

Establishing Intra-rater Reliability of Physical Fitness Tests used in Elementary School Children between the Age of 6-14 Years: A Pilot Study

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Abstract: *Introduction:* Physical fitness is a multifaceted ability of an individual to carry out activities efficiently. Childhood and adolescence are crucial periods of life when physical fitness can be built up. Several fitness test batteries that assess different dimensions of fitness have been designed and implemented. Studies have determined the reliability of a variety of fitness measures, albeit in adolescent and young adults. Given that the evaluation of fitness and the assessment of intervention of fitness programs in elementary school children is important, it is imperative that as a first step, we establish intra-rater reliability of the following commonly used tests: curl up test, sit and reach test, hand grip strength test, 4x10 m shuttle run test, and 1600 m run/walk test in Indian children. *Method:* 20 elementary school children, were tested on the fitness measures by trained field workers across three (3) trials on each test. *Results:* Children that participated in the study had a mean age of 11.30 ± 1.455 , a mean height of 141.9 cm, a mean weight of 33.13 kg, and a mean body mass index (BMI) of 16.19 Kg/m². The ICC of curl up, hand grip strength, sit and reach, 4x10 m shuttle run, 1600 m run/ walk test ranged from 0.91 to 0.96. *Conclusion:* The physical fitness measures used in this study had good to excellent intra-rater reliability.

Keywords: Intra -rater reliability, physical fitness tests, elementary school children

1. Introduction

Physical fitness is the ability of the body to carry out every day activities with little fatigue and with enough energy left for emergencies. As per the American Alliance of Health, Physical Education, Recreation & Dance (AAHPERD), a person is physically fit if he is flexible, has good levels of abdominal muscle strength and endurance, has good cardiovascular endurance and his/her body fat percentage falls within a normal range [1]. Fitness is an important during childhood and adolescence as these are crucial developmental periods of life as dramatic physiological and psychological changes take place during these time periods [2], [3]. More importantly, fitness status of a child has important health consequences during adulthood [4]. It is thus, imperative that physical fitness should be built up during these early years, to avoid negative health consequences later in life.

Physiotherapy plays a vital role in improving physical fitness. There are various exercise approaches which can be beneficial for the same. To advice the exercises, Physiotherapists need to evaluate the fitness level of an individual. Thus, physical fitness testing can facilitate awareness of the current health status of an individual. There are several Laboratory and field tests available to measure physical fitness. Laboratory tests such as, measuring maximum oxygen uptake (VO₂ max.) involves specialized equipment, is expensive, necessitates specialized skill, cannot be performed in the field, and is time consuming. On the other hand, field tests are quick, simple,

and do not require costly equipment. There are several physical fitness test batteries that have been designed to assess all components of fitness. Some of the test batteries used in children or adolescents are, the presidential challenge test [5], the national physical fitness programme [6], the ALPHA programme [7], the fitness gram test [8] etc. and most of them consist of five or more individual tests. For an example, the National physical fitness programme is a test battery developed for an Indian population. It consists of 6 components namely cardio respiratory endurance, muscular strength, muscular endurance, flexibility, explosive strength, and body composition (percentage of body fat). Safrit et al (1990) have stated that the sit up test, sit and reach test, one mile run test, body composition analysis by BMI or skin fold measurement are most widely used tests [9]

Current concerns about the health and wellness of our youths has generated widespread interest in fitness measurement. Hence there is a definite need to study current fitness levels of elementary school children. In this study physical fitness status was assessed by a test battery which included the following components of the physical fitness: sit and reach test for flexibility, hand grip measurement for upper limb strength, curl up test for abdominal strength and endurance, 1600 meters run/ walk test for cardiovascular endurance and lastly 4 x10 meters shuttle test for agility testing. As a first step, to establish validity of the tests we evaluated intra-tester reliability of these commonly used fitness tests.

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Purpose of the study: The purpose of this study was to evaluate intra-rater reliability of curl up test, sit and reach test, hand grip strength test, 4x10 meters shuttle run test, 1600 meters run/walk test in Indian elementary school children.

2. Method

Participants: 20 healthy elementary school children, both girls and boys between the ages of 6-14 year who understood simple instructions in Hindi/ English were included in the study. Children with any diagnosed medical conditions like Juvenile Diabetes, Congenital Heart conditions, Respiratory conditions, Neurological, Metabolic disorders etc. and children with physical disability or cognitive problems were excluded.

Test Battery:

Body Mass Index (BMI) measurement: BMI was calculated using the following formula. The subject's weight will be measured by digital weighing scale. Body weight was recorded to the nearest 0.5 Kgs. Height of a subject is measured by stadiometer and recorded in meters. After obtaining weight and height BMI was calculated by the formula: $\text{Weight (in Kg)} / \text{Height}^2 \text{ (in mts)}$

Curl up test: Subject is asked to lie flat on an exercise mat with knees flexed and feet about 12 inches apart from the buttocks. Arms are placed across the chest. The subject is then asked to raise their shoulders and trunk in a curl up motion such that the forearm touches the thigh. Subsequently the shoulders and trunk are lowered until the body rests on the ground. Subjects are instructed to perform a maximum numbers of curl ups in one minute (n).

Sit and reach test: - Subjects are asked to sit in a long sitting position with legs along the side of a wall on which a measuring tape is attached horizontally at the level of the shoulder. The subject is instructed to hold their arms outstretched along the tape. An initial measurement is taken at the level of the finger tips. The subject is asked to reach forward as far as they can reach and a second measurement is taken. The difference between the two measurements is recorded in centimeters (cm).

Hand grip test: - The strength of the dominant hand grip is measured by standard hand held dynamometer. The subject is asked to sit holding the dynamometer with the arm held to the side, elbow flexed to 90 degrees, forearm in mid-prone position and wrist in held in neutral position. Subject is asked to grip the handgrip of the dynamometer as hard as possible and then release it. Grip strength is measured in kilograms (Kg).

1600 meter run/walk test: - At first 1600m is marked in an open space. Subjects are then asked to run or walk the marked distance as fast as possible, while they are timed using a stop watch. The time taken by subjects is recorded in minutes (min) and seconds (s).

4x 10 meters shuttle run test: - Two lines are marked on non-slippery floor 10 meters apart.

Subjects are asked to run between the two marks as fast as possible and complete four (4) laps, while they are timed using a stop watch. The time required to complete the test is measured in seconds up to one decimal point.

3. Procedure

After receiving written permission from school authorities, parental consent and student assent was obtained. The following physical fitness tests were carried out in a random order: Curl ups, hand grip strength, sit and reach test, 4x10 m shuttle run test, 1600 m run/ walk test. The BMI of each child was calculated from the height and weight data. Ten (10) field workers were trained by principal investigator as to how to carry out the tests and were made to practice until proficient. Five (5) work stations were created in the school premises and were manned by the trained field workers. Children who volunteered to participate in the study received standardized instructions and a comprehensive demonstration of the test to be performed. Three readings were recorded and analyzed for each test with adequate rest periods between each trial. The data was compiled in Microsoft excel and analyzed for Intra-rater Correlation coefficients (ICC) using SPSS version 16.

4. Results

Demographics:

20 elementary school children including 11 Girls and 9 boys were assessed for the Physical fitness tests. As seen in table 1 the mean age of the children who participated in the study was 11.30 ± 1.45 , their mean height was 141.9 ± 10.36 cm, mean weight was 33.13 ± 9.03 kg and mean BMI of 16.19 ± 2.97 Kg/m². The height and weight data from this study was well within normative values [10] of children in the age group 8-14 years ranges (weight = 16.7 to 78.3 kg and height = 112.6 to 175.4 cm).

Table 1: Descriptive Statistics of Age, Height, Weight and BMI (N=20)

	Mean	SD	Age Range	Normal Values (IAP) ¹⁰
Age	11.30	1.455	8 -14	
Weight (kg)	33.13	9.03	19.3 - 54.6	16.7 - 78.3
Height (cm)	141.92	10.36	121 - 156.5	112.6 - 175.4
BMI (kg/m ²)	16.19	2.97	12.5 - 16.2	12.3 - 25.9

Reliability:

Intra-rater reliability of the Physical fitness tests was evaluated using the Intra-class Correlation Coefficient (ICC) and the following results were found: the ICC for hand grip strength = 0.958, 4x10 meters shuttle run test = 0.947, ICC for 1600 meters run/walk = 0.919, sit and reach test = 0.964, and curl up test = 0.827. Please refer to table 2 for confidence intervals of the ICC values.

Table 2: Intra class Correlation Coefficient for Physical fitness test

Test	Mean	ICC	95% Confidence interval	
			Lower bound	Upper bound
Hand Grip Strength	14.20	0.958	0.912	0.982
4x10 m shuttle run test	13.70	0.947	0.881	0.978
1600 m run/walk test	12.52	0.919	0.771	0.970
Sit and reach test	11.62	0.964	0.922	0.985
Curl up test	15.72	0.827	0.620	0.927

5. Discussion

In this reliability study of commonly used physical fitness tests twenty (20) elementary school children between the age group of 6-14 years participated. There were eleven (11) girls and nine (9) boys with the mean age of 11.30 ± 1.455 . Additionally, the height of children in our sample ranged between 121- 156.5 cm and their weight ranged between 19-55 kg. Furthermore, the mean BMI of children in our sample was 16.19 ± 2.97 Kg/ m². The demographics of the sample in this study fallswell within the normal range of the Indian population as per the Indian association of Pediatrics growth chart [10].

This study is one of its kind that measures intra-rater reliability of the five (5) common physical fitness tests used to measure various dimensions of fitness in Indian elementary school children. The curl up test and hand grip strength is used to measure strength of abdominal muscles and upper limb muscles respectively. The sit and reach test is done for assessment of flexibility. Cardiorespiratory fitness is measured by 1600 m run/ walk test while agility is assessed using the 4x10 m shuttle run test.

A fundamental requirement of the validity of a test, which is repeatedly used to evaluate interventions and assess the fitness of children is intra-rater reliability or the consistency of measurements over repeated trials. In this study, we found Intra-class correlation coefficient (ICC) of curl up, hand grip strength, sit and reach, 4x10 m shuttle run, 1600 m run/ walk test ranges from 0.91 to 0.96. This suggests high intra-rater reliability of these tests. Similar results have been reported by Peolsson et al 2001, Anderson et al 1997, Castro-Piñero 2009 [11], [12], [13]. Thus, curl up, hand grip strength, sit and reach, 4x10 m shuttle run and 1600 m run/ walk test can be used reliably in the assessment of Indian elementary school children in a school setting conducted by trained field workers. This in turn will be beneficial to physiotherapist to assess the physical fitness of larger population of elementary school children using these field tests.

Small sample size is the main limitation of this study. Further recommendation, can be evaluation of the current status of physical fitness of elementary school children.

6. Conclusion

All the Physical fitness tests had high intra-rater reliability when Indian elementary school children between the age 6-14 years were tested over several trials. Hence, these tests can be reliably used to test fitness in schools and for evaluating pre-post interventional studies and cross sectional studies with the help of field workers.

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