reducing sedentary behavior. This study provides a valuable framework for promoting physical literacy and optimizing physical education practices.

Keywords: fundamental movement skills, social emotional development, physical activity levels, kids' athletics in China.

Introduction

Despite research showing the benefits of physical activity (PA), fundamental movement skills (FMS), and social-emotional (SE) development in children, many, especially in China, do not meet PA recommendations (Yang et al., 2022; Liu et al., 2023; Peng et al., 2024). There is a lack of studies on holistic interventions for children aged 7 to 10 that integrate PA, FMS, and SE. Traditional physical education often fails to engage children, leading to poor FMS proficiency and health outcomes (Diao, 2018; Ulrich, 2019; Wang et al., 2021). PA positively impacts children's overall health, yet FMS proficiency remains low due to barriers like academic pressure and lack of facilities (Barnett et al., 2016; Bolger et al., 2019; Meng et al., 2020; Xu et al., 2023). The Kids' Athletics program, developed by the IAAF, effectively promotes FMS and PA in an engaging, age-appropriate manner (Čillík et al., 2018; Katzenbogner et al., 2018).

The model integrates the ecological framework, health-related quality of life (HRQOL), social vulnerability index (SVI), and physical activity-related health competence model (PAHCO) (Sudeck & Pfeifer, 2016; Lemes et al., 2021; Amalia et al., 2021). Structural equation modeling (SEM) was used to analyze the relationships among FMS, SE, and PA. FMS enhancement was hypothesized to improve SE

development through increased motor competence and self-confidence. PA development, including increased moderate- to high-intensity activity and reduced sedentary behavior, was expected to positively influence physical fitness and SE dimensions, such as self-management and social awareness. SEM systematically revealed these interactions.

This study evaluates the impact of the Kids' Athletics program on the development of fundamental movement skills (FMS), social-emotional (SE) development, and physical activity (PA) in Chinese children aged 7–10 years. A comprehensive model was constructed to provide an effective intervention approach, supporting children's physical, psychological, and social well-being during key developmental stages.

In this research model, the development of fundamental movement skills, social-emotional, and physical activity are the core dependent variables of the study and will be influenced by other potential variables of the model. Thus, the following hypotheses are proposed:Improving fundamental movement skills can promote the social-emotional development of children aged 7-10 years (H1); The improvement of fundamental movement skills plays a positive role in promoting medium to high intensity physical activities in children aged 7-10 years (H2); The development of fundamental movement skills can reduce sedentary behavior within a week in children aged 7-10 years (H3); The social-emotional development of children aged 7-10 years has a positive impact on their participation in moderate-to-high-intensity physical activities during the week (H4); The social-emotional development of children aged 7-10 years can reduce the time they spend in sedentary behaviors throughout the week (H5); Following the intervention, the relationship between weekly moderate to high intensity physical activity and sedentary behaviors was weakly correlated in children aged 7-10 years (H6).

Materials and Methods

Study Participants

The study included 305 children aged 7–10 years from Nanning, Guangxi, China, selected through cluster random sampling and divided into experimental (n =152) and control (n = 153) groups. Participants included 50 boys and 54 girls aged 7–8, 47 boys and 50 girls aged 8–9, and 56 boys and 48 girls aged 9–10. Good health, the absence of moderate or severe cognitive impairment, and the signed informed consent of participants, parents/guardians, and school principals were requirements for inclusion. Cognitive disabilities, serious illnesses, or delays in motor development were among the exclusion criteria. There were 77 boys and 75 girls in the experimental group and 76 boys and 77 girls in the control group.

All protocols were approved by the Ethics Committee of Mahasarakham University, NO:184-038/2024.

Study Organization

From April to June 2024, 305 children aged 7–10 in Guangxi participated in a study using cluster random sampling. The quasi-experimental longitudinal design assessed the impact of the Kids' Athletics program on fundamental movement skills (FMS), physical activity (PA), and social-emotional (SE) development across three phases:

1. Baseline Assessment: Assessed children's development of FMS, PA, and SE.

2. Intervention: Evaluated how well the Kids' Athletics program worked to enhance these areas.

3. Model Development: Constructed a successful intervention model and examined the correlations between variables.

The Chinese Fundamental Movement Skill Test (CFMST) was used to measure FMS. It assesses stability (reverse straight-line walking, balance beam walking), object control (kicking over obstacles, stationary ball shooting), and movement (sideways slide, single-leg hopping). CFMST has proven reliability and validity for Chinese children (Li & Liu, 2022).

Social-emotional development was measured using the Student Social-Emotional Competency Scale (Self-Assessment Version) by Mao Yaqing's team (validated by Yang et al., 2020; Yang et al., 2023). It includes 30 items across six dimensions (e.g., self-awareness, collective management) scored on a 5-point Likert scale. Reliability coefficients ranged from 0.786 to 0.872, with an overall Cronbach's alpha of 0.943. Fit indices (CFI=0.989, TLI=0.981, SRMR=0.017) confirmed the scale's strong reliability and validity.

Physical activity levels were assessed using the Physical Activity Level Evaluation for Children and Adolescents Aged 7–18 Years, a reliable and widely used standard in China's health industry.

The Kids' Athletics program comprised 8 weeks of game-based interventions, focusing on mobility, stability, object manipulation, and teamwork. Activities lasted 45 minutes each, four times a week, and had catchy game names that promoted involvement outside of the classroom.

Statistical Analysis

All outcome and demographic variables were subjected to standard descriptive statistics. SPSS 26.0 was used for statistical analysis, and AMOS 24.0 was used for structural equation modeling to investigate the connections between FMS, SE, and PA results.

Results

Overall Results after Intervention

With the exception of the walking-on-the-balance-beam test, the intervention markedly enhanced students' mobility abilities on the majority of assessments. The experimental group's mean time in this test was 3.58 seconds, whereas the control group's was 3.93 seconds. The t-value was 1.78 and the p-value was 0.076 ($p > 0.05$), which showed that there was no significant difference even though the experimental group's time was somewhat faster.

The experimental group's social-emotional competency ratings were noticeably higher, with the biggest gains being in self-awareness and group management. The experimental group's mean score was somewhat higher than the control group's for the «others' perception» dimension, but the difference was not statistically significant ($p > 0.05$), indicating that the intervention had little impact on this

Table 1. Overall of FMS, SE, PA in post-test (N=305)

Content	Control group (n = 153) M ± SD	Experimental group (n = 152) M ± SD	t-test	p-value
Sideways slide running	7.59 ± 1.58	7.20 ± 1.57	2.13	0.034*
Jumping continuously on one foot	4.23 ± 0.89	3.93 ± 0.82	3.03	0.003*
Changing hands and shooting the ball on the spot	4.05 ± 0.86	3.81 ± 0.83	2.50	0.013*
Kicking the ball over the obstacle	7.60 ± 2.72	6.92 ± 2.16	2.45	0.015*
Walking on the balance beam	3.93 ± 2.02	3.58 ± 1.29	1.78	0.076
Walking backward in a straight-line	13.34 ± 5.80	11.63 ± 4.00	3.00	0.003**
Self-awareness dimension total score	19.10 ± 4.22	21.38 ± 3.70	5.03	0.000***
Total score of self-management dimension	19.46 ± 4.63	20.87 ± 3.81	2.91	0.004**
Total score of others' perception dimension	18.41 ± 4.07	18.82 ± 4.11	0.88	0.381
Total score of others' management dimension	18.73 ± 4.23	20.24 ± 3.83	3.25	0.001***
The total score of collective cognition dimension	19.31 ± 4.79	21.31 ± 3.68	4.10	0.000***
The total score of collective management dimension	18.90 ± 4.36	20.31 ± 3.68	3.05	0.003**
Total score of social-emotional competencies	113.91 ± 23.68	122.93 ± 19.55	3.63	0.000***
Total weekly physical activity time	696.10 ± 449.22	811.19 ± 459.12	-2.21	0.028*
Total weekly sedentary behavior	946.14 ± 817.07	797.07 ± 449.23	1.98	0.049*

Note: *p < 0.05, **p < 0.01, ***p < 0.001

dimension. A longer intervention period or alternative methods may be needed.

Both total weekly and average daily physical activity times were significantly higher in the experimental group ($p < 0.05$), demonstrating the intervention's effectiveness in increasing activity levels. Sedentary behavior also decreased significantly in the experimental group ($p = 0.049$), nearing the significance threshold but still indicating a notable reduction in static behaviors.

Overall Results after Intervention Promotion

Significant enhancements were noted across all fundamental movement skill (FMS) metrics, characterized by reduced completion times in activities such as sideways slide running (decreasing from 8.15 to 7.39 seconds), single-leg hopping (from 4.48 to 4.08 seconds), and kicking a ball over obstacles (from 8.20 to 7.26 seconds), all yielding highly significant t-test outcomes ($p < 0.01$). Lower standard

Table 2. Pre-test and post-test difference statistics of FMS, SE, PA

Test content	Pre-test (n = 305) M ± SD	Post-test (N =3 05) M ± SD	t-test	p
Sideways slide running	8.15 ± 1.22	7.39 ± 1.58	6.72	0.000***
Jumping continuously on one foot	4.48 ± 0.79	4.08 ± 0.87	6.02	0.000***
Changing hands and shooting the ball on the spot	4.10 ± 0.97	3.93 ± 0.85	2.37	0.018*
Kicking the ball over the obstacle	8.20 ± 2.65	7.26 ± 2.48	4.53	0.000***
Walking on the balance beam	4.11 ± 2.26	3.76 ± 1.70	2.18	0.030*
walking backward in a straight-line	14.29 ± 5.47	12.49 ± 5.05	4.29	0.000***
Self-awareness dimension total score	17.13 ± 2.19	20.24 ± 4.12	-11.63	0.000***
Total score of self-management dimension	16.76 ± 2.50	20.16 ± 4.29	-11.95	0.000***
Total score of others' perception dimension	17.2 ± 2.36	20.30 ± 4.38	-10.90	0.000***
Total score of others' management dimension	17.16 ± 2.47	19.60 ± 4.09	-8.94	0.000***
The total score of the collective cognition dimension	15.55 ± 2.63	18.62 ± 4.09	-11.00	0.000***
The total score of the collective management dimension	16.92 ± 2.95	19.48 ± 4.10	-8.87	0.000***
Total score of social-emotional competencies	100.72 ± 6.93	118.4 ± 22.15	-13.30	0.000***
Total weekly physical activity time	571.52 ± 587.32	753.46 ± 457.08	-4.26	0.000***
Total weekly sedentary behavior time	1103.85 ± 615.73	871.85 ± 663.04	20.96	0.000***

Note: *p < 0.05, **p < 0.01, ***p < 0.001

deviations in the post-test analysis showed an improvement in performance consistency. These outcomes confirm the efficacy of the intervention by highlighting gains in speed, coordination, balance, flexibility, and stability.

Significant improvements in self-awareness, self-management, social awareness, relationship management, collective awareness, and collective management were noted in the area of social-emotional (SE) development; post-test evaluations revealed significant increases in comparison to pre-test scores (t-values ranging from -8.87 to -13.30, $p < 0.001$). For instance, self-management scores increased from 16.76 to 20.16, and self-awareness ratings increased from 17.13 to 20.24. These results imply that the intervention greatly improved social engagement, emotional control, and teamwork.

Levels of physical exercise also showed significant improvement. Weekly moderate-to-vigorous physical activity duration increased from 571.52 to 753.46 minutes ($t = -4.26$, $p < 0.001$), an increase of 181.94 minutes (nearly 3 hours). A tendency toward more consistent engagement is indicated by the decline in standard deviations. Monthly sedentary behavior, on the other hand, decreased by 232 minutes (about 4 hours), from 1103.85 to 871.85 minutes, with a highly significant t-test result ($t = 20.96$, $p < 0.001$). These changes are a reflection of overall lifestyle improvements, including better social connections, mental wellness, academic performance, and physical health.

Intervention Model Construction and Result

For an SEM model to function effectively, it must be statistically and methodologically identifiable. A properly specified model meets key requirements, including standardized variance for latent variables and assigning a factor loading of 1 to one measured variable influenced by the latent variable, enabling free estimation of variance (Qiu & Lin, 2019).

FMS Observables: FMS was measured via six observable variables: sideways slide running (FMS1), continuous single-leg hopping (FMS2), stationary ball shooting (FMS3), kicking a ball over obstacles (FMS4), balance beam walking (FMS5), and backward straight-line walking (FMS6).

SE Observables: Social-emotional (SE) dimensions were measured using six variables: self-perception (SE1), self-management (SE2), others' perception (SE3), others' management (SE4), collective perception (SE5), and collective management (SE6).

PA Observables: Physical activity (PA) was evaluated with two variables: moderate-to-vigorous physical activity (PA1) and sedentary behavior (PA2).

Model Validation: The CFA model demonstrated good fit indices ($\chi^2/df = 2.435$, NFI = 0.921, CFI = 0.952, TLI = 0.942, RMSEA = 0.069), confirming the model's robustness in explaining relationships between motor skills, socio-emotional development, and activity levels.

Common Method Bias (CMB): The Harman one-factor test was used to evaluate CMB. The one-factor CFA model showed poor fit ($\chi^2/df = 6.731$, NFI = 0.779, CFI = 0.804, TLI = 0.786, RMSEA = 0.137, SRMR = 0.127), indicating minimal CMB in the model.

Reliability and Validity Metrics: FMS (CFMST Test): Cronbach's $\alpha = 0.618$, $\chi^2/df = 3.394$, NFI = 0.934, TLI = 0.920, CFI = 0.952, RMSEA = 0.089, SRMR = 0.048, indicating good construct validity.

SE Outcomes: Overall Cronbach's $\alpha = 0.943$, CFI = 0.989, TLI = 0.981, SRMR = 0.017, confirming strong reliability and validity.

PA Questionnaire: Cronbach's $\alpha = 0.85$ for moderate-to-vigorous activity and 0.72 for sedentary behavior, with structural validity verified through principal component analysis. Three key factors explained 63.7% of the total variance, and variables showed high loadings on expected factors, supporting validity.

These findings confirm the SEM model's methodological rigor, construct validity, and ability to assess relationships among FMS, SE, and PA effectively.

The results of the structural model fitness index analysis showed the following: $\chi^2/df=2.388$; RMSEA=0.068; GFI=0.927; NFI=0.926; IFI=0.955; CFI=0.955; PNFI (0.742), PCFI (0.766), PGFI (0.644) are all greater than 0.5.The results of the analyses show that the structural model of intervention effect has a good fit, that is, the theoretically hypothesized path relationship is more in line with the actual measured data, and the structural model construction and assumptions are more satisfactory (shown in Table 4).

Correlation Coefficients analysis

In the path correlation analysis, FMS was significantly negatively correlated with SE ($r = -0.33$, $p < 0.001$) and PA1 ($r = -0.24$, $p < 0.001$). SE showed a significant positive correlation with PA1 ($r = 0.19$, $p = 0.001$) but a significant negative correlation with PA2 ($r = -0.17$, $p = 0.005$). FMS and PA2 were not significantly correlated ($r = 0.12$, $p = 0.066$), nor were PA1 and PA2 ($r = 0.02$, $p = 0.756$).

Combining the model hypotheses and the results of the structural model analysis, the relationships between model variables were further tested, as summarized in Table 5. The results showed significant differences for all hypotheses except H3 and H6, which were not significant. The improvement in fundamental movement skills among 7–10-year-old children after the intervention significantly promoted social-emotional development and increased time spent in moderate- to high-intensity physical activities. Positive social-emotional growth also decreased sedentary behavior and increased engagement in moderate-to-high-intensity activities. However, neither the increase in moderate-to-high-intensity activity participation nor

Table 3. Structural model fit parameter results

Statistical	Absolute Fitness Index			Value Added Fitness Index			Simplicity Fitness Index		
	χ^2/df	RMSEA	GFI	NFI	IFI	CFI	NFI	CFI	GFI
Adaptation Standards	3	<0.08	>0.9	>0.9	>0.9	>0.9	>0.5	>0.5	>0.5
Parameters of the model	2.388	0.068	0.927	0.926	0.955	0.955	0.742	0.766	0.644

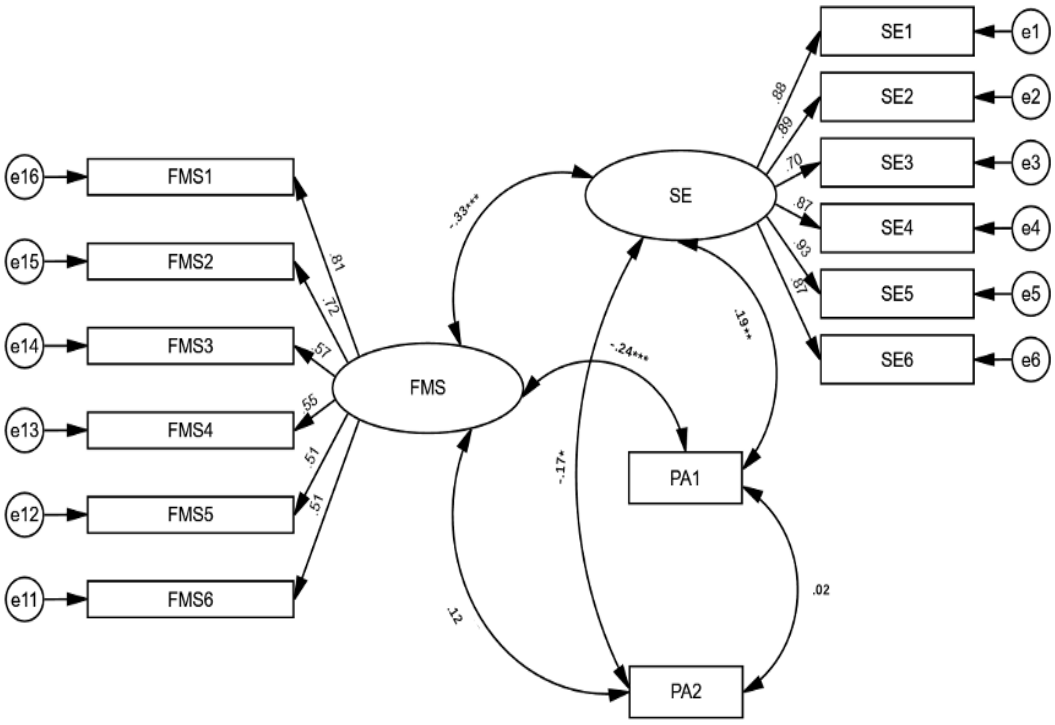

Fig. 1. Result of intervention structural equation modeling

the decrease in inactive time throughout physical activity development in this age group were significantly impacted by the improvement in fundamental movement abilities.

The results have shown that the most indices of model fit were at a good level. These findings underscore the need to disentangle types of activity participation and consider their unique relations with motor skill development. FMS impacted between activity levels PA1 and PA2, indicating children's activity participation is limited by their motor abilities and the way in which the activities are provided. This highlights the importance of interventions not just to support physical activity but also to encourage social-emotional development.

Discussion

Overview of the Main Hypothesis

This study formulated six hypotheses to examine the relationships between fundamental movement skills (FMS), social-emotional development (SE), and physical activity (PA):

H1: It was hypothesized that improvements in movement skills would enhance socio-emotional development. The findings supported this with a significant correlation ($r = -0.33$, $p < 0.001$).

H2 & H3: These hypotheses proposed that better FMS would lead to increased moderate-to-vigorous physical activity (PA1) and reduced sedentary behavior (PA2). The results supported both hypotheses, although the difference in H3 was not statistically significant ($r = 0.12$, $p = 0.066$). However, it still suggested that improved FMS could help reduce sedentary time to some extent.

H4 & H5: These hypotheses suggested that social-emotional development would increase PA1 and decrease PA2. The results confirmed these assumptions ($r = 0.19$ and $r = -0.17$, respectively), aligning with the theory that emotional regulation and social confidence encourage active participation.

H6: This hypothesis examined the relationship between PA1 and PA2 but found no significant correlation ($r = 0.02$), indicating that reducing sedentary behavior requires interventions beyond simply increasing PA.

Table 4. Hypothesis testing for each structural path

Hypothesis	Path	Standardized Estimate	Estimate	S.E.	C.R.	P
H1	FMS↔SE	-0.33	-3.104	0.713	-4.315	***
H2	FMS↔PA1	-0.24	-287.627	81.864	-3.513	***
H3	FMS↔PA2	0.12	203.574	110.554	1.841	0.066
H4	SE↔PA1	0.19	321.168	99.089	3.241	**
H5	SE↔PA2	-0.17	-397.684	142.882	-2.783	*
H6	PA1↔PA2	0.02	5376.426	17327.635	0.310	0.756

Note: *p < 0.05, **p < 0.01, ***p < 0.001

Discussion of Conclusions

In general, our primary hypothesis is substantiated in this research. The experiment and control groups had no difference in FMS or social-emotional competency prior to the intervention (all $p > 0.05$), indicating that both groups started at comparable baseline levels. This provided a solid foundation for assessing the actual impact of the Kids' Athletics program.

Following the Kids' Athletics program, the experimental group showed notable improvements in nearly all FMS measures compared to the control group. Skills such as sideways sliding ($p = 0.034$), one-foot continuous jumping ($p = 0.003$), changing hands to shoot ($p = 0.013$), kicking over obstacles ($p = 0.015$), and walking backward on a line ($p = 0.003$) all improved significantly. These enhancements reflect gains in children's speed, agility, balance, hand-eye coordination, reaction time, and spatial awareness. However, one skill—walking on a balance beam ($p = 0.076$)—did not show significant improvement, suggesting that this skill may require a longer intervention or more targeted training to yield noticeable progress.

Regarding social-emotional outcomes, the intervention group scored significantly higher than the control group in several SE dimensions after the program. Improvements were especially pronounced in self-awareness, self-management, management of others, collective awareness, and collective management skills. The most significant gains were observed in self-perception and collective management, highlighting the program's effectiveness in fostering children's self-awareness and teamwork abilities. However, the "Others' Perception" dimension did not show a significant improvement, possibly due to the short intervention duration or because the activities were not directly focused on this skill. This suggests that future implementations may require additional or adapted strategies to better cultivate children's awareness of others.

The Kids' Athletics program also had a positive impact on children's activity behaviors. The experimental group increased their moderate-to-vigorous physical activity by an average of about 115 minutes per week ($t = -2.21$, $p = 0.028$) more than the control group and reduced their sedentary time by approximately 149 minutes per week ($t = 1.98$, $p = 0.049$) compared to controls. These findings suggest that students not only enjoyed the activities but also began adopting more active lifestyles, spending less time on sedentary pursuits. While the reduction in sedentary behavior was statistically significant, the magnitude of change was modest, indicating room for further improvement in decreasing inactive time.

Most importantly, SEM analysis confirms the interconnected nature of these outcomes. The structural model demonstrated a good fit ($\chi^2/df = 2.388$; NFI = 0.926; CFI = 0.955; IFI = 0.955; RMSEA = 0.068; SRMR = 0.066), validating the proposed relationships among FMS, SE, and PA. According to the model's path coefficients, the development of FMS had a significant positive effect on children's SE development (path coefficient = 0.33). In other words, as children's fundamental movement skills improved, their social-emotional competence also increased. This makes intuitive sense: better motor skills likely enhanced children's confidence, self-control, and opportunities for positive social interaction, thereby improving various aspects of their social-emotional skills.

Our results align with and extend previous research findings in this field. Consistent with national trends noted by Yang et al. (2022) and colleagues, children in our sample initially exhibited suboptimal physical activity levels and similar fundamental movement skill proficiency, highlighting the need for interventions. Past studies have indicated that traditional physical education programs often fail to sufficiently engage children or improve FMS (Diao, 2018; Ulrich, 2019; Wang et al., 2021). Our baseline assessment corroborates these findings, showing no notable differences between groups, suggesting that without a specialized program, regular school activities may not be enough to enhance these skills or behaviors.

The significant motor skill improvements observed with the Kids' Athletics intervention align with the findings of Čillík et al. (2018) and Katzenbogner et al. (2018), who demonstrated that the IAAF Kids' Athletics program effectively promotes FMS and physical activity in children. Our study reinforces these results in a Chinese context while also emphasizing gains in agility, coordination, and balance through specific skill assessments. Additionally, previous studies have well established that increased physical activity yields health benefits for children (Barnett et al., 2016; Bolger et al., 2019; Meng et al., 2020; Xu et al., 2023). Our findings build on this body of evidence by showing that a targeted program can significantly increase weekly PA levels and reduce sedentary time, directly addressing the concern that many children do not meet recommended PA guidelines (Yang et al., 2022; Liu et al., 2023; Peng et al., 2024).

Practical Applications of the Results

Since FMS is inextricably linked to social-emotional learning, schools and youth sports programs must accord FMS training top priority. The inclusion of exercises for enhancing performance in basic motor skill functions such as jumping, balancing, and throwing in curricula can allow youths to develop motor competency, confidence, and social skills, thereby contributing to their overall development. The benefits of physical activity for children vary based on their FMS skill level. It is thus highly important to consider their current abilities when designing activity programs. By structuring programs to accommodate all skill levels, educators can ensure that each child is appropriately challenged and experiences success. On a policy and curriculum level, a balanced program incorporating moderate and vigorous activities, cooperative games, and skill drills can maximize developmental outcomes.

With these findings in mind, schools and trainers can develop interventions and programs that seamlessly integrate active lifestyles with social-emotional learning. For instance, physical education classes can incorporate teamwork-based games and challenges that emphasize communication and collaboration alongside fitness. Similarly, youth sports coaches can include reflective discussions on teamwork and self-discipline in training sessions, reinforcing the link between physical skill development and emotional growth.

Importance of the Study Findings

This research supports a whole-child conceptualization for child development in the context of physical education. Our findings affirm improvement in bodily capacities is highly connected to improvement in social-emotional domains—a connection supporting integrated interventions

as being highly effective. The evidence supporting a sports-based program in improving self-perception, self-regulation, and inter-person capacities contributes usefully to closing research gaps in integrated physical activity and social-emotional interventions in early childhood (Yang et al., 2022). Moreover, close correspondence between our SEM model and seeming inter-relationship between domains (FMS ↔ SE ↔ PA) provide empirical substantiation for theoretical frameworks proposing inter-connected child development. Practically, this advises interventions for child motor skill improvement should not be thought of as a method for improving bodily health but as a method for improving affect and relationships as much as possible. The significance in our findings is in demonstrating a structured program in physical activity can be a basis for generalizable learning outcomes. That justifies widening the mission for physical education beyond health-fitness to include key personal development domains like confidence, teamwork, and self-regulation. By shedding lights on inter-relationship between them, our research compels decision-makers and educators to invest in integrated programs (like Kids' Athletics or programs like it) addressing multiple dimensions in child development at once.

Future Research Directions

Some skills, such as balance-related abilities and social-emotional learning aspects like «Others' perception,» showed limited improvement. Future interventions should extend program duration or adjust content to address these areas more effectively. Long-term studies are needed to determine whether improvements in fundamental movement skills, social-emotional learning, and physical activity persist over time and whether they translate into other benefits like academic performance or long-term health. Additionally, self-reported physical activity data revealed inconsistencies, emphasizing the need for objective measurement methods. Further research should explore the link between increased physical activity and reduced sedentary time to improve future intervention strategies.

Conclusions

These findings lend strong support for the capability of well-structured playful interventions like the Kids' Athletics program for enhancing children's fundamental movement skills, social-emotional development, and rates of physical activity. The findings underscore the integrated nature of these aspects of development and the necessity of the integrated delivery of youth education and the promotion of physical activity.

These results reinforce that the improvement of fundamental movement skills improves more than mere motor ability but also affects positive social-emotional development and provokes enhanced levels of physical activity with diminished sedentary behavior. These conclusions underscore the need for the development and implementation of physical activity interventions that simultaneously affect multiple aspects of children's development. And the significant relationship between increased physical activity behaviors and reduced sedentary behaviors needs to be supported by additional research findings.

Interventions of the future must consider the extension and enhancement of the approaches of training toward more effectively providing areas of improvement that were weaker, such as balance-related ability and the development of social awareness. Durability of these improvements over the years and the more widespread effect upon education and health must be determined by longitudinal study. Policymakers and teachers are more effectively enabled by the implementation of such knowledge to build more successful interventions that benefit children's health and well-being, leading toward the enhancement of long-term development.

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Conflict of Interest

The authors have no conflicts of interest.

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Фундаментальні рухові навички дітей, соціально-емоційний розвиток та розвиток фізичної активності на основі інтервенції з дитячої легкої атлетики: Метод моделювання структурними рівняннями (SEM) та аналіз

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 6 с., 4 табл., 1 рис., 19 джерел.

Мета дослідження. Мета цього дослідження полягала у вивченні стану розвитку основних рухових навичок, соціально-емоційного розвитку та фізичної активності у китайських дітей віком від 7 до 10 років. Використовуючи інтервенцію з дитячої легкої атлетики, для аналізу траєкторій їхнього розвитку було застосовано метод моделювання структурними рівняннями (SEM).

Матеріали та методи. Дослідження проводилось у період з квітня по червень 2024 року за участю 305 учнів початкової школи. Задля проведення дослідження використовували тест на визначення рівня фундаментальних рухових навичок у дітей, опитувальник для оцінки рівня фізичної активності дітей та підлітків (7-18 років) та опитувальник соціально-емоційної компетентності учнів. З метою вивчення взаємозв'язків між зазначеними сферами розвитку було застосовано метод моделювання структурними рівняннями.

Результати. Після завершення інтервенційного періоду спостерігалося значне покращення показників основних рухових навичок, соціально-емоційної компетентності та рівнів фізичної активності (усі показники $p < 0,05$). Експериментальна група перевершила контрольну групу за більшістю показників, окрім виконання ходьби на гімнастичній колоді з метою визначення рівноваги тіла та оцінки сприйняття оточуючих ($p < 0.05$). Структурна модель показала адекватну відповідність, а кореляційний аналіз шляхів виявив значну негативну кореляцію між основними руховими навичками та соціально-емоційним розвитком ($r = -0,33$, $p < 0,001$) і фізичною активністю ($r = -0.24$, $p < 0.001$). Крім того, соціально-емоційний розвиток продемонстрував позитивну кореляцію з фізичною активністю ($r = 0,19$, $p = 0,001$) і негативну кореляцію з малорухливою поведінкою ($r = -0,17$, $p = 0,005$). Значущих кореляцій між основними руховими навичками та малорухливою поведінкою, а також між різними рівнями фізичної активності не спостерігалося.

Висновки. Отримані дані дозволяють зробити висновок, що покращення фундаментальних рухових навичок сприяє поліпшенню соціально-емоційного розвитку та підвищенню рівня фізичної активності, а також зниженню малорухливої поведінки. Це дослідження забезпечує цінну основу для популяризації фізичної грамотності та оптимізації практик фізичного виховання.

Ключові слова: фундаментальні рухові навички, соціально-емоційний розвиток, рівні фізичної активності, дитяча легка атлетика в Китаї.

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