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Research on the Reliability of Children's Physical Fitness Test Results in Family Environment

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Abstract: In order to promote the development of children's physical fitness testing, this paper adopts methods such as literature review, experimentation, and data analysis to analyze the results of physical fitness tests conducted by parents in the home environment on children with the help of the online physical fitness testing system for young children and the results of tests conducted by professionals in the campus environment. The correlation between height and weight, ten-meter back and forth running, sitting and forward bending, standing long jump, double-foot continuous jump, tennis long throw and other items in the family environment was analyzed to determine the reliability of the test results, so as to lay a theoretical foundation for promoting family physical fitness testing .

Keywords: young children; physical fitness test; test-retest reliability; correlation

1. Introduction

1.1. Research Background

As the living standards of Chinese residents continue to improve and their awareness of self-health management continues to increase, more and more people pay attention to their health. A healthy body depends on the development of good exercise habits. With the improvement of people's living standards and the acceleration of the pace of life, the space and time for children to exercise are greatly affected. Today, children's physical fitness is generally valued; however the development of children is not optimistic. The number of children who lack exercise is increasing, and obesity is getting younger and younger. Therefore, people's requirements for physical fitness are no longer limited to being free from disease and pain. People are more eager to have a strong and fit body, especially for the physical condition of the next generation. Children's physical fitness and other courses aimed at children's physical health have appeared, and children's physical condition has been widely valued [1], and the high obesity rate of children has become a worldwide problem [2] .

In recent years, the continuous decline in the physical fitness level of Chinese teenagers has attracted great attention from the whole society, but a problem that has not attracted enough attention is also becoming increasingly prominent, that is, the physical condition of preschool children in China is not optimistic, and the obesity rate, myopia rate and other indicators of disease of young children keep climbing. According to the monitoring data of Hangzhou's national physique released by the Hangzhou Municipal Sports Bureau in 2016, the obesity rate of preschool (4-6 years old) children in the Hangzhou area exceeds 4%, and there are usually two or three "little chubby" in each class. China's promulgation of the "China Children's Development Program (2011-2020) " proposes to improve children's physical fitness and fully implement the national student physical

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health standards [3]. Xin Liu pointed out in "Physical Education for Preschool Children" that children's speed, flexibility, sensitivity and other physical qualities can be achieved through the intervention of various sports [4]. Wenying Huang and Yan Wang pointed out in "Analysis and Research on Children's Basic Movement Ability" that it is necessary to implement planned, purposeful, systematic and scientific training of basic movement skills, and correctly guide the development of children's basic movement ability, so as to achieve physical fitness as the purpose of physical exercise [5].

1.2. Significance

The "Kindergarten Work Regulations" clearly requires: "Kindergartens should establish a health check system for children and children's health cards or files. Physical examinations are performed once a year, height and eyesight are measured every six months, weight is measured once a quarter, and children's physical health and development are regularly monitored, analyzed and evaluated [6] " . However, according to Hejie Zhang's survey of kindergartens in Shanxi and Beijing, only about 21.5% of kindergartens are equipped with full-time physical education teachers [7]. Bi Zhuang's research in Guangdong shows that among kindergarten teachers, teachers who graduated from physical education majors only account for 2% of the total number of teachers [8], the poor teacher conditions make it difficult to monitor children's physique. In addition, Professor Jiping Tang pointed out in the research that 91 % of the parents are very supportive of their children's participation in physical exercise, but only 31.8% of the parents will often communicate with the kindergarten teachers about their children's physical health [9]. Using the family as a unit to test the physical fitness of young children, the parents will feed back the physical status of the children to the kindergarten teachers; thus it will establish a joint force between the family and the school, which will greatly improve the work on the physical fitness of young children. Therefore, this study will be based on the online physical fitness of young children. The management system verifies the reliability of the results of parents' physical fitness tests on children in the family environment, thereby providing a theoretical basis for the linkage between home and school for children's physical fitness.

1.3. Definition of Core Concepts

1.3.1. Family Environment

The family environment mentioned in this article does not only refer to the house where the family lives, but also includes the meaning of home in the humanistic definition: that is, where the family is, the home is there. Therefore, the family environment in this article is a large and broad macro concept. Even if parents use the school venue to test their children, it should be recognized as the family environment.

1.3.2. Children 's Physical Fitness Test

Physique is the quality of the human body, the health status of the human body and the ability to adapt to the outside world. The human body is measured according to the corresponding standard. The physical fitness test for young children in this article refers to the test for young children according to the items and standards stipulated in the "National Physique Measurement Standard Manual (Children's Part)". The parent test part has made some adjustments due to the limitations of venues and equipment.

1.3.3. Online Children's Physique Management System

The online children's physique management system mentioned in this article is a health intervention software developed by a school laboratory to improve children's physique. Parents or kindergarten teachers can download the online children's physique management system on their mobile phones to monitor and give feedback to children in real time. According to the physical condition of the children, scientific physical exercise guidance can also be provided to young children according to the personalized exercise prescription given by the system. The system operation interface is concise and clear, and it is divided into four modules: health test, view report, exercise prescription, and personal information. Users can conduct physical fitness tests on young children according to the guidance of the system, and the results will be displayed intuitively in the form of radar charts in the "View Report". At the same time, the system will give personalized exercise prescriptions according to different physical conditions.

2. Objects and Methods

2.1. Research Object

193 preschool children (5-6 years old) in Xiasha Xuezheng Kindergarten in Hangzhou City, Zhejiang Province, including 100 boys and 90 girls participated in the study. A total of 130 copies of valid data were screened.

2.2. Experiment

The experimental part of this article is to analyze the correlation of two sets of data of the same child, that is, the data of the physical fitness test conducted by the parents in the home environment with the help of the online children's physical fitness management system and the physical fitness test data conducted by professional physical fitness testers in the campus environment (these two experiments will be referred to as "home test" and "campus test" later). According to the clear stipulations in the National Physique Measurement Standard Manual (children's part), a physical fitness test including height, weight, 10- meter turn-and-turn run, standing long jump, tennis long throw, continuous jumping with both feet, sitting and forward bending, and walking on a balance beam has been formulated.

2.2.1 Campus Test

On-campus tests are tested in an on-campus setting by testers. The test items are: 10-meter back and forth running, jumping continuously with both feet, sitting and bending forward, standing long jump, tennis long throw, walking on balance beam and height and weight. The test instruments are: stopwatch, tape measure, tennis ball, balance beam, electronic height and weight scale, sitting and bending tester.

The campus test is chosen to be conducted after the children have finished their nap. The kindergarten teacher wakes up the child from sleep; after that they keep the child lying on his back on the bed without moving. The tester sits next to the child, measures the pulse, and counts it for 15 seconds. The obtained pulse rate is multiplied by 4 to record the data. The unit is times / min. Be as quiet as possible during the process. After the heart rate test is over, the preschool teacher will lead the child to the location of other physical fitness test items. There is no item sequence requirement, and the child can choose the test item by himself. Among them, the two-foot continuous jump and the 10-meter turn-back run were tested twice, and the best result was taken.

2.2.2. Home Environment Test

The parents of the tested children install the online children's physique management system according to the requirements, and conduct tests on the children according to the guidance of the health test section, which is required to be carried out in a home environment. All test tools are prepared by the families themselves, and the results of the physical test results obtained are truthful and filled in the system.

Due to equipment limitations, the balance ability measurement item in the "National Physique Measurement Standard Manual (Children's Part)" - walking on the balance beam was changed to standing on one foot with eyes open, but it was not included in the statistics of this article.

3. Results and Analysis

3.1. Results

3.1.1. Sitting and Forward Bending

Table 1. Sitting and forward bending data

	Campus sitting and forward bending	Sitting forward at home	Sitting and forward bending at home	Score for sitting and forward bending on campus
Sample size N	1 30			
Progressive significance (two-sided)	0.000	0.000	0.000	0.001
Spearman correlation coefficient	0.748 **		0. 671 **	

130 pieces of available data for sitting and forward bending items were obtained. The four items of sitting and forward bending data are all non-normally distributed, so the Spearman coefficient calculation method is used to analyze the data: 0.8-1.0 very strong correlation; 0.6-0.8 strong correlation; 0.4-0.6 moderate correlation; 0.2-0.4 weak correlation; 0.0-0.2 very weak correlation or no correlation. The correlation coefficient of the campus test data with the test value and the home test data is 0.748 , which is a strong correlation; the correlation coefficient between the campus test data with the score value and the home test data is 0.671 , which is a strong correlation, but the correlation is lower than the test value.

3.1.2. Continuous Jump with Both Feet

Table 2. Double-leg continuous jump data

	Campus jumping with both feet	Jumping with both feet at home	Jumping with both feet on campus	Continuous jumping with both feet at home
Sample size N	1 30			
Progressive significance (two-sided)	0.228	0.000	0.000	0.001
Spearman correlation coefficient	0.374 **		0.340 **	

130 pieces of data available for jumping with both feet were obtained. The 3 items of data of continuous hopping with both feet are non-normal distribution, and only 1 item of data is normal distribution, so the Spearman coefficient calculation method is used to analyze the data. The correlation coefficient of the campus test data with the test value and the home test data is 0.374 , which is a weak correlation; the correlation coefficient between the campus test data with the score value and the home test data is 0.340 , which is a weak correlation, but the correlation is lower than the test value.

3.1.3. Standing Long Jump

Table 3. Standing long jump data

	Campus standing long jump	Standing long jump at home	Campus standing long jump points	Home standing long jump
Sample size N	13 0			
Progressive significance (two-sided)	0.649	0.817	0.000	0.002
Pearson correlation coefficient	0.496 **			
Spearman correlation coefficient			0.527 **	

There are 130 available data for standing long jump. The two data items of the standing long jump test value are normally distributed, so the Pearson product difference correlation calculation method is used to analyze the data; the two data items of the standing long jump score value are not normally distributed, so the Spearman coefficient Algorithms is used to analyze the data. The correlation coefficient between the campus test

data of the test value and the home test data is 0.496 , which is a medium degree of correlation; the correlation coefficient of the campus test data with the score value and the home test data is 0.527, which is a medium degree of correlation, but the correlation is higher than the test value.

3.1.4. Tennis Long Throw

Table 4. Tennis long throw data

	Campus tennis throw	Tennis throw at home	Campus tennis throw points	Tennis throw points at home
Sample size N	1 30			
Progressive significance (two-sided)	0.762	0.008	0.000	0.004
Spearman correlation coefficient	0.242 *		0.201 *	

The available data for the tennis long throw event is 130 copies. The three items of tennis throw data are not normally distributed, and only one item of data is normally distributed, so the Spearman coefficient calculation method is used to analyze the data. The correlation coefficient of the campus test data with the test value and the home test data is 0.242, which is a weak correlation; the correlation coefficient between the campus test data with the score value and the home test data is 0.201, which is a weak correlation, but the correlation is lower than the test value.

3.1.5. Ten-meter Switchback Run

Table 5. Ten-meter switchback running data

	Campus 10-meter shuttle run	Home ten-meter switchback run	Points awarded for the 10-meter back and forth run on campus	Points awarded for the 10-meter back and forth running at home
Sample size N	130			
Progressive significance (two-sided)	0.157	0.000	0.000	0.001
Spearman correlation coefficient	0.088		0.017	

130 available data for the ten-meter switchback event were obtained. Three items of data in the ten-meter switchback run were not normally distributed, and only one item was normally distributed. Therefore, the Spearman coefficient calculation method was used to analyze the data. The correlation coefficient between the campus test data of the test value and the home test data is 0.088, which is extremely weak or irrelevant; the correlation coefficient of the campus test data with the score value and the home test data is 0.017, which is extremely weak or irrelevant.

3.1.6. Height and Weight

Table 6. Height Data

	Campus height	Height at home
Sample size N	1 30	1 30
Progressive significance (two-sided)	0.000	0.161
Spearman correlation coefficient	0.937 **	

There are 130 available data for the height item. One of the height data did not conform to the normal distribution, so the Spearman coefficient calculation method was used to analyze the data. The correlation coefficient between the campus test data and the home test data is 0.937 , which is a very strong correlation.

The available data for the weight item is 130 copies. The weight data did not conform to the normal distribution, so the Spearman coefficient calculation method was used to analyze the data. The correlation coefficient between the campus test data and the home test data is 0.842, which is a very strong correlation.

Table 7. Weight data

	Campus weight	Weight at home
Sample size N	1 30	1 30
Progressive significance (two-sided)	0.000	0.075
Spearman correlation coefficient	0.842 **	

3.2. Analysis

3.2.1. Strongly Related Projects

The home test data of height and weight are the two data with the highest reliability, and the correlation between the test values of height is as high as 0.937, which is related to the simple test method of height and weight, the common measurement tools, and the height and weight are objective and real, fluctuating smaller, so the reliability of home test results is extremely high. But it should be recognized that there are still small fluctuations in height and weight over time throughout the day, especially in weight, the fluctuations before and after meals cannot be ignored. Therefore, if testing at home is used, it should be tested within the same specified time period, and the time period after meals should be avoided.

3.2.2. Strongly Related Items

The items with strong correlation are only sitting and forward bending. The correlation of the test data is 0.748 , and the correlation of the assigned data is 0.671. The reliability of the home test is high, but the reliability decreases after the assignment. Therefore, if you need to use the home testing, you still need to optimize the testing process.

The number of people whose test scores at home were better than those at school was 81, accounting for about 61.8% of the total , and most of the test scores improved significantly. During the sitting and forward bending test, the subjects often stretched their arms forward suddenly to obtain better results. During the campus test, the testers will ask the subject to retest as required, but when doing the home test, parents usually relax their requirements and record the results of violation tests, which results in data deviations.

3.2.3. Moderately Relevant Items

The correlation coefficients of the two pairs of standing long jump are all moderately correlated, and the difference is small. The correlation coefficient of the test score is 0.496, and the correlation coefficient of the score score is 0.527. The number of people whose test scores at home were better than those at school was 78 , accounting for about 59.5 % of the total. However, after conversion into points, there were still 51 people whose test scores at home were better than those at school, and 31 people whose test scores at home were better than those at school. Campus test grades, that is, 62.9% of the subjects have deviations in the physical fitness test grades. Even if it is statistically related to a moderate degree, there is a large degree of deviation in practical applications. The reliability of home test scores for the standing long jump project is lower. The equipment requirements for the standing long jump event are low, and the reason for the error may appear in the measurement process or the control of the rules during the test process, such as not prohibiting small jumps or stepping on the line.

3.2.4. Weakly Correlated Items

Home test scores for double-legged hops and long tennis throws were items that were weakly correlated with school test scores.

3.2.4.1. Continuous Hopping with Both Feet

The correlation between jumping with both feet is higher. The Spearman coefficient of the actual data of the home test and the school test is 0.374, and the Spearman coefficient of the grading is 0.34. About 67.2% of the subjects have deviations in the physical fitness test. Jumping with two feet is a project that requires a lot of space and equipment. It reflects the coordination of the human body and the muscle strength of the lower limbs. It is necessary to draw a horizontal line every 0.5 meters on the flat ground, and draw 10 lines in total. Place a soft square bag (10 cm long, 5 cm wide, and 5 cm high) horizontally on the line, and set up a starting line 20 cm away from the first soft square bag. The number of parents who have not uploaded the results of continuous

double-foot jumping of subjects in the online children's physique management system is the largest at 15, far more than other items, and among the uploaded results, the time spent on continuous double-foot jumping at home is the same as that of double-foot continuous jumping on campus. Foot hop timing deviations greater than or equal to 150 % is found in as many as 21 people. The requirements for the size and layout of the double-foot continuous jump event caused about 27.5 % of the parents to give up the test or the data deviated greatly from the normal value.

3.2.4.2. Long Tennis Throw

The correlation coefficient between the test value and the assigned score of tennis throw distance for the home test and school test is only 0.242 and 0.201. There are 68 people whose home test value is better than the school test, and 59 people whose school test value is better than the home test. The reason for the deviation may be "tennis balls". The "National Physique Measurement Standard Manual (Children's Part)" stipulates that tennis balls must be used, but even in Hangzhou, tennis is a niche sport, and there are even fewer families with tennis balls at home. Parents have to choose balls made of other materials for testing, which greatly affects the reliability of the test.

3.2.5. Very Weak or No Correlation

The home test and the school test of the 10-meter shuttle run are the only tests that have a very weak or no correlation. After scoring, only 20 % of the subjects' scores in the home test are the same as those in the school test. As a short-distance running event, the 10-meter shuttle race has a narrow range of points, and the difference between the two levels is only 0.4 seconds. Even in the national track and field competition, the manual timing error of the 100-meter race is also about 0.28 seconds[10]. At home, parents often use the timer in the smart phone APP to time the time. The structure of the smart phone is not suitable for quick response, and its reaction time is longer. It is very likely to cause deviations in the grades assigned.

4. Analysis of Factors Affecting the Reliability of Home Testing

4.1. Influence of Test Time Zone

The diurnal variation of height and weight is significant. The height of the same individual in the morning is significantly greater than the height in the evening[11], and the weight varies with different time, diet, drinking, sweating (including hidden perspiration), excretion, respiration, hormone levels, etc. The real-time "in and out" of each system of the body fluctuates greatly. The influence of the time zone has little influence on the actual test results, and the influence can be eliminated by specifying a fixed time.

4.2. Execution Factors of Test Rules

Each test item has its own specific rules. For example, sitting and forward bending must slowly and steadily push the cursor until it cannot move, and the cursor cannot be pushed forward explosively; when standing long jump, it is not possible to jump small, step on the line or move your hands backward support. When professionals conduct tests on campus, they will test the subjects strictly according to the requirements, and those who violate the rules will be tested again, while in the home environment, parents do not understand the rules, or do not strictly abide by the test rules to save trouble, and thus deviation occurs, which reduces the reliability of the test results. The precautions for the measured items should be prominently reminded on the APP page that guides parents to take the physical fitness test, so as to avoid deviations caused by different rules and scales as much as possible.

4.3. Limiting Factors of Venue and Equipment

Site and equipment constraints have the greatest impact on the reliability of home testing. Jumping with two feet continuously, ten-meter back and forth running, tennis long throw and other events all require a wide field of more than 15 meters, which means that it is necessary to test outdoors and draw the field in advance. Tennis long throw requires not only courts, but also tennis balls. However, as a small sport, tennis is not very popular. If parents are forced to buy tennis balls, it will have a negative impact.

For projects with more restrictions on venues and equipment, it can be optimized, such as changing the long throw of tennis balls to long throws of sandbags; the "balance beam" project that tests balance ability but is not included in the home test due to equipment restrictions can be replaced with an eye-opening single stand on your feet and develop a set of scoring criteria for it.

In the home environment, the mobile APP is often used for timing, the reaction time is long, and the timing accuracy is lacking. In addition, the range of the scoring standard for some events is narrow, and it is difficult to eliminate errors in the home environment. Short distance speed measurement events such as the ten meter return run should be conducted in a speed measurement environment that is as fair as possible.

5. Conclusions and Recommendations

5.1. Conclusion

In conclusion, our study demonstrates that home testing for height and weight is highly reliable and can be performed in a home setting with a prescribed testing time. The home test of sitting and forward bending has high reliability, and it can be tested in a home environment under the premise of emphasizing the test rules. Home tests of double-leg hop and tennis ball throw have some reliability, but need to be optimized for testing in a home setting.

5.2. Recommendations

But our study also has some limitations. In fact, one of them is that the home test of the ten-meter switchback run is not reliable, and it should be tested uniformly by professionals in the school environment. In addition, the current "National Physique Measurement Standard Manual (Children Part)" was promulgated in April 2003. Many items and standards in it are inconsistent with the current situation, and new standards need to be formulated as soon as possible.

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Conflicts of Interest

The author declares no conflict of interest.

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