PHYSICAL FITNESS PARAMETERS OF SCHOOL GOING CHILDREN OF KHYBER PUKHTUNKHWA-PAKISTAN

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Abstract

The aim of the study was to measure and evaluate the physical fitness of school going children aged 11 to 15 years through cross-sectional survey in Khyber Pukhtukhwa. Seven universally accepted field-based tests having known reliability were used to assessthe anthropometric status, balance, body muscle strength, flexibility, speed and agility, cardiovascular endurance and muscular endurance. Boys showed gradual increase in their performance from 11 to 14 years while it tends to decrease at the age of 15 years. The correlation coefficient among tests is significant however relationship is weak reflecting fitness as multidimensional concept.Multiple Regression analysis predicts that all tests are independently related to the performance. The analysis reveals that about 40% of school going children falls in the categories of "Very Poor" and "Poor" level of abilities. The evaluated physical fitness parameters of children if used as bench marks instead of compulsive division into norms would be more reliable developmental characteristics for comparison with their counterparts elsewhere and determining national norms and policies related to youth as way forward.

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Introduction

There is paradigm shift regarding the perception of physical activities from competing and winning medals to health-related fitness of the public at large. The reduction of students' vulnerability is associated with not only better economic prosperity but also with better physical and mental health outcomes and less dependence on social welfare (Levin, 2009). Moreover learning among children is effective rather increases if cognitive activities are carried out along with physical activities (Hokalmann, 2016). Widely recognized perception of physical fitness however is the ability to perform daily tasks with greater efficiency without undue fatigue and with ample reserve energy to enjoy leisure time activities and to meet the other emergencies (Pate, 1988). Physical fitness is a multidimensional concept that evolves with age and involves muscles, skeleton, heart and mind related activities that enhance physical, intellectual, psychological, emotional and social development (Haga, 2008; Howley& Franks, 2003, Cauderay, Narring&Michaup, 2000). However, now a day's increasing dependence on mechanical devices in daily life and reduction in work-related and leisure-time physical activities is rendering life style of both males and females sedentary.

Exercise scientists divide physical fitness into two categories- health related fitness and motor skillsor performance related fitness and has defined its nine components- Balance, Strength, Power, Speed, Agility, Flexibility, Coordination, Muscular endurance and cardiovascular endurance (Pal &Ghosh, 2015) . In order to assess these fitness one cannot rely on single test for assessment of fitness; hence multiple tests become mandatory to be employed to measure various physical fitness aspects of the individual.

There are about 10 million children both male and female, aged 11 to 15 years studying in 80000 middle and high schoolsof Pakistan, of which 1.5 million students are enrolled in Khyber Pukhtunkhwa (KP) province (Pakistan Education Statistics 2015-16, 2017). National Education Policy 2009 of Pakistan emphasizes academic achievements as well as physical development of children during schooling. Hence all schools are under obligation to offer physical

training programs to all children. Question remains do we have healthy youth meeting the required physical fitness? National data on children's physical fitness for determining the national norms is not available and consequently informed decision-making for the formulation of education and youth policies and plans is lacking.

This study aims at to measure and evaluate the physical fitness parameters to determine the health and developmental trends among school going children. The results of this study wouldreveal physical structural and functional characteristics of the children. Sarhad University of Information Technology (SUIT) being alive to such crucial needs of national importance has launched country wide program to evaluate the physical fitness of school going children allover Pakistan. Major objectives of the study were as under:

1. To assess the physical fitness of the school going children and adolescents for determining their health status and growth pattern.
2. To define accurate and field-based battery of physical fitness tests to monitor health and sport related fitness of children and adolescents.
3. To find out the relationship between different tests of the devised battery.
4. To assess the relationship between age and performance level of children.
5. To compares the physical fitness of Pakistani children with their counterparts in other countries.

Methodology
This cross sectional study aimed at anthropometric measurements and physical fitness tests of school going children and adolescents aged 11 to 15 years. The research design based on inductive, evaluative, quantitative, one shot and contrived study was followed.

Population and Sample
Khyber Pukhtunkhawa is a northern province of Pakistan located at the base of world renowned mountain ranges- Himalayas, Hindu

Kush and Karakorum. It has 25 administrative districts. The 1.5 million school going children of KP aged 11 to 15 years were the target population of the survey. The specified cohort of children generally studies in grades 6th to 10[th]hence the selection of secondary schools were the obvious choice. A sample of 1750 children was drawn through stratified non-random convenient sampling from both rural and urban boyssecondary schools of 8 districts of KP province.

Physical fitness test battery- a survey tool
Progress in sport sciences has led to the development of variety of tests and different batteries have been designed to measure the physical fitness and sports performances of athletes and children. The tests for assessing the physical fitness abilities of children involve both laboratory and field environment. The laboratory procedures require well equipped laboratory, expensive equipment, and transportation of children if parents and schools allow as well as technically trained operators. So these laboratory based tests were not considered ideal for the focused situation and hence field-based tests were opted as convenient measures in school settings.

Table 1: Tests and elements tested

No.	Tests	Elements Tested
1	Flamingo Balance Test (FL T)	Balance (Coordination of total body equilibrium)
2	Sit- and- Reach (S & R)	Flexibility (Range of muscular movement)
3	Standing Broad Jump(SBJ)	Explosive power of leg muscles
4	Hand Grip Test (HG)	Static arm strength
5	Sit-up Test (SU)	Abdominal muscular endurance (Dynamic trunk Strength)
6	10 x 5 m Shuttle Run (SHR)	Speed and Agility
7	20 m Beep Test (BT) (Progressive Shuttle	Cardio vascular endurance

run)	

There are different test batteries comprising varying number of tests are in vogue to measure the physical fitness abilities of athletes, children and adolescents such as American AAHER, Indian, Srilankan, EUROFIT, etc. However EUROFIT test battery enjoys more recognition as its tests have shown adequate and consistent validity and reliability. After due analysis of different tests of various batteries (Bianco, et al., 2015) and discussion with the focus group a SUIT Physical Fitness Test Battery was devised and pilot tested keeping in view its cost, adaptability in field tests having required validity and reliability to match the local school environment as well as compatibility with international practices and standards. The protocol was reviewed by the focus group of the SUIT. The SUIT Physical Test Battery is comprised of a set of seven physical fitness tests as indicated in Table 1.

This Battery, in addition to obtaining anthropometric information of children can also be effectively used to measure their BMI, upper and lower body muscular strength, speed, leg power, flexibility, cardio-vascular and muscular endurance, agility and balance abilities as indicators of physical fitness standards and growth pattern of the youth in Pakistan.

Data Recording
The survey was planned to determine the physical fitness of school going boys of Khyber Pukhtunkhawa aged 11 to 15 years. Prior to the execution of tests in schools a one-day workshop on capacity building was arranged for 30 master trainers (mostly physical education teachers)drawn from different institutions and districts of the Province. During the orientation workshop the master trainers were explained the protocol of each test included in the test battery along with the salient features of the planned project. In the program beside theoretical lectures, practical demonstrations were the essential part of the orientation. Furthermore a CD was prepared to clarify the protocol of these tests to maximize the uniformity. Each master trainer in turn associated 5-10 volunteers to conduct the tests in schools and collection of data.

All the master trainers carried out field tests after explanation of tests, demonstration and necessary warm up exercises. Field work was monitored by well experienced and trained professionals of physical education serving under District, Provincial and Federal sport management.

Anthropometric Measurements
The age of the subjects (date of data recording minus date of birth) was calculated from official record of the schools. Body weight of subjects was measured by a sensitive weighing device. The height of the children was measured with Stadiometer from naked feet to vertex point of head.

Statistical Analysis
The data obtained from the schools through the physical fitness tests were analyzed through SPSS 20. Simple descriptive statistic (Mean and Standard deviation) was used to determine central tendency. One way analysis of variance (ANOVA) was used to determine if there were significant differences in performance and status of tests in the battery. Pearson product moment correlation coefficient was used to find out the relationship in the performance of children in tests of the battery. The percentile statistics assisted to establish norms by tests. The level of significance was used as 0.05.

Results and Discussion
i.   Analysis of Anthropometric Characteristics
Body mass index (BMI) is a surrogate measure of body fatness because it is a measure of excess weight rather than excess body fat. Overweight children tend to have higher BMI due to increased level of fat or fat free mass whereas among relatively thin children low BMI refers to fat free mass.
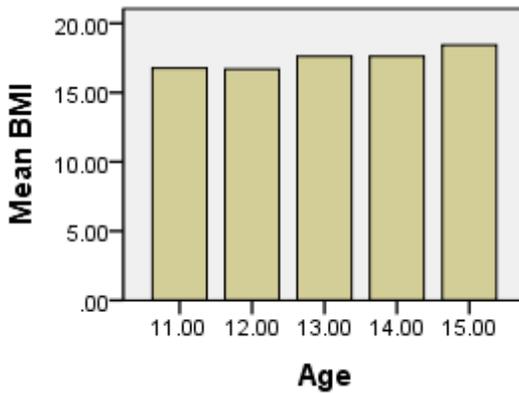
Table 2:Anthropometric Parameters of Physical Fitness Survey of School going Children

S. No.	Parameter	Mean	SD	Minimum	Maximum
1	Age	13.00	01.41	11.00	15.00
2	Weight (Kg)	45.40	10.77	21.00	96.00

| 3 | Body Mass | 17.43 | 03.26 | 10.30 | 33.70 |

Table 3: Age-wise distribution of BMI of school going children

Age	11	12	13	14	15
Mean	16.76	16.70	17.61	17.63	18.43
SD	3.17	3.19	3.50	2.93	3.18

Graph 1: Distribution of BMI by Age

Table 4: Comparison of age-wise BMI Norms-India, WHO and Pakistan

Boys	11 years	12 years	13 years	14 years	15 years
India	14.5-18.5	15-19	15.5-21	16-21.5	16.5-21.5
WHO	14.5-23.2	15-24.2	15.4-25.2	16-26	16.6-26.8
Pakistan	13.6-20.0	13.5-19.9	14.1-21.1	14.7-20.5	15.2-21.6

Table 5: Correlation between Age, Weight and Body Mass Index (BMI)

	Age	Weight	BMI
Age	1		
Weight	0.411*	1	

| BMI | 0.185* | 0.613* | 1 |

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

The results of the survey shows (Table 2) that the average value of body mass index (BMI) for 11 to 15 years old boys is 17.43 ± 3.26 (Mean & SD). The anthropometric values regarding height and weight show gradual increase among school going children with age. The body mass index (BMI) value for 11 years old boys was found as 16.76 ± 3.17, for 13 years old as 17.63 ± 2.93 and for 15 years old as 18.43 ± 3.18 (Table 3). In a similar survey the anthropometric characteristics of 13-15 years old Turkish boys whether actively play sport or not remain almost similar and show no significant difference (Erikoglu, et al., 2015).

While comparing the age-wise BMI norms of India, WHO and Pakistan (Table 4) it appears that upper limits of BMI ranges in all age groups of India and Pakistan are similar however lower ranges are bit different. Upper limits of WHO for BMI ranges is much higher for each group than India and Pakistan whereas lower limits of Pakistani children are lowest than India and WHO.

The correlation analysis between age, weight and BMI reflects (Table 5) higher correlation between weight and BMI.

ii. Analysis of Neuromuscular capacities

Table 6: Mean, Standard Deviation and Range of Physical Fitness Parameters (n=1750)

S. No.	Test	Mean	SD	Range
1	Flamingo Test (Falls/min)	08.91	4.79	0.00- 30.00
2	Sit & Reach (inch)	09.80	2.35	1.00- 19.00
3	Standing Broad Jump (ft)	05.62	1.84	3.00- 6.80
4	Hand Grip Test (Kg)	31.19	15.63	4.90-105.00
5	Sit-up (pieces/30 sec)	16.67	3.34	9.00- 47.00
6	Shuttle Run Test (sec)	13.51	1.22	1.40- 22.12
7	Beep Test (Levels)	05.15	0.89	1.70- 08.20

The mean value of fitness parameters of school going children in KP, Pakistan i.e. body balance, flexibility, explosive power of legs,

arm strength, abdominal muscular endurance (dynamic trunk strength), speed & agility and cardiovascular endurance have been analyzed as 8.91, 9.80, 5.62, 31.19, 16.67, 13.51, 5.15 and S.D. as 4.79, 2.35, 1.84, 15.63, 3.34, 1.22 and 0.89 respectively (Table 6). Furthermore the range of fitness parameter appeared as (0-30), (1-19), (3-6.8), (4.9-105), (9-47), (1.4-22.12) and (1.7-8.2) respectively.

Table 7: Age-wise distribution of Mean and Standard Deviation of Tests (n=1750)

Age	Mean & SD	FL T	S & R	SBJ	HG	SU	SHR	BT
11	Mean	8.13	9.28	5.45	25.98	15.98	13.55	4.97
	SD	3.87	2.36	1.07	13.43	3.22	0.95	0.91
12	Mean	8.86	9.69	5.48	26.13	16.42	13.58	5.06
	SD	4.89	2.41	0.88	13.02	3.29	0.90	0.89
13	Mean	8.97	9.88	5.62	32.30	16.79	13.45	5.23
	SD	4.75	2.41	1.23	16.02	3.55	1.08	0.88
14	Mean	9.93	10.18	5.82	33.27	17.37	13.65	5.32
	SD	6.04	2.22	3.45	15.16	3.10	1.31	0.85
15	Mean	8.63	9.95	5.73	38.27	16.76	13.32	5.20
	SD	3.90	2.26	1.25	16.62	3.36	1.66	0.85

Flamingo Test measures the capacity of standing and balance of an individual. It involves power of leg, pelvic and trunk muscles that also play role in balance. Most of the studies have reported flamingo test results in seconds by deducing fall interval. The data of this study reveals the mean value of the flamingo balance test for 11-15 years old school going boys as 8.91±4.79 falls per minute (Table 6). The study reflects that balancing values for 11 years old boys is found as 8.13±3.87 falls per minute, for 13 years old as 8.97±4.75 falls per minute and for 15 years old as 8.63±3.90 falls per minute (Table7).

Studies are evident that balancing abilities increase with growth of children (McArdle, 1986).Sport produce positive effect on balance

ability and the development of the related muscles where as balancing ability among sedentary children remain similar (Erikoglu, et al., 2015).
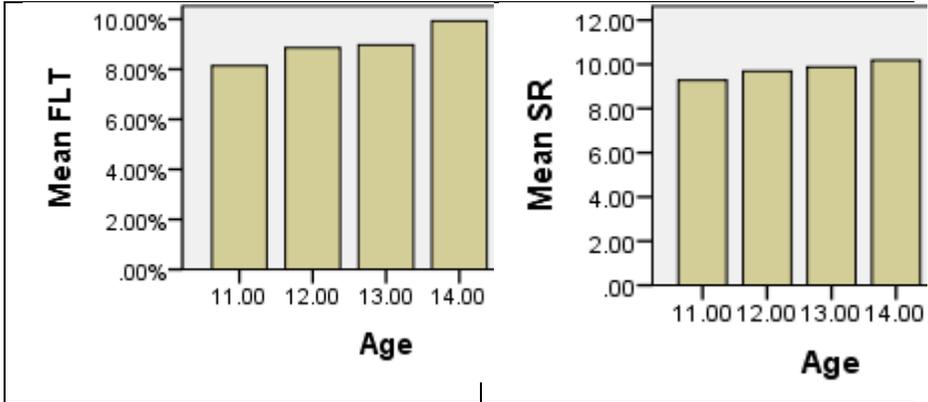

Graph 2: Balance and Flexibility by Age

The Sit and Reach Test (S & R) has been used to determine the flexibility of lower back and hamstring muscles and structure of joints by measuring accessibility points on a scale. It is usually said that greater the number of inches/centimeters, greater the flexibility of trunk. In this survey the mean value of flexibility performance of 11-15 years old boys is found as 9.80±2.35 inches (24.0cm) (Table 6). The data show mean value regarding flexibility for 11 years old boys as 9.28±2.36 inches (23.2cm), for 13 years old as 9.88±2.41 inches (24.7cm) and for 15 years old boys as 9.95±2.26 inches (24.9cm) (Table 7). The analysis of data indicates that ability of flexibility increases as the age increase from 11 to15 years.

Cauderay, Narring& Michaud (2000) conducted survey of Swiss children and reported the average value of S & R for 11 years old boys as 24 cm, for 13 years old as 23.2 cm and for 15 years old boys as 26.5 cm. The findings of the study are also comparable with Turkish counter parts as has been reported by Erikoglu, et al (2015) that the average value of sit and reach for 7-11 years old boys as 28.77 cm, for 12-14 years old boys as19.65 cm and for 13-16years old male students as 23.4 cm. The study concluded that the

flexibility may depend on the activity level of the individual. Various studies have identified different factors like active and sedentary conditions, age, nature of sport, etc. responsible for differences in muscles flexibility of children.

Standing Broad Jump Test (SBJ) without run up evaluates the anaerobic power in term of explosive strength of leg muscles of school going children. The data reveals that explosive muscle strength mean value for 11-15 years old boys as 5.62 ± 1.84 feet (169 cm) (Table 6). The SBJ values for 11 years old boys 5.45 ± 1.07 feet (164 cm), for 13 years old as 5.62 ± 1.23 feet (169 cm) and for 15 years old boys as 5.73 ± 1.25 feet (172 cm) (Table 7). From the analysis of data it can be concluded that anaerobic power of leg muscles shows linear increase in relation with age.

While assessing fitness of boys and girls Cauderay, Narring& Michaud (2000) reported the average value of standing broad jump test for 11 years old Swiss boys as 164 cm, for 13 years old as 184 cm and for 15 years old boys as 210 cm. It can be observed that in both cases there is improvement in fitness with age. However in case of Swiss counterparts the improvement is more in term of physical fitness.
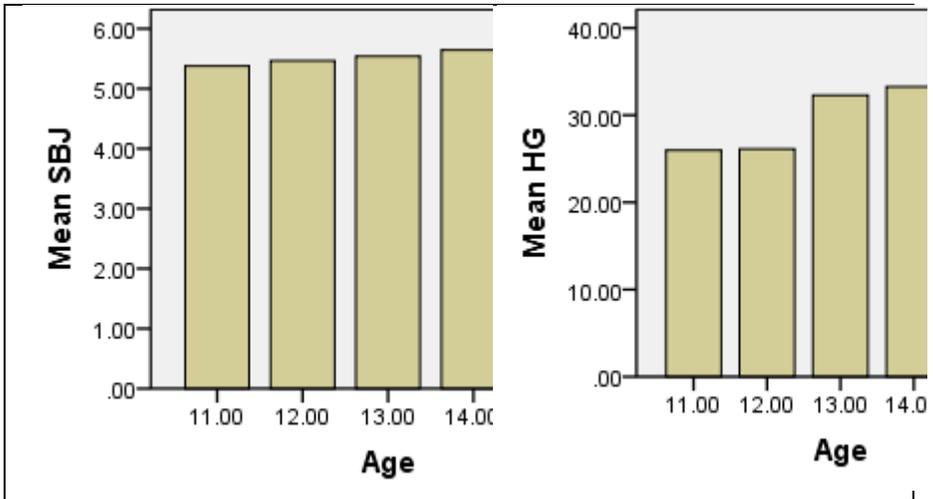

Graph 3: Lower and Upper muscular Strength by Age

The Hand Grip Test has been used as per international practices to determine the static strength of arm muscles. The mean strength value for 11-15 years old boys is found as 31.19±15.63 kg (Table 6). Mean hand grip value in the study for 11 years old boys is 25.98±13.43 kg, for 13 years old as 32.30±16.02 kg and for 15 years old male children as 38.27±16.62 kg (Table 7). Analysis of the data shows that arm muscle static strength increases with growth among 11-15 years old adolescents.

The Sit-ups (SU) Test determines the abdominal muscles strength and endurance as the subjects repeatedly bend and extend the torso at the hip in 30 seconds. It is very popular test in use being very simple that determines abdominal muscles strength accurately. The sit-up performance value in 30 seconds for 11-15 years old school going boys is found as 16.67±3.34 pieces per 30 seconds (Table 6). Age-wise analysis of data reflect that for 11 years old boys the sit-up value is as 15.98±3.22 pieces per 30 seconds, for 13 years old as 16.79±3.55 pieces per 30 seconds for 14 years old as 17.37±3.10 pieces per 30 seconds and for 15 years old adolescent boys as 16.76±3.36 pieces per 30 seconds (Table 7). The results of the study show that performance gradually increases from 11 to 14 years but decreases slightly among 15 years old boys.

The studies carried out on Turkish children reveal sit-up value in 30 seconds for 10.5±1.4 years old boys playing basketball as 16.6 pieces, for 11 years boys 18.15 pieces, for 12 years old as 22.19 pieces, for 12-15 years old boys as 21.57 pieces and for 15-16 years old boys as 20.4 (Erikoglu, et al., 2015). In case of Pakistani children the values of sit-ups test in each group are comparatively lower than their Turkish counter parts.
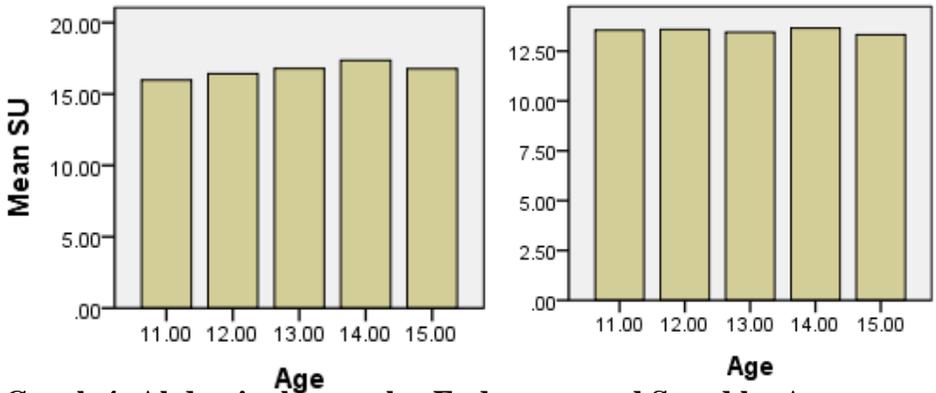
Graph 4: Abdominal muscular Endurance and Speed by Age

The Shuttle Run Test (10X5 m) (SHR) has been used to define the speed and agility by measuring the shortest time. The average performance value for 11-15 years old boys is found as 13.51 ± 1.22 seconds. When data is analyzed age-wise the speed time for 11 years old boys is measured as 13.55 ± 0.95 seconds, for 13 years old as 13.45 ± 1.08 seconds and for 15 years old male adolescents as 13.32 ± 1.66 seconds. The results reflect decrease in time in relation to age or increase in speed with growth among 11-15 years school going children.

Cauderay, Narring& Michaud (2000) reported the results of shuttle run test of Swiss children and adolescents- for 11 years old boys as 21.4 seconds, for 12 years old as 20.8 seconds, for 13 years old as 20.2 seconds, for 14 years old boys as 19.8 seconds and for 15 years old boys as 19.4 seconds.
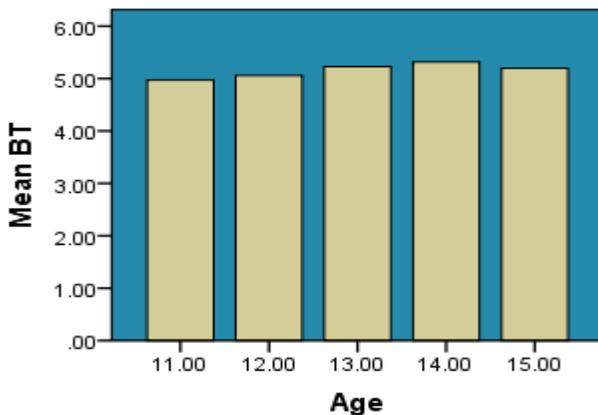
Graph 5: Cardiovascular Endurance by Age

The Beep Test (BT) or 20-m endurance shuttle run determines the aerobic capacity of individual- more the level of stages covered better the cardiovascular endurance. The results of the study indicate the mean value of beep test for 11-15 years old boys as 5.15 levels (Table 6). Age-wise analysis reflects average value of beep test for 11 years old boys as 4.97, for 13 years old as 5.23, for 14 years old as 5.32 and for 15 years old boys as 5.20 levels (Table 7).

The survey conducted by Cauderay, et al., (2000) on Swiss children show the value of beep test for 11 years old boys as 5.8, for 13 years old boys as 6.7 and for 15 years old boys as 7.5 levels. The comparison in terms of trend by age between Pakistani boys and Swiss counter parts appear similar but the cardiovascular endurance ability of Pakistani children is comparatively lower than their Swiss counter parts.

Table 8: Correlation coefficients between results of different tests of SUIT battery (n=1750)

	Age	Wt	BMI	FL T	SR	SBJ	HG	SU	SHR
Wt	.411**	1							
BMI	.185**	.613**	1						
FL T	.061*	.081**	-.037	1					
SR	.110**	.099**	.035	.068**	1				
SBJ	.069**	.091**	.039	-.027	.094**	1			
HG	.287**	.505**	.219**	.081**	.151**	.199**	1		
SU	.106**	-.074**	.040	-.041	.199**	.088**	-.061	1	
SHR	-.045	-.034	-.141**	.242**	.067**	-.057*	.121**	-.034	1
BT	.114**	-.033	-.010	-.049*	.027	.044	-.002	.150**	-.079**

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

To what extent do the results of different tests correlate with one another? The relationship between the results of different physical fitness tests of SUIT battery has been analyzed using Spearman's correlation coefficients that appeared to vary between tests from as low as -0.002 (NS) to 0.61 (p<0.01). The relationship between the tests of SUIT battery show weaker correlation except the association between weight and BMI which is highest correlation (Table 8).

The survey involved various age groups of male students from 11 to 15 years and all were subjected to physical fitness tests. In order to analyze the significance of difference between the performances of different age groups, analysis of variance was applied. Table 9

gives the results of multiple regression analysis using all tests. Between the groups F value of all tests ranges from 42.52 (Hand Grip Test) to 2.59 (Sit & Reach) and hence all tests are independent in performance. The data reflect that the various age groups (11-15 years old boys) included in the study exhibit significance difference at 0.05 level in all the tests. This analysis reflects that all tests included in the survey enjoy their identity to assess the performance. Since the between groups difference of all the tests exhibit significant difference there is a need to give consideration to age groups while establishing norms.

Table 9 : Analysis of variance (ANOVA)

		Sum of Squares	df	Mean Square	F	Sig.
BMI	Between Groups	719.755	4	179.939	17.537	.000
	Within Groups	17904.478	1745	10.260		
	Total	18624.233	1749			
FLT	Between Groups	604.099	4	151.025	6.659	.000
	Within Groups	39576.531	1745	22.680		
	Total	40180.631	1749			
SR	Between Groups	159.975	4	39.994	7.332	.000
	Within Groups	9518.234	1745	5.455		
	Total	9678.209	1749			
SBJ	Between Groups	35.036	4	8.759	2.587	.035
	Within Groups	5907.633	1745	3.385		
	Total	5942.668	1749			

HG	Between Groups	37951.604	4	9487.901	42.518	.000
	Within Groups	389394.004	1745	223.148		
	Total	427345.608	1749			
SU	Between Groups	365.334	4	91.333	8.334	.000
	Within Groups	19124.440	1745	10.960		
	Total	19489.774	1749			
SHR	Between Groups	23.631	4	5.908	3.993	.003
	Within Groups	2582.088	1745	1.480		
	Total	2605.719	1749			
BT	Between Groups	26.988	4	6.747	8.745	.000
	Within Groups	1346.321	1745	.772		
	Total	1373.309	1749			

Table 10:Qualitative grading regarding the performance of school children (%)

Test	0-20 Very Poor	21-40 Poor	41-60 Average	61-80 Good	81-100 Very Good
BMI	22	15	28	17	18
FLT	21	26	15	24	14
SR	29	14	15	24	18
SBT	22	22	17	19	20
HG	25	19	16	21	19
SU	27	19	26	11	17
SHR	26	14	24	17	19
BT	21	19	21	28	11

It is customary in such studies to construct norms as a gauge for health and sport potentials. Determination of norms depends on following factors:

1. Gender
2. Age
3. Region/area
4. Purpose
5. Type of sport

Most of the studies have even avoided divulging into percentile practice for defining norms without referring to due indicators of each category. In this study subjects are boys belonging to hilly areas and results can be transformed into age wise bench marks for way forward.

The results of study reflectthe need to organize nationwide awareness campaign for all including children and elderly men and women by using media both print and electronic. Revamping of grade-wise physical education program for school children demands motivational reorientation and achievement of fitness be rewarded in similar wayas academic achievement. The data of such surveys will enable to establish the fitness management information system (FMIS) covering physical fitness parameters of school going children. Moreover it would facilitate the selection of youth for sports, competitions and long term planning for nurturing talents. Presidential / Prim Ministers/ Chief Minister's physical fitness awards or medals need to be instituted as token of appreciation. Physical fitness census be made a regular periodic feature in the country as other population surveys by the Government of Pakistan, Statistic Division.

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