RELATIONSHIP OF UPPER AND LOWER BODY MUSCULAR STRENGTH WITH CARDIO-RESPIRATORY ENDURANCE AMONG SCHOOL GOING CHILDREN

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Abstract

The aim of this study was to explore the relationship between upper and lower body muscular strength as well as cardio-respiratory endurance among school going children 11 to 15 years of age. A sample of 1750 boys was drawn from the targeted population. Children were tested on handgrip (HG) to measure the strength of upper body muscles, on Standing Broad Jump (SBJ) to measure the strength of lower body muscles, used Beep Test (BT) for cardio-respiratory endurance and height and weight to determine Body Mass Index (BMI). Multiple regression analysis depicted association of lower body muscular strength (SBJ) with upper body muscular strength (HG) and cardio-respiratory endurance (BT) (R^2= 0.011 and 0.10 respectively). The analysis reflected the significant relationship, though weak, between lower body strength (SBJ) and upper body strength (HG) and cardiorespiratory endurance (BT). Hence lower body muscular strength can be considered useful indicator for muscular strength and cardio-respiratory endurance among school going children.

Key Words: Upper and lower body muscular strength, children, cardio-respiratory endurance, physical fitness.

Introduction

Adoption of active life style by the people is now a dream of every nation. Surveys have confirmed the overall climate of sedentary society in which sport is more of a passively consumed mass entertainment rather than an actual activity practiced as an integral part of people's life style (Sekot, 2017). Studies lend support to the views of health related

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benefits of physical fitness for both youth and adults. Physical fitness enables individuals to perform daily tasks with bearable fatigue and still having enough energy to carry out other tasks. Issues like cardiovascular diseases, metabolic, diabetes, obesity, mental health and musculoskeletal abnormalities among children and people at large are emerging as serious problems that increasing reliance on the physical activities and food transformation (Ruiz et al., 2009). Now cognitive development has also been associated with physical fitness. It is thought that combining physical activity with sensory enrichment has even stronger and far reaching effects on the brain (Hockelmann & Gujjar, 2017). Evidence has also demonstrated the importance of physical activity as an effective strategy to reduce the risk and relapse of breast cancer (Ortegaa, 2017). The health related components of fitness are also critical to performance in different sports. These multiple factors have drawn attention of governments, national and international agencies world over for launching programs and strategies to develop knowledge, discourse and skills among children that they need to be physically active, fit and healthy throughout their life. Hence schools have become center of interest to develop awareness about the importance of physical fitness among youth and adults. Consequently health related fitness testing of children has gained momentum. The situation in Pakistan is not different. Sedentary lifestyle among children is considered as the major cause of ill health and diseases during later stages of life.

Body composition refers to body mass and percentage of body fat, flexibility refers to the range of motion in joints. Cardio-vascular endurance is defined as the ability of the blood vessels, heart and lungs to take in, transport and utilize oxygen. Muscular strength and endurance refers to exertion of maximum force by muscles.

Musculoskeletal fitness is multidimensional construct comprising muscle strength, endurance and power for performance. Muscle strength is considered an ability to produce measurable force during a single maximal voluntary contraction (movement). Muscle endurance is described as ability of muscle(s) to perform repeated contractions for an extended period of time whereas muscle power is a physiological construct reflecting the rate at which work is performed (force x distance) (Knuttgen & Kraemer, 1987 Kell, Bell, & Quinney, 2001).

There are many test batteries in use which test different dimensions of

physical fitness. However every test provides information of specific nature of fitness of a part of the body only. Question arises can we use results of one test as index of different parameters? Only a few studies like Milliken, Faigenbaum, Loud & Westcott (2008) have been carried out in this direction for identifying the association of upper and lower body muscle strength. The present study not only attempt to affirm the relationship but extend further to elucidate the relationship between muscular fitness and cardio-respiratory endurance.
Castro-Pinero et al., (2010) conducted a study to examine relationship among different measures of upper and lower body muscular strength on Caucasian children aged 6-17 and found that standing long jump (SLJ) was strongly associated with lower body muscular strength tests (SLJ, vertical jump, squat jump and counter movement jump) and with upper body muscular strength tests (throw basketball, push-ups and isometric exercises) except handgrip. Furthermore they had graded SLJ or SBJ test as a general index of muscular fitness in youth.

Handgrip strength and knee extensor and flexor muscle strengths are useful indices of upper and lower extremity muscle strength, respectively. These upper and lower extremity muscle strength values may be useful target goals for improvement of exercise capacity, risk management, and activities of daily living in male HF (heart failure) patients (Izawa et al., 2012).

Castro-Pinero, et al. (2010) was of the opinion that association between upper and lower body muscular strength in youth is contradictory and suggested requirement of further investigations.

Objectives of the Study
Followings were the major objectives of the study:

1. To analyze the association between upper and lower body muscular strength in school going children.
2. To investigate the relationship between upper and lower body muscular strength and body composition outcomes among children.
3. To assess whether the standing broad jump be a predictor of upper and lower body muscular strength.

Nature of Research

The study was descriptive, quantitative and cross-sectional in nature. Evaluation of physical fitness components was carried out in secondary schools of eight districts of KPK province of Pakistan. Selection of schools was non-random.

Subjects

The target population was 11 to 15 years old school going children in KP province of Pakistan. This cohort is specific to secondary level schools having grades 6 to 10 as official age for grade 6 is 11 years. Hence a total of 1750 subjects from public sector secondary schools were drawn as sample for the study. From a school 125 students were participated in the study by drawing 25 students from each grade.

Procedure

Laboratory-based tests are though very accurate but require purpose built laboratory, costly equipment, qualified technical staff and access of specific group only. On the other hand, field-based tests do have reported validity and are low cost as they do not need expensive equipment. It can easily be administered and can cover vast area. Hence field based tests were the obvious choice.

A workshop for physical education personnel was arranged before initiating field testing so as to familiarize all with the tests and to standardize the evaluation procedure. Beside lecture and discussion sessions practical demonstration was the essential part of the workshop.

Data Collection

During first phase anthropometric measurements were registered- age of subjects from school record, body weight measured in school uniform and height was calculated from naked feet to vertex point of head. During second phase subjects underwent different fitness tests. A total of 1750 children were assessed. Due to hot weather a few reports of participant's faintness were received. Some of the participants did complaint about pain or had any type of injury during study. However ever there was nothing serious.

Statistical Analysis

The data analysis was carried out by SPSS using both descriptive and inferential statistics. Characteristics of subjects were expressed as average value (means) and standard deviation (SD) unless otherwise indicated. Correlation analysis was performed to examine the association between strength of upper and lower muscles as well as muscle strength and cardio-respiratory endurance tests. The accepted level of significant was set at $p < 0.05$.

Results

Table 1: Description of characteristics of sample (n=1750)

Parameters & Tests	**Mean**	**SD**
Age (Years)	13	01.41
Weight (Kg)	45.40	10.77
Body Mass Index (BMI)	17.43	03.26
Standing Broad Jump (Ft)	05.62	01.84
Handgrip (Kg)	31.19	15.63
Beep Test (Levels)	05.15	00.89

Table 2: Age-wise distribution of upper and lower muscular strength and cardio-respiratory fitness parameters

Parameter		**11**	**12**	**13**	**14**	**15**
BMI	Mean	16.76	16.70	17.61	17.63	18.43
	SD	3.17	3.19	3.50	2.93	3.18
Standing Broad Jump (SBJ) (Ft)	Mean	5.45	5.48	5.62	5.82	5.73
	SD	1.07	1.07	1.23	3.43	1.25
Handgrip (HG) (Kg)	Mean	25.98	26.13	32.30	33.27	38.27
	SD	13.43	13.02	13.02	15.16	16.62
Beep Test (BT) (Levels)	Mean	4.97	5.06	5.23	5.32	5.20
	SD	0.91	0.89	0.88	0.85	0.85

TABLE 3: SPEARMAN CORRELATION COEFFICIENT BETWEEN ANTHROPOMETRIC PARAMETERS, BMI, UPPER AND LOWER BODY MUSCLE STRENGTH AND CARDIO-RESPIRATORY ENDURANCE

	Age	**Weight**	**BMI**	**SBJ**	**Handgrip**

Weight	.411**	1			
BMI	.185**	.613**	1		
SBJ	.069**	.091**	.039	1	
Handgrip	.287**	.505**	.219**	.199**	1
Beep Test	.114**	-.033	-.010	.044	-.002

**Correlation is significant at 0.01 level (2-tailed)

Table 4: ANOVA[a,b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	337.718	3	112.573	13.87	.000[c]
	Residual	14163.305	1746	8.1		
	Total	14501.024	1749			

a. Dependent Variable: SBJ
b. Weighted Least Squares Regression - Weighted by Age
c. Predictors: (Constant), BT, HG, BMI

Table 5: Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.752	.156		30.508	.000
	BMI	.006	.006	.023	.936	.349
	HG	.006	.001	.107	4.404	.000
	BT	.096	.022	.103	4.374	.000

a. Dependent Variable: SBJ
b. Weighted Least Squares Regression - Weighted by Age

Table 6: Paired Sample Correlation

	N	Correlation	Sig.

Pair 1	HG & SBJ	1750	.106	.000
Pair 2	BMI & SBJ	1750	.045	.060
Pair 3	BMI & HG	1750	.211	.000
Pair 4	HG & BT	1750	.002	.920
Pair 5	SBJ & BT	1750	.102	.000

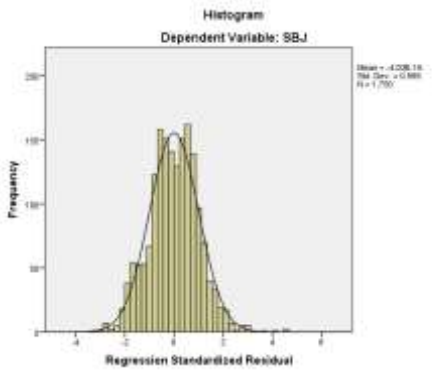
Correlation is significant at 0.01 level

Paired sample correlation analysis reflects association between lower and upper body muscle strength and cardiovascular endurance.

Table 7: Correlation coefficient (*r*) , unstandardized multiple regression coefficient (β), standard error (SE), and coefficient of determination (R^2) examining the association of lower body muscle strength -standing broad jump (SBJ) with upper body muscular strength & cardio-respiratory endurance in school going children aged 11-15 years (n=1750)

Dependent Variable	**Independent Variable**	***r***	**β**	**SE**	***p***	**R^2**
SBJ	**BMI**	.045	.011	.006	.060	.002
	HG	.106	.006	.001	.000	.011
	BT	.102	.095	.022	.000	.010
HG	**BMI**	.211	.988	.110	.000	.044
	SBJ	.106	2.012	.451	.000	.011
	BT	.002	.042	.422	.920	.000
BT	**BMI**	-.016	-.004	.006	.495	.000
	SBJ	.102	.110	.026	.000	.010
	HG	.002	.000	.001	.920	.000

Correlation is significant at 0.01 level



Regression analysis indicates that Lower body muscle strength has weak correlation with upper body muscle strength and even cardiovascular endurance (Table 7). However, upper body muscle strength show no correlation with body mass index (BMI).

Discussion

Another indication of good muscle tone and strength is the attainment of age-appropriate motor development. Izawa et al., (2012) has concluded from their study that these upper and lower body muscle strength could be useful target for improvement of exercise capacity, risk management and activities of daily life.

The age associated gain or loss in muscle strength is usually attributed to increase or decrease in number and size of muscle fibers. Power gain or loss mainly depends on physical function of muscles. There is a possibility that physical activity may increase the time and speed of response from childhood to adulthood where as these changes are opposite in aging situation (Metter, Conwit, Tobin & Fozard., 1997).

Previous research on institutionalized elderly has established a relationship between physical activity and muscle strength and concluded that there was an association between increased muscle strength (knee extensor muscles) and respiratory muscle strength (as measured using maximal respiratory pressure) as well as between walking capacity. (Simões, Castello, Auad, Dionisio, & Mazzonetto, 2009).

Conclusion

The data reflects positive correlation but weak. Hence it does not seem appropriate to declare lower body strength to be indicator of upper body strength as well as cardio-respiratory endurance.

The study supported that no single measure adequately sum up overall level of body's muscular strength. All dimensions need to be assessed individually and then interpreted in an integrated and unified assessment of overall fitness (Castro-Pinero et al., 2010)

On the bases of the study it is purposed that a larger group may be involved in cross sectional study to identify lower body strength as indicator of upper body strength and cardio-vascular endurance.

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