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Impact of Digital Platform Usage on Physical Health among Chinese Young Children

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ABSTRACT

The current study examines the impact of digital platform use on preschoolers' physical health and explores gender and grade differences in its effects. A single-group pre-post quasi-experimental design was used, involving 343 children (170 boys, 173 girls; mean age 4.82±0.89 years). Physical health pre-tests were first conducted. Then, structured interventions (collective teaching, special activities, daily infiltration, home-school collaboration) were delivered twice weekly for 270 days via an intelligent physical fitness test platform, followed by post-tests. Paired sample t-tests and repeated measures ANOVA were analyzed. Results were that digital platform use significantly enhanced overall physical health (total score: t =18.74, p < 0.001; pass rate rose from 89.5% to 95.2%, excellent rate from 45.6% to 63.8%). Specifically, boys showed greater improvement in strength indicators than girls; children in large classes made better progress in most indicators than those in small and middle classes. Cross-age comparisons confirmed the intervention's effect exceeded natural growth. These findings suggest that digital platform use increases preschoolers' physical health, but classified guidance is needed to address gender and educational stage differences. This study provides empirical evidence for global early childhood health promotion and suggests strengthening interventions for boys and younger children.

KEYWORDS

Use of digital platforms; Physical health; Single-group pre-post quasi-experimental design; Young children

1 Introduction

1.1 Impact of Digital Platform Usage on Physical Health among Chinese Young Children

International research shows that physical health of young children, as a comprehensive reflection of body shape, physiological function and motor quality, is crucial to their growth and future health [1]. However, challenges to physical health of young children worldwide include the WHO report on rising childhood obesity and widespread lack of exercise [2]. Multiple monitoring data show uneven development in strength, endurance and flexibility, with risk of decline [3-4]. Studies note increased screen time leads to declined physical activity, increased sedentary behavior [5], and reduced exploration opportunities, affecting health [6]. These problems are widespread in developed and developing countries, calling for global strategies.

Digital technologies are widely used in early childhood education, including wearable devices, multimedia tools and mobile applications [7-8] for effective guidance and decision-making [9-10]. The impact is twofold: excessive screen time increases risk, active use promotes activity [11-12]. Digital platforms, integrating data collection, analysis, and interactive feedback, are increasingly used to enhance physical health of young children. However, empirical research is lacking, especially on mechanisms for individual differences.

1.2 Theoretical Foundation

This study is based on Stodden et al.'s (2008) conceptual model of reciprocity between motor ability and health [13], emphasizing dynamic reciprocal relationship among motor ability, physical activity, health fitness and weight status, forming a positive feedback loop [14-15]. The model guides child interventions, demonstrating early physical activity drives motor ability improvement and promotes health [16-17]. Applied to this study, the digital platform supported positive feedback through data-driven personalized interventions, such as game tasks enhancing competence, home-school collaboration increasing activity participation, and improving fitness indicators [18].

1.3 The Present Study

Given the research gap, this paper examines the impact of digital platforms on physical health of young children and differences in gender and school stage. Questions: (1) Does use of digital platforms affect physical health? (2) Are there gender and stage differences? (3) How to distinguish effects from natural growth? Hypotheses: *(H1) Use enhances physical health; (H2) Boys have higher level than girls after use; (H3) Older children have higher level than middle and younger after use.*

2 Methods

2.1 Participants

Cluster sampling selected 343 children from a public kindergarten in Shenzhen (170 boys, 49.6%; 173 girls, 50.4%; average age 4.82±0.89 years). By age: 98 small class (3-4 years old), 115 middle (4-5 years old), 130 large (5-6 years old). Excluded children with health issues or absenteeism; informed parental consent and ethical review by kindergarten.

2.2 Design

The design was a single-group pre- and post-measurement quasi-experiment, with digital platform usage as independent variable and physical health level as dependent, no parallel control group (due to ethical equity and research focus). Cross-time comparisons controlled for natural growth effects.

2.3 Experimental Materials

Experimental materials included a child movement health management system: hardware (intelligent physical measurement device and base station for eight automatic measurements); software (teacher-end platform and WeChat mini-program supporting automated testing, report generation, fun game lesson plan library, home task push). Assessment tools based on National Physical Fitness Test (Preschool Part) [19], covering height, weight, 10-meter shuttle run (agility), etc.

2.4 Procedures

The study consists of three steps: (1) pre-test (September 2024) to establish baseline and diagnose weaknesses; (2) Intervention (October 2024 - June 2025), implementing three-level intervention system (kindergarten, class, individual) through gamification exercises and home-school collaboration; (3) Post-test (July 2025) to assess intervention effect.

2.5 Data Analysis

Data analyzed using SPSS 26.0. Paired sample t-tests compared pre- and post-test scores. Cross-age comparisons distinguished intervention effects from natural growth.

3 Results

3.1 The Overall Intervention Effect of Digital Platform use on the Physical Health of Young Children

Effectiveness examined using pre- and post-test paired sample t-test. As shown in Table 1, posttest scores significantly higher than pretest for all seven indicators except sit and reach. Digital platform use for one academic year significantly improved overall physical health.

Table 1 Pre-post-test paired sample t-test results of differences in the impact of digital platform use on physical health

$N = 343$

Dimension	Pretest ($M±SD$)	Posttest ($M±SD$)	t	p
Height (cm)	108.20±4.30	113.30±3.99	16.71***	<.0001
Weight (kg)	17.71±2.37	19.48±2.58	9.50***	<.0001
10-meter shuttle run (s)	9.81±1.22	6.94±1.02	-31.73***	<.001
Standing long jump (cm)	83.42±12.06	97.40±14.05	14.24***	<.001
Tennis throw (m)	4.33±1.49	6.50±1.82	16.78***	<.001
Double jumps (s)	9.23±1.89	5.06±1.19	-33.65***	<.001
Sit and reach (cm)	9.34±3.44	9.93±3.55	2.29*	0.023
Walk on the balance beam (s)	13.48±3.27	6.80±2.12	-31.13***	<.001

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

3.2 Gender Differences in the Impact of Digital Platform Use on Children's Physical Health

Digital platforms have positive effects on different genders, but progress trajectories vary (Table 2). Boys showed significant improvement in strength events like standing long jump and 10-meter shuttle run; girls have significant advantage in flexibility events like sit and reach. Balance improvement comparable and less affected by gender.

Table 2 Gender differences in the impact of digital platform use on physical health

Dimension	Male (*N*=170)		t	Female (*N*=173)		*t*
	Pretest M±SD	Posttest M±SD		Pretest M±SD	Posttest M±SD	
Height (cm)	108.53±4.33	113.77±3.94	12.15***	107.88±4.27	112.84±4.00	11.46***
Weight (kg)	18.03±2.38	19.67±2.61	6.28***	17.39±2.32	19.30±2.55	7.13***
10-meter shuttle run (s)	9.71±1.19	6.93±0.98	-21.57***	9.91±1.24	6.95±1.06	-23.30***
Standing long jump (cm)	85.23±11.76	99.59±14.81	9.84***	81.65±12.11	95.24±12.94	10.31***
Tennis throw (m)	4.57±1.56	6.71±1.81	11.21***	4.09±1.39	6.29±1.82	12.55***
Double jumps (s)	9.18±1.96	5.05±1.14	-22.92***	9.28±1.82	5.08±1.25	-24.65***
Sit and reach (cm)	8.70±3.41	9.14±3.70	1.12	9.97±3.37	10.70±3.22	2.19*
Walk on the balance beam (s)	13.22±3.21	6.93±2.19	-21.74***	13.74±3.32	6.68±2.04	-22.45***

3.3 Stage-level Differences in Intervention Effects for Young Children

Young children's quality development shows differentiation pattern: flexibility increases at all ages but slows with age, lower age range critical; upper limb strength (tennis ball throwing) has age gradient, explosive growth over 4.5 years. Intervention program effective overall and adapted to different age groups' development rhythm.

3.4 Test of Effects based on Cross-age Comparisons

Cross-age comparison designed to distinguish intervention from natural growth. Compared post-test data of lower age group (e.g. 4-4.5 years) after intervention with pre-test of higher age group (e.g. 5-5.5 years). No difference means equivalent to growth; better proves value-added. As shown in Table 5, younger group significantly better in most indicators ($p<0.05$), confirming digital platform effect exceeded natural growth.

Table 3 Tests of the effectiveness of the intervention on physical health

Dimension	4-4.5 years old (posttest)	5-5.5 years old (pretest)	*t*	4.5-5 years old (posttest)	5.5-6 years old (pretest)	*t*
Height (cm)	113.30±4.06	108.08±4.44	-9.11***	113.69±4.44	107.88±4.53	-9.51***
Weight (kg)	19.26±2.55	17.49±2.28	-5.47***	19.25±2.66	17.91±2.26	-3.93***
10-meter shuttle run (s)	6.94±1.02	9.90±1.21	19.62***	6.93±1.02	9.87±1.36	18.32***
Standing long jump (cm)	95.56±13.04	83.58±11.46	-7.30***	97.78±13.94	83.38±11.98	-8.04***
Tennis long throw (m	6.58±1.91	4.29±1.48	-10.05***	6.61±1.92	4.19±1.48	-10.19***
Double jumps (s)	5.14±1.22	9.21±1.72	20.19***	5.12±1.18	9.24±1.95	19.39***
Sit and reach (cm)	10.17±3.75	8.91±2.93	-2.80**	10.03±3.51	8.81±3.23	-2.62**
Walk on the balance beam (s)	6.96±2.33	13.59±3.09	17.95***	7.11±2.26	13.41±3.26	16.95***

4 Discussion

4.1 A data-driven Intervention Model is an Effective Path to Achieving Overall Improvement

The study found that the digital-enabled four-in-one model system improved the physical health of young children, with a significant increase in pass and excellent rates, marking a paradigm shift from experience-driven to data-driven. The intelligent platform instantly diagnoses and identifies common weaknesses, enhancing the precision and efficiency of intervention. In line with international research, digital technology can increase interest in sports and promote home-school interaction and cooperation [13-14]. This model further highlights the value of precision. The cross-age comparison confirmed that the intervention produced a value-added effect beyond natural growth, verifying the scientificity and superiority of data-driven decision-making. The finding is in line with global trends in physical education for preschool children, and digital intervention strategies significantly increase physical activity levels in young children [18].

4.2 Intervention Strategies Should Respect and Respond to the Differentiated Characteristics of Gender Development

The study revealed that there were gender differences in the effects of the intervention that were in line with the laws of physical and motor development: boys made more significant progress in strength and explosive power events, while girls maintained an advantage in flexibility. The findings suggest that promotion programs need to be inclusive and flexible, offer diverse options and challenges, and support young children to have successful experiences in their respective areas of expertise, achieving a unity of all-round development and individual expression. This is in line with the international view that the differences in physical functions between boys and girls require different guidance methods [8-9]. Mobile App intervention has also shown similar gender differentiation effects among young children worldwide [20].

4.3 The Timing of Intervention Should be Closely Related to the Developmental Sensitive Periods of Each Age Group

Fine-age group analysis Outlines key Windows for physical fitness development. Around 4.5 years old is the sensitive period for upper limb strength and agility. Digital intervention dynamically identifies timing to ensure that support is in sync with the child's developmental rhythm for maximum benefit. This requires an age-appropriate approach to teaching. The concept of the sensitive period is widely recognized in international early childhood physical education [10][11].

4.4 The Promotion of Different Physical Qualities Should be Classified According to Their Inherent Laws

The research results highlight the differences in response to intervention among different physical constitutions. Strength, agility, coordination and other qualities were significantly improved through gamified activities; Flexibility improvement is relatively slow, and the resistance to progress increases with age. This reflects the inherent particularity of physical development. Flexibility promotion requires continuous, gentle daily infiltration rather than periodic reinforcement. Future practices establish categorized approaches: Strength-oriented projects focus on intervention, and qualities such as flexibility start at a young age and are cultivated throughout the entire course on a regular basis [7][12].

5 Research Contributions, Research Limitations and Future Prospects

5.1 Research Contributions

This study, through a quasi-experimental design, empirically demonstrated the application efficacy of digital platforms in promoting early childhood health, and revealed the boundary conditions for moderating effects by gender and school stage, enriched the empirical knowledge in the intersection of educational technology with preschool education and physical health, and provided an empirical example for the effectiveness of data-driven interventions, which can be extended to an international context.

5.2 Limitations and Future Prospects of the Study

A one-year intervention with a single-group pre - and post-test design could be followed up in future clusters of randomized controlled trials to provide stronger evidence of causal inference. Mainly relying on quantitative data, in the future, qualitative methods such as interviews will be used to explore the user experience. In the future, we will explore the precise exercise recommendation of AI algorithms, the digital integration of physical health and psychosocial development, and conduct cross-national comparisons to verify the applicability of the models.

6 Practical Implications

First, establish a data-driven intervention cycle: Build a regular monitoring-feedback-intervention closed-loop mechanism, use platform data to identify group weaknesses and individual shortcomings, push gamified exercise prescriptions, and achieve holistic-to-precise support applicable to preschool physical education globally. Second, design differentiated activity modules: Develop gender-friendly and age-ladder dual-track game libraries targeting gender and stage differences—boys focus on enhanced strength tasks and flexibility games, girls on strength and balance activities; leverage developmental sensitive periods to prioritize strength-agility combined games. Third, implement a classified policy system: Categorize physical fitness programs into key breakthrough types (e.g., strength, agility) and sustained immersion types (e.g., flexibility); the former can be strengthened via monthly thematic games, while the latter should be integrated into daily sessions through low-intensity, high-frequency daily infiltration for gradual improvement.

7 Conclusions

The following conclusions were drawn from this study: Precision intervention models based on digital platforms can effectively promote the overall improvement of physical health in young children. The core advantage lies in achieving targeted educational intervention through data diagnosis and generating value-added effects beyond natural growth.

Second, there are significant gender and age differentials in the physical development of young children. Boys have greater potential in strength-based projects, while girls perform better in flexibility. Seize the critical window of opportunity for quality development and implement age-appropriate teaching. Third, the development patterns of different physical qualities vary, and the improvement of flexibility is a common difficulty that requires long-term and continuous attention. In summary, data-driven intervention represents tool innovation and practice deepening, which can provide reference for global preschool children's physical education and promote international early childhood health promotion.

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