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A study to evaluate the effectiveness of a physical intelligence program on physical fitness interventions for 5- and 6-year-old children

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Abstract

The current problems of young children in China, such as a year-on-year decline in physical fitness and health, delayed development of basic movements, a high rate of obesity detection, and lagging construction of physical activity curricula, have seriously affected the healthy development of young children. Physical education, as one of the key paths to improve health, has been moved forward to the early childhood stage. In view of this, this study takes physical intelligence program as the research object, and conveniently selects 64 children aged 5-6 years old from the third kindergarten in Shangrao City, and divides them into the experimental group (32) and the control group (32) by using the method of randomized numerical table. The experimental group underwent a 15-week physical intelligence program, and the control group underwent regular kindergarten physical activity. The physical fitness indicators of the two groups were tested before and after the intervention, and the differences of each physical fitness indicator within and between the groups before and after the intervention were compared using the paired samples t-test and the independent samples t-test. The results showed that after the implementation of the intervention test, in terms of body shape, the height of the children in both groups increased, but there was no significant difference between the groups, which was mainly considered as a factor of natural growth; and in terms of body weight, the Body Smart program had a fat-lowering effect on the children. The physical intelligence program had a significant effect on the intervention of four events, namely, sitting forward bend, standing long jump, tennis ball throw and walking balance beam, in 5- to 6-year-old children. Therefore, the physical intelligence program has a promotional effect on the physical health of young children.

Keywords: *physical intelligence program; physical fitness; growth and development; interventional study; preschoolers*

1 Introduction

In recent years, research on early childhood sports has been developing rapidly, and people are gradually recognizing the diversified values of sports and increasing their health consciousness. How to develop early childhood sports in a scientific way so as to accurately solve the dilemmas and bottlenecks in the development of early childhood sports at the present stage has become the key to in-depth discussion.

Guo Z Y et al.(2021) In China on the one hand, due to the lack of exercise in young children, a series of problems such as myopia, obesity, delayed motor development and so on have been triggered, which seriously affects the development of young children's athletic ability

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and hinders the improvement of their health level. On the other hand, kindergarten physical education curriculum has not yet a unified textbook and curriculum standards, and there is no specific evaluation standard, most kindergartens use garden-based teaching materials, which can easily lead to deviation from the objectives in the practice of kindergarten physical activity (Guo Ziyu et al.2021). Therefore, the development of exercise promotion programs and interventions that conform to the laws and characteristics of young children's physical and mental development can make up for the current deficiencies in the development of physical activities for young children in kindergartens, promote the development of basic motor skills in preschool children, and provide theoretical and practical references for the improvement of young children's physical fitness and health.

2 Literature Review

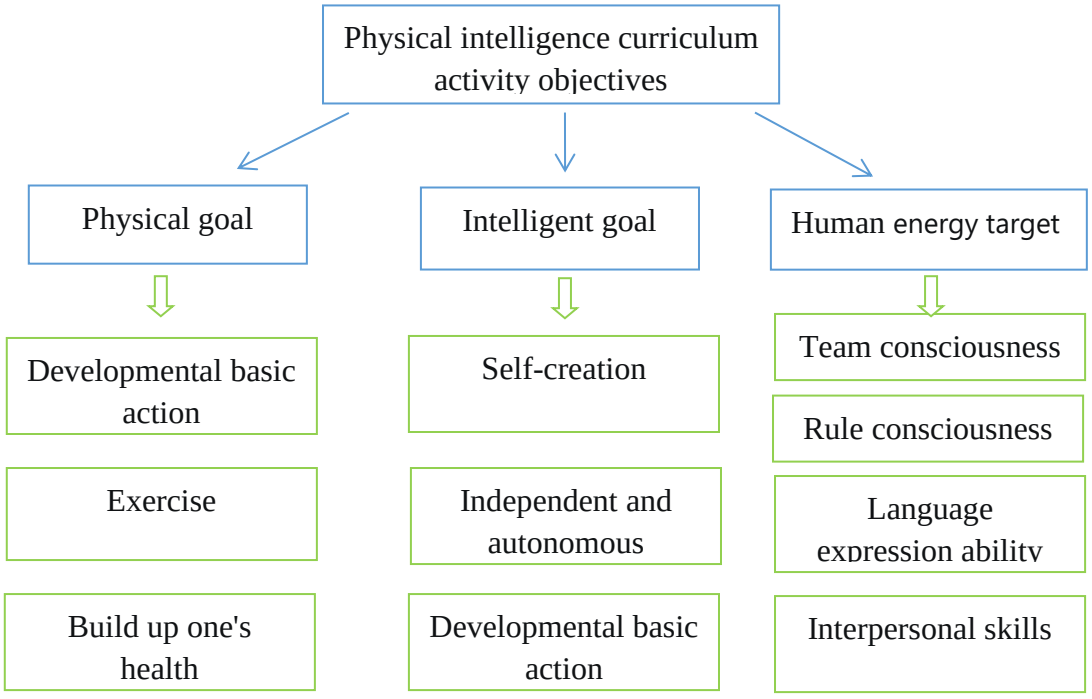
2.1 State of the art of research on somatic intelligence programs

Early educators who advocated the theory of a physical intelligence program for young children were Fröbel & Rönsch (1912), the founders of kindergarten in Germany, who pointed out that how to entice young children in play is fundamental to early childhood education. The world of the young child is almost entirely filled with play, and play is a very important part of the child's life, through which the young child expresses his or her mental activities. (Fröbel & Rönsch, 1912). Play is a very important part of children's lives. Physical education games for young children should be stimulated in a way that is appropriate to the development of the child's behavior so that it can have a good impact on the child's intelligence.

In terms of research content, most scholars summarize and analyze the basic features of physical intelligence courses. Zhang L B & Qiu L Q (2019) categorized physical intelligence courses into unarmed physical intelligence courses, light instrumental physical intelligence courses, and parent-child activity physical intelligence courses according to the teaching content. A complete physical intelligence program usually consists of a warm-up session, a scenario introduction session, a basic section, and a concluding section, and a physical intelligence program for 3-4 year olds is usually based on the basic movements of climbing, crawling, patting, kicking, etc., with certain story scenarios and in a playful teaching mode. For example, ants climbing up the tree and other climbing games. 4-5 year olds can develop basic movements such as walking, running, jumping and other basic movements, which are also presented in a game-like teaching mode with certain story scenarios. For example, the bunny goes home and other games to exercise children's jumping games. 5-6 years old children can be walking, running, jumping and other large muscle group movement development as the goal, with light equipment to complete the development of children's basic movements in all aspects, and more comprehensively promote the development of their physical fitness. From this, it can be seen that the arrangement of the curriculum content of physical intelligence is a gradual process from shallow to deep and from simple to complex. (Zhang, Libin & Qiu, Liqiang, 2019) . According to Wang H H & Wang L (2018), the physical intelligence program has become one of the most popular programs at the early childhood level for several reasons: first, the physical intelligence program strengthens the education of human ability. It integrates the education of patriotism, collectivism, spiritual civilization and moral character while participating in sports, which in turn also strengthens social adaptability. Secondly, it increases children's interest in participating in sports and lays a good foundation for lifelong sports. With the theme of

happiness and the basic teaching mode of games, the physical intelligence program can protect and develop the curiosity of young children and cultivate their interest in actively participating in sports. Thirdly, the development of young children's intelligence by the physical intelligence program. At present, most of the physical intelligence courses are taught in a scenario-introduction mode, which is situationalized and anthropomorphized, and makes full use of questioning and other forms to let children actively think about the problem, thus exercising the development of their intelligence. (Wang Huihong & Wang Liu, 2018) (Wang, Huihong & Wang, Liu, 2018). Wang Yan & Li Zohui (2017) pointed out that the design and planning of physical-intelligence activities mainly follow the principle of "three changes, four movements, and five transformations" (Wang Yan & Li Zohui, 2017).The three changes are The three changes are conformity, change and alteration; the four movements are driving, interaction, action and moving; and the five transformations are storytelling, children's, life, cartoonization and fun. Lin Z Y (2019) pointed out that the main outstanding teaching objectives of physical and intellectual activities contain three aspects: physical, intellectual and human goals (Lin Zeyu, 2019). (See Figure 1 for details)

Figure 1 Activity goals for young children's physical intelligence



According to the viewpoints of the above scholars and the practice of early childhood education in some countries, under the influence of the educational ideas after the 1990s, there has been a very obvious development of young children's physical intelligence, in the areas of teaching evaluation, objectives, evaluation content, teaching methods and values. Researchers have gradually focused on how to fully develop the physical intelligence of young children, and how to use physical intelligence to maximize the creativity and autonomy of young children. In addition to the above, researchers have also begun to gradually expand their field of study into the field of curriculum research. It is a very obvious trend for the future development that

the study of young children's physical intelligence is gradually transforming into humanistic research.

2.2 Current state of research on young children's physical health

2.2.1 Tests of physical fitness of young children

España-Romero et al. (2010) Physical fitness test indicators are selected with due consideration of subject race, age, validity and reliability. Validity refers to the ability of a test to reflect what it was designed to measure and is judged by comparing it to the gold standard method. Reliability refers to the reproducibility of test values in repeated trials on the same individual person (España-Romero et al., 2010) . Wu, X. Y. (2015) pointed out the existing testing systems used to assess the physical health status of children and adolescents globally, including the U.S. Healthy Fitness Program, the European Union's identified public health surveillance systems - ALPHA, FITNESSGRAM, PREFIT, EUROFIT, the Canadian Physical Activity Physical Fitness (CPAFLA), AFEA test, etc. The validity and reliability of these tests have been confirmed. Among them, the survey items of the U.S. Healthy Fitness Program for adolescents include testing body composition with BMI, cardiorespiratory endurance with a heart rate tester and long-distance running exercise, muscular strength and muscular endurance with grip strength and standing jump, and sit-ups, push-ups, and seated forward bends (Wu, X.Y., 2015). Ruiz et al. (2011) stated that the level of assessment of ALPHA was established in the framework of the EU-funded HELENA study (The Impact of Adolescent Nutrition on Healthy Lifestyles in Europe) and used for public health surveillance, and that ALPHA was tested with 20-meter round-trip run to assess cardiorespiratory fitness, grip strength, standing long jump to assess musculoskeletal fitness, BMI, skin fold thickness, and waist circumference to assess body composition (Ruiz et al., 2011). The two systems are applicable to adolescents, however, both of these systems are applicable to adolescents. However, both of the above systems are applicable to adolescents.Ortega et al. (2015) summarized and validated the proposed Physical Fitness Field Test Scale (PREFIT) for children aged 3-5 years old: cardiorespiratory fitness and musculoskeletal fitness are reflected by the results of the 20-meter round-trip run and the grip strength and the standing long jump, respectively; the speed and agility qualities and balance are expressed by the results of the 10-meter × 4 shuttle run and the one-legged standing test, respectively. (Ortega et al. 2015).

According to Yang T J (2018), physical fitness test indicators are divided into three categories: physical form, physical function and physical fitness indicators (Yang, Taiji, 2018) . The State General Administration of Sport (2003) promulgated the National Physical Fitness Measurement Standard (Early Childhood Section), which contains eight test indicators for physical form (height and weight) and physical fitness (10-meter toss, standing long jump, tennis ball throw, two-legged continuous jump, seated forward bending, and walking the balance beam) (State General Administration of Sport, 2003). The program is based on the following criteria.

In this study, according to the physical development and load level of children aged 3-6 years old, and considering various aspects of safety, validity, reliability and testing efficiency, the above eight items were selected as indicators of physical fitness and athletic ability based on the National Physical Fitness Measurement Standards (Early Childhood Section) to comprehensively evaluate the physical fitness and health level of children.

2.2.2 Young children's physical fitness and basic motor skills

Eric Vlahov et al. (2014), in order to explore the extent to which young children's motor developmental skills predicted high school fitness, selected young children with an average age of 4.8 years old to take the TGMD test, and completed the AAHPERD health fitness test (1.5-mile run, sit-ups, seated forward bends, and percent body fat) 11 years later, and found that the basic motor skill test scores were strong predictors of all fitness metrics, but manipulative movement skills were better predictors of fitness than mobility movement skills. The researchers emphasized that educators should consider teaching basic movement skills, not just general physical activity, at an early age to improve long-term fitness levels (Vlahov et al., 2014) .Lima et al. (2017) longitudinally tracked physical activity, movement capacity, cardiorespiratory fitness (peak maximal oxygen uptake), and body fat metrics in children with a mean age of 6.75 ± 0.37 years, using the KTK to assess movement capacity, and found that movement capacity and peak maximal oxygen uptake directly influence obesity in young children, and that movement capacity serves as a mediating variable influencing the relationship between moderate- to vigorous-intensity physical activity and the relationship between obesity (Lima et al., 2017). Till Utesch et al. used meta-analysis to synthesize the relationship between movement capacity and physical fitness in people between the ages of 4.5 and 20.4 years, and the results showed that there was a moderate to high positive correlation between movement capacity and physical fitness, which continued to increase with age (Utesch et al., 2019) .Frith and Loprinzi (2019) compared the levels of various indicators of physical fitness and the levels of various items of basic motor skills in young children and found that the higher the level of basic motor skills in young children, the higher the level of musculoskeletal endurance, and that strengthening the level of basic motor skills in young children contributes to the development of physical fitness in childhood and adolescence (Frith & Loprinzi, 2019). . Zhang L et al. (2020) used the motor skill assessment tool of MABC-2 and the test indexes of the National Physical Fitness Measurement Standard Manual (Early Childhood Part) to assess 5-6 year old children, and analyzed that there is a certain connection between the physical fitness of 5-6 year old children and basic motor skills. Tennis ball throw and balance beam walking were positively correlated with fine motor skills of the hands and dynamic and static balance, while standing long jump and two-legged continuous jump were correlated with fine motor skills of the hands (Zhang Liu et al.2020) .

In summary, existing research on physical fitness and health has focused on two main research directions: systematic reviews related to physical fitness and health (including the selection of measurement indicators, test items, and domestic and international development studies) and cross-sectional analyses, and has mostly analyzed the association between exercise interventions and physical fitness and health. Regarding the influence of the developmental level of young children's basic motor skills on physical fitness, the results of the longitudinal studies reflect a certain degree of uncertainty, suggesting that the influence of the level of basic motor skills on physical fitness and health as the level of basic motor skills continues to grow with age is influenced by a combination of other more complex and multifaceted factors. The relationship between young children's basic motor skills and young children's physical fitness levels needs to be further explored. More researchers have confirmed the positive correlation between the two in general, but because of the differences in the indicators used to test the

physical fitness level of young children, the instruments used to measure basic motor skills also vary somewhat from country to country.

3 Methodology

3.1 Teaching experimental method

Based on reviewing a large amount of literature and combining the results of the survey on the physical and mental health of young children in Jiangxi Province, this study determines the physical intelligence curriculum and forms a complete curriculum system including the guiding ideology, curriculum objectives, curriculum content, curriculum organization and curriculum evaluation. Sixty-four children aged 5-6 in the third kindergarten of Shangrao City were selected and divided into the experimental group (32) and the control group (32) by using the method of randomized numerical table, and a 15-week intervention experiment was carried out in September-December 2022. The experimental group was taught the physical education program twice a week for 40 minutes, while the control group was taught the regular kindergarten physical activity program twice a week for 40 minutes. The rest of the kindergarten activity time was the same for both groups, and the children in both groups did not participate in any other physical education programs or training during the experimental period.

3.2 Physical fitness test

The test was conducted according to the physical form and physical fitness contents stipulated in the National Physical Fitness Measurement Standards Handbook (Early Childhood Section). The physical form test is mainly about the height and weight of the children, while the physical fitness test includes 10-m sprinting, tennis ball toss, standing long jump, sitting forward bending, two-legged continuous jumping and walking on the balance beam. The physical fitness tests are conducted by professionally trained staff, thus ensuring uniformity of testing standards and avoiding human error in testing.

3.3 Statistical methods

The data were analyzed using SPSS 25.0, and all parameters conformed to normal distribution and chi-square, and the data were expressed as ($x \pm s$). First, the paired-sample t-test was used to compare whether there was a difference in the test scores before and after the experiment for subjects in the same group; then the independent-sample t-test was used to compare whether there was a difference in the post-test scores between the experimental group and the control group. The test level was $\alpha = 0.05$.

4 Results and Discussion

4.1 Comparison of physical health in the experimental group before and after the intervention

In terms of physical form, based on the natural growth of young children, no comparisons will be made within groups and comparisons will be made between groups. As shown in Table 1, after the experimental intervention, in terms of physical fitness, the boys in the experimental group improved 12.10% in seated forward bending, 8.71% in 10 m running back, 27.61% in tennis ball throwing, and 7.23% in walking on the balance beam. The girls' sitting forward bending performance improved by 13.90%, 10 m running back performance improved by 8.17%, tennis throwing performance improved by 27.54%, and walking on the balance beam

performance improved by 14.76%, and the above differences were statistically significant (P value <0.05). The differences between the boys' and girls' performance in standing long jump and two-legged continuous jump were not statistically significant before and after the intervention (P value > 0.05).

Table 1

Comparison of differences in physical fitness test scores of young children before and after the experiment in the experimental group (N=32)

test index	Sex	Pre-experiment	After the experiment	*T*	*P*
Sitting forward bend	Boy	9.26±4.56	10.38±3.22	-1.258	0.039*
	Girl	10.86±3.92	12.37±3.24	-2.387	0.035*
10m fold and run	Boy	6.89±0.65	6.29±0.45	4.214	0.021*
	Girl	7.59±1.00	6.97±0.83	4.335	0.033*
Standing Long Jump	Boy	107.29±19.50	109.16±18.15	-0.658	0.158
	Girl	89.77±21.85	92.78±18.37	-0.965	0.359
Tennis ball toss	Boy	6.52±1.97	8.32±1.01	-2.336	0.031*
	Girl	4.72±1.41	6.02±1.33	-2.645	0.027*
Continuous jump on both feet	Boy	6.02±1.78	5.82±0.66	0.569	0.276
	Girl	6.10±2.46	5.67±1.34	0.658	0.319
Walking the balance beam	Boy	5.67±2.77	5.25±1.82	0.539	0.037*
	Girl	6.30±1.95	5.37±1.23	0.678	0.022*

4.2 Comparison of physical health in control group before and after intervention

In terms of physical form, based on the natural growth of young children, no comparisons will be made within groups and comparisons will be made between groups. As can be seen from Table 2, after the experimental intervention, in terms of physical fitness, in the control group, the boys' performance in the 10-m run increased by 6.92%, the tennis ball throw increased by 22.17%, and the standing long jump increased by 3.66%, while the girls' performance in the 10-m run increased by 5.10%, the tennis ball throw increased by 16.55%, and the standing long jump increased by 2.42%, and the differences were statistically significant (P value <0.05). The differences between boys and girls before and after the intervention were not statistically significant (P value > 0.05) for sitting forward bending, jumping continuously on both feet and walking on the balance beam.

Table 2

Comparison of differences in physical fitness test scores of young children in the control group before and after the experiment (N=32)

test index	Sex	Pre-experiment	After the experiment	*T*	*P*

Sitting forward bend	Boy	9.55±3.89	9.82±2.45	-0.875	0.529
	Girl	11.46±3.87	11.78±1.22	-0.687	0.676
10m fold and run	Boy	6.94±0.87	6.46±0.33	5.167	0.023*
	Girl	7.25±0.57	6.88±0.93	4.779	0.029*
Standing Long Jump	Boy	106.38±14.03	110.27±17.56	-1.867	0.038*
	Girl	92.31±17.98	94.55±18.24	-1.882	0.019*
Tennis ball toss	Boy	6.09±1.93	7.44±1.34	-1.976	0.038*
	Girl	4.35±0.90	5.07±1.55	-1.783	0.035*
Continuous jump on both feet	Boy	5.83±0.69	5.60±0.71	0.876	0.312
	Girl	5.92±0.82	5.73±0.87	0.775	0.359
Walking the balance beam	Boy	6.10±3.87	5.78±2.35	0.768	0.237
	Girl	5.82±1.06	5.61±1.34	0.573	0.367

4.3 Comparison of physical health of children in the experimental and control groups after the intervention

As known from Tables 3 and 4, after the experimental intervention, there was no statistically significant difference between the heights of male and female students in terms of body morphology (p-value > 0.05 in both cases). In terms of body weight, boys in the experimental group were 3.52% lower than the control group, and girls were 4.67% lower than the control group, and the differences were statistically significant (p-value <0.05). In terms of physical fitness, the boys in the experimental group improved their sitting forward bends by 5.39%, tennis ball throws by 11.83%, two-legged continuous jumps by 3.93%, and walking on the balance beam by 8.65%. The girls' sitting forward bending performance improved by 5.01%, tennis ball throwing performance improved by 18.74%, and balance beam walking performance improved by 4.28%, and the above differences were statistically significant (P value <0.05). The differences between the two groups were not statistically significant (P value > 0.05) in the 10-meter dash, standing long jump, and two-legged continuous jump of the girls.

Table 3

Comparison of differences in physical fitness test scores of young children in the experimental and control groups after the experiment (N=32)

Test index	Sex	Experiment group 2	Control group	*T*	*P*
Height	Boy	116.05±9.27	116.68±5.56	-2.315	0.455
	Girl	114.25±6.11	114.37±6.28	-1.564	0.631
Body weight	Boy	21.91±3.83	22.71±4.28	-0.41	0.047*
	Girl	20.23±3.18	21.22±3.71	-0.52	0.035*
Sitting forward bend	Boy	10.38±3.22	9.82±2.45	2.235	0.026*
	Girl	12.37±3.24	11.78±1.22	1.335	0.041*
10m fold	Boy	6.29±0.45	6.26±0.33	2.331	0.362

and run	Girl	6.97±0.83	6.88±0.93	1.551	0.689
Standing	Boy	109.16±18.15	110.27±17.56	-7.312	0.533
Long Jump	Girl	92.78±18.37	94.55±18.24	-3.215	0.027
Tennis ball	Boy	8.32±1.01	7.44±1.34	1.756	0.035*
toss	Girl	6.02±1.33	5.07±1.55	1.225	0.021*
Continuous	Boy	5.82±0.66	5.60±0.71	0.375	0.036*
jump on	Girl	5.67±1.34	5.73±0.87	-1.532	0.126
both feet					
Walking the	Boy	5.25±1.82	5.78±2.35	-1.279	0.015*
balance	Girl	5.37±1.23	5.61±1.34	-0.564	0.023*
beam					

5 Conclusions and recommendations

The results showed that, in the within-group comparison, in terms of body shape, the height and weight of the children in the experimental group and the control group increased with normal development after the intervention; in terms of physical fitness, the children in the experimental group, both boys and girls, showed a significant improvement in the performance of the five items, namely, 10-m run, standing long jump, sitting forward bending, two-legged consecutive jump, and walking on the balance beam (P-value <0.05), and there was no significant difference in the performance of the tennis ball throwing long distance items of the boys and the girls before and after the experiment. There was no significant difference between before and after the experiment. In the control group, both boys and girls showed significant improvement in the 10-m run, tennis ball toss and standing long jump (P value <0.05), while there was no significant difference between the pre- and post-experimental results of the seated forward bending, two-legged continuous jump and walking on the balance beam for both boys and girls. Liu Y B and Xu J (2019) and Gao W Z and Wang H (2021) found that the use of different forms of targeted physical activity content teaching for children aged 4-6 years was found to improve the physical fitness of young children (Liu Yibing & Xu Jie, 2019; Gao Weizhen & Wang Huan, 2021). Chen T Y et al (2020) implemented a twenty-week play-based physical fitness program for kindergarten children using a game format combined with physical fitness training, and after the experiment, the passing or excellence rates of kindergarten children's one-minute rope skipping, 20-meter fast running, seated forward bending, and basketball dribbling with 10-meter folding around an obstacle course were all improved to some extent (Chen Tuyu et al,2020). Both this study and the above previous studies indicate that appropriate exercise has a positive effect on the physical health of young children, and the experimental group has more indicators with significant differences than the control group intervention.

At the intergroup level, there was no significant difference in height between the experimental group and the control group after the intervention in terms of body shape. In terms of body weight, there was a significant difference between the two groups, which was attributed to the fact that there were more aerobic exercises in the content of the physical intelligence program, which had a better effect on the fat loss of young children; in terms of physical fitness, the experimental group of young children, both boys and girls, had a significant improvement in the scores of the five items, namely, 10-m run, standing long jump, sitting forward bending, two-legged consecutive jumps, and walking on the balance beam (P-value＜0.05), while the

tennis ball throws of the two groups had no significant difference after the experiment. There was no significant difference between the two groups after the item test. Jiang Y H (2015) believes that morning physical fitness, instrumental physical fitness, and game physical fitness have a certain role in promoting the physical fitness of young children, and have good social significance for the overall growth of young children (Jiang Yuhang, 2015) . Pu H L and Yang D (2017) implemented a four-month physical intelligence course for middle school children, with the main features of organizing situational games, multiple basic movement learning, and using one brightly colored equipment for each session. After the experiment, it was found that the positive effects of this program on the balance and coordination qualities of middle class children were more obvious (Pu Hongling & Yang Dan, 2017) . Pei J Y (2019) conducted a three-month physical intelligence program teaching to older children, and after the intervention activities, it was found that there was a significant improvement on the qualities of sensitivity, coordination, flexibility, and balance, but there was little effect on the children's waist and abdominal strength and explosive power (Pei, Jianying, 2019) . Both this study and the previous studies mentioned above indicate that the physical intelligence program has a positive effect on the physical health of young children.

In summary, the training of the physical intelligence program can effectively reduce the body fat rate and improve the physical qualities of upper limb strength, agility, coordination, and balance of 5- to 6-year-old children, and the program has the characteristics of flexible size of the venue and easy to be carried out by teachers, so it is recommended that the physical intelligence program be incorporated into the curriculum of physical activities for 5- to 6-year-old children to promote the development of young children's physical fitness and health in a targeted way. In future studies, we will further improve the promotion of the program on the development of lower limb strength in young children, and further explore the impact of the program on the cognitive ability of young children.

References

Chen, Tu-Yu Chen, Wen-Chao Li, Kang-Yao Wu, Hua-Wen Hsu, Wen-Nan Li, Hui-Yuan Sun, & Lei Shih. (2020). A study on the effects of a game fitness program on the physical fitness of kindergarten children. *Fujian Sports Science and Technology*, 3, 53-56.

España-Romero, V., Artero, E. G., Jimenez-Pavón, D., Cuenca-Garcia, M., Ortega, F. B., Castro-Pinero, J., Sjöstrom, M., Castillo-Garzon, M. J., & Ruiz, J. R. (2010). Assessing health-related fitness tests in the school setting: reliability, feasibility and safety; the ALPHA Study. *Medicine*, 490-497.

Fröbel, F., & Rönsch, G. (1912). *Friedrich Fröbel*.

Frith, E., & Loprinzi, P. D. (2019). Association between motor skills and musculoskeletal physical fitness among preschoolers. *Maternal and Child Health Journal*, 23, 1003-1007.

Gao, Wei-Zhen, & Huan Wang. (2021). Meta-analysis of the effects of physical activity interventions on the physical fitness of 3- to 6-year-old children in China. *Chinese School Health*, 42(9), 1311-1317, 1322.

Guo ZY, Feng ZH, Wang WX, et al. (2021). Prevalence characteristics of overweight and obesity in Chinese schoolchildren and its intervention countermeasures. Chinese School Health, 2021, 42(11) : 1747-1750.

Jiang, Y.. (2015). *Research on the implementation status of garden-based early childhood physical education curriculum* Master, Shenyang Normal University]. CNKI

Lin, Zeyu. (2019). *A study on the current situation of physical intelligence program development in kindergartens in Datong City urban area*, Inner Mongolia Normal University].

Lima, R. A., Pfeiffer, K. A., Bugge, A., Møller, N. C., Andersen, L. B., & Stodden, D. F. (2017). Motor competence and cardiorespiratory fitness have greater influence on body fatness than physical activity across time. *Scandinavian Journal of Medicine & Science in Sports*, 27(12), 1638-1647.

Liu, Yibing, & Xu, Jie. (2019). Evaluation of the effect of exercise intervention on the physical fitness level of 4~6-year-old children in kindergarten - An analysis based on a controlled trial in a kindergarten. *Journal of Nanjing Institute of Physical Education*, 1

Ortega, F. B., Cadenas-Sánchez, C., Sánchez-Delgado, G., Mora-González, J., Martínez-Téllez, B., Artero, E. G., Castro-Pinero, J., Labayen, I.,. Chillón, P., & Löf, M. (2015). Systematic review and proposal of a field-based physical fitness-test battery in preschool children: the PREFIT battery. *Sports Medicine*, 45, 533-555 .

Pu, Hongling, & Yang, Dan. (2017). An experimental study on the effects of "physical intelligence" and "fun track and field" programs on the physical fitness of young children. *Journal of Shenyang Sports Institute*, 36(01), 124-128.

Pei, Jianying. (2019). *Experimental analysis of the effect of physical intelligence class on physical fitness of young children*, Shanxi Normal University]

Qiu, Yaoyu, Guan, Yingrong, and Huang, Qi. (2018). Physical health status of young children aged 3-6 years old in Jiangxi Province. Chinese School Health, 2018, 39(10) : 1525-1527.

Ruiz, J. R., Castro-Piñero, J., España-Romero, V., Artero, E. G., Ortega, F. B., Cuenca, M. M., Jimenez-Pavón, D., Chillón, P., Girela-Rejón, M. J., &amp ; Mora, J. (2011). Field-based fitness assessment in young people: the ALPHA health-related fitness test battery for children and adolescents. *British Journal of Sports Medicine*, 45(6), 518-524.

State General Administration of Sport. (2003). Manual of National Physical Fitness Standard (Early Childhood Section). People's Sports Press.

Utesch, T., Bardid, F., Büsch, D., & Strauss, B. (2019). The relationship between motor competence and physical fitness from early childhood to early adulthood: a meta-analysis. *sports Medicine*, 49, 541-551 .

Vlahov, E., Baghurst, T. M., & Mwavita, M. (2014). Preschool motor development predicting high school health-related physical fitness: a prospective study. *Perceptual and Motor Skills*, 119(1), 279-291.

Wang, Huihong, & Wang, Liu. (2018). Exploring the nature of early childhood education under the concept of "playfulness"-based on the content and characteristics of the development of early childhood physical intelligence program. *Science and Education Guide* (2), 142-143.

Wang, Y., & Li, Zohui. (2017). Research on the teaching mode of physical intelligence program in early childhood institutions. *Contemporary Sports Science and Technology*, 7(7), 53-55.

Wu, X. Y.. (2015). Research on Healthy Fitness Programs in the United States and its Implications. *Journal of Hebei Institute of Physical Education*, 29(5), 80-82.

Yang, Taiji. (2018). On the concept and relationship between physical fitness and health fitness. *Contemporary Sports Science and Technology*, 8(16), 178-179.

Zhang, Liu, Li, Hongjuan, Wang, Huan, Hu, Shuiqing, & Wang, Zhengsong. 2011 A new species of the genus Pterocarpus (Hymenoptera, Staphylinidae) from China. (2020). Associations between basic motor skills and physical fitness in young children. *Chinese School Health*, 41(4), 554-557.

Zhang, L. Bin, & Qiu, L. Qiang. (2019). An experimental study of physical intelligence on the development of physical fitness in 5- to 6-year-old children. *Contemporary Sports Science and Technology*, 9(1), 226-227.