Minimum Muscular Fitness and Ventilatory Function in South Indian School Children

Rawat[1], Vikas; Rajesh[2], S.K., and Nagarathna[3], Raghuram
[1]PhD Scholar, Swami Vivekananda Yoga Anusandhana Samsthana, Bangalore, India. Pin: 560019. (vikasrawat.svyasa@gmail.com).
[2]Assistant Professor, Deputy Coordinator PhD Program, Swami Vivekananda Yoga Anusandhana Samsthana, Bangalore, India. Pin: 560019. (Email: rajesheskay@svyasa.org)
[3]Swami Vivekananda Yoga Anusandhana Samsthana, Bangalore, India. Pin: 560019.
Corresponding author: Vikas Rawat., PhD Scholar, Swami Vivekananda Yoga Anusandhana Samsthana, Bangalore, India. Pin: 560019, E-mail: vikasrawat.svyasa@gmail.com

Abstract

Emerging society has considered physical fitness as one of the important indicators of health. Muscular fitness and ventilatory functions are the important domains of physical fitness. The present study was designed to evaluate minimum muscular fitness and ventilatory functions in South Indian Children. Three hundred and fifty two healthy school children of both genders in age range of 10- 16 years who attended Yoga based Personality Development Camp were recruited for the study. Sample consisted of 203 boys and 149 females with a mean age of 12.90 years (SD=1.55). Anthropometric measurements, Kraus-Weber (KW) minimum muscular fitness test and PEFR were recorded. Out of 352 subjects tested 251 (71.31%) subjects failed in completing the test successfully. The overall failure rate in boys was 71.9% while in girls it was 70.5% with non significant differences between the two genders. The observation that the group of students who succeeded on minimum muscular fitness had significantly higher PEFR, points to a positive relationship between muscle fitness and lung functions. A failure rate of 71% on KW test in urban children (10-16years) of both genders points to an urgent need of physical fitness training programs for the enhancement of the strength in areas that shape their physical fitness.

KEY WORDS: physical fitness, muscular fitness, ventilatory function, Kraus-Weber, PEFR

Introduction

Emerging society has considered physical fitness as one of the important indicators of health. Physical fitness is the ability to perform physical activity, and makes reference to a full range of physiological and psychological qualities *(Ortega et al, 2008)*. Being physically fit has been defined as "the ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies" *(PCPFS, 1952)*. Physical fitness during adolescence is related to a healthy cardiovascular disease risk profile in adults *(Twisk et al, 2002)*. Fitness refers to the maximum capacity that people have or achieve while they perform physical activity that can be measured as the level of strength and flexibility of the muscular groups in different body parts. After two decades of clinical experience, Kraus and Hirschland prepared six tests of minimum muscular fitness for children called Kraus-Weber test (KW). The battery evaluates strength and flexibility of trunk and leg muscles. Studies have shown that this test represents minimum muscular

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fitness, and that falling below the normative level in this test predisposes to orthopedic and emotional difficulties *(Kraus & Hirschland, 1953).*

Studies show wide variations in the children fitness levels as measured on KW test. Initial studies on American and European children from comparable urban and suburban communities showed that 57.9% of the 4264 American students while only 8.7% of the 2870 European students failed to pass the test *(Kraus & Hirschland, 1954).* In the first Indian survey in the year 1975 on minimum muscular fitness in 375 school children in Lonavla, Maharashtra, the failures reported was 40.3% with multiple failures to the extent of 63.9 per cent *(Gharote & Ganguly, 1975).* Further, a recent study in year 2000 by the same group revealed that 20.8 per cent boys failed in the tests *(Gharote, 2000)* and this improved performance was attributed to better training through sports and physical activities promotions in the school. Multiple failures were 4.8 percent while flexibility failures alone were 11.6 percent.

Measurement of ventilatory functions is another useful measure to assess physical fitness in children and adults *(Petty, 2006).* Peak expiratory flow rate (PEFR) which is the maximum flow achieved during rapid exhalation delivered with maximal force starting from the level of maximal lung inflation is an essential measure of ventilatory function *(Pedersen, 1997).* PEFR is a simple quantitative and reproducible measure of resistance and severity of airflow obstruction *(Holcroft et al, 2003).* The purpose of this study was to evaluate the present status of muscular fitness and ventilatory function using Kraus-Weber Test and mini peak expiratory flow meter in healthy South Indian Children.

Methods

Participants: Three hundred and fifty two healthy school children of both genders in age range of 10- 16 years who attended yoga based Personality Development Camp in summer holidays in the serene campus of SVYASA University, Bengaluru, were randomly selected from a pool of 540 children. Children with a history of asthma, a recent history of respiratory infection with or without persistent cough within the past two weeks and those with any major disability or illness were excluded from the study.

Consent and ethical clearance: Signed informed consent was obtained from the parent or guardian of the child at the time of registration after they had read the proposal of the study. All procedures were reviewed and accepted by the institutional ethical committee. The children were explained in detail about the nature of the study and the voluntary nature of participation and were not provided with any incentives for their participation.

Methods: All the children were the participants of a ten day residential yoga based personality development camp organized during summer holidays in the month of April. The testing was performed in a spacious room during the morning hours between 9 to 11 AM on 2nd day of the camp after the child had acclimatized to the camp life. The children were taken in batches of five to the room situated adjacent to the hall. After documenting the demographic data, PEFR followed by Kraus Weber test was recorded.

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Measurements

Kraus-Weber test: The Kraus-Weber test is composed of five strength items and one flexibility item *(Kraus & Hirschland, 1953).* Failure of any one of the six items means a failure of the total test.

1. The first test item measured the strength in abdominal and psoas (hip flexor) muscles. The subject was instructed to lie supine with the hands behind the neck. The feet were held by the examiner. On command the subject rolled up into a sitting position.

2. In the second test item the subject was asked to lie supine, hands behind neck and knees bent. The feet were held. On command the subject tried to roll up into a sitting position. This is a test of abdominal muscles without using the psoas muscle.

3. This is a test item for the strength of lower abdominal muscles. During this test, the subject lies flat on his back with his hands behind his neck. He was then instructed to lift the legs straight off the floor about 10 inches and to hold the position for 10 seconds.

4. The upper back muscles were tested during the 4th test item. The subject was asked to lie prone with a pillow under the abdomen but far enough down to give a seesaw effect. While lying on the stomach, the subject was asked to lift the head, shoulders, and chest off the floor and hold for 10 seconds.

5. In the fifth test, the position was the same as in the 4th test. The subject was instructed to lie prone over the pillow and place his hands in front and rest his head on them. The examiner held the chest down and asked the subject to lift his legs up without bending the knees and maintain this position for 10 seconds. The lower back muscles were tested with this.

6. In the sixth test item, the subject was tested for the flexibility of back and ability to stretch the hamstring muscle. The subject was asked to stand erect with his hands at sides and feet together. On command he was instructed to lean down slowly to touch the floor with his fingertips. The knees were kept straight and the leaning down position was asked to be maintained for 10 seconds. No bouncing was allowed to touch the floor.

PEFR Measurement: A mini PEFR meter (Clement Clarke) was used to check the PEFR of the children. The purpose and technique of performing PEFR was explained along with a demonstration of the correct manner of performing the test. When subjects had understood the method and were able to perform correctly, they were made to give the test in the standing position. They were closely observed to ensure that they maintained an airtight seal between their lips and the mouthpiece of the instrument *(Holcroft et al, 2003).* The highest value of the three readings was recorded as the final PEFR value.

Physical characteristics:

The weight (Kg) was recorded using a standard electronic weighing scale. The participants were asked to remove as much outerwear as possible. Further they were asked to remove the shoes and step up onto the weighing scale and stand still over the center of the scale with body weight evenly distributed between both the feet. Standing height (cm) was measured without shoes and without traction using a standard scale.

Data analysis: All the statistical analyses were performed using the Statistical Package for Social Sciences (version

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16.0). Descriptive statistics was used to examine the frequency and percentage to compare successes and failures in Kraus-Weber Test items based on age and gender. Independent-samples t-tests were performed to determine the significance of the observed differences in physical characteristics of the subjects according to success and failure.

A total of 352 students (203-boys, 149-girls) were enrolled in the study. Participants' age ranged from 9 to 16 years with a mean age of 12.90 years (SD=1.55). Table I shows physical characteristics and frequency distribution of children's performance on the two tests i.e. PEFR & Kraus Weber tests.

Results & Discussion

Table I: Frequency distribution of children on KW test and PEFR

age groups	Gender	N	Weight		Height		PEFR		KW test	
			Mean	SD	Mean	SD	Mean	SD	Success N (%)	Failure N(%)
	Girls	13	32.52	6.54	135.04	10.47	226.92	64.47	1(7.7)	12(92.3)
	Boys	14	37.89	7.26	138.14	6.68	239.29	37.31	2(14.3)	12(85.7)
10	Total	27	35.3	7.32	136.64	8.68	233.33	51.52	3(11)	24(89)
	Girls	16	33.6	5.94	141.69	6.38	250.63	39.58	4(25)	(75)
	Boys	26	36.66	7.17	140.84	6.99	266.54	52.07	9(34.6)	17(65.4)
11	Total	42	35.5	6.82	141.16	6.7	260.48	47.83	13(29.8)	29(70.2)
	Girls	26	37.93	8.53	143.35	10.34	238.85	48.36	4(15.4)	22(84.6)
	Boys	42	40.86	9.04	146.88	8.86	285.76	45.37	11(26.2)	31(73.8)
12	Total	68	39.74	8.9	145.53	9.53	267.82	51.58	15(20.8)	53(79.2)
	Girls	33	45.11	7.19	152.17	7.32	297.88	52.78	13(39.4)	20(60.6)
	Boys	56	46.83	12.07	151.93	9.78	293.39	52.23	15(26.8)	41(73.2)
13	Total	89	46.19	10.52	152.02	8.9	295.06	52.18	28(33.1)	61(66.9)
	Girls	29	49.02	9.2	155.83	6.92	304.14	42.8	12(41.4)	17(58.6)
	Boys	39	46.08	9.84	156.96	8.39	324.87	57.35	8(20.5)	31(79.5)
14	Total	68	47.33	9.62	156.48	7.76	316.03	52.32	20(30.9)	48(69.1)
	Girls	27	49.81	6.84	156.1	7.09	312.22	47.9	8(29.6)	19(70.4)
	Boys	18	54.72	6.39	170.21	7.78	381.67	62.43	9(50)	9(50)
15	Total	45	51.77	7.03	161.74	10.1	340	63.6	17(39.8)	28(60.2)
	Girls	5	48.22	10.8	155.4	5.04	308	50.7	2(40)	3(60)
	Boys	8	49.59	7.95	161.75	2.83	336.25	63.23	3(37.5)	5(62.5)
16	Total	13	49.06	8.73	159.31	4.85	325.38	58.25	5(38.8)	8(61.3)
	Girls	149	43.24	9.95	149.54	10.56	280.47	57.89	44(29.5)	105(70.5)
10-16	Boys	203	44.34	10.76	151.49	11.92	300.21	62.38	57(28.1)	146(71.9)
	Total	352	43.87	10.43	150.66	11.39	291.85	61.22	101(28.7)	151(71.3)

PEFR= Peak expiratory flow rate.
Note: Total failure percentage is 71.31

KW test: Out of 352 subjects tested a total of 251 (71.31%) subjects failed to complete the test successfully. The overall failure rate in boys was 71.9 while in girls it was 70.5 with non significant difference between the two genders. Further 25.85% of students failed in one of the items of the test. It is observed that the failure rates that ranged from 89% dropped to 50% as the age advanced in both girls and boys; the maximum failure rate of 89% was observed in the age group of 10 years and the dropped to 60.2% in the boys of 15 years of age. Table 2 presents the analysis of success and failures in the number of items of the Kraus-Weber test. Table 3 presents the success and failures in Individual items of the Kraus-Weber test. The maximum number of students failed in the test item meant for Strength of Upper Back muscles where the failure rate was

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observed to be 93.8%. Physical characteristics of the subjects who were successful or failed in the KW test items are summarized in Table 4. Successful group of subjects have shown significantly higher PEFR as compared to the failure group.

Table 2:–Analysis of Failure rates in the different Items in the Kraus-Weber Test (N-356)

	Number of items failed					Total
KW test	5	4	3	2	1	
N	8	28	48	76	91	251
%	2.27	7.95	13.64	21.59	25.85	71.31

Table 3: Performance On Individual Items Of KW Test

	Success		Failures	
Items	N	%	N	%
Abdominals Plus Psoas	44	12.5	308	87.5
Abdominals Minus Psoas	86	24.4	266	75.6
Psoas & Lower abdominals	99	28.1	253	71.9
Upper Back muscles	22	6.3	330	93.8
Lower Back muscles.	167	47.4	185	52.6
flexibility and strength back and hamstrings	121	34.4	231	65.6

Table 4: Comparison Of Physical Characteristics and KW Test

Physical parameters	KW result	N	Mean	SD	t	p
Weight	Successes	101	43.6	10.686	-0.36	0.716
	Failures	251	44.0	10.34		
Height	Successes	101	151.8	11.96	1.19	0.235
	Failures	251	150.2	11.14		
PEFR	Successes	101	309.6	64.12	3.51	0.001
	Failures	251	284.7	58.64		

In the current study, overall 71.3% failure rate was observed in any one of the six test items in Kraus-Weber test. The failure percentage observed in this study has been second highest reported so far in India. This seems to be in line with a recent study in India which has concluded that basic levels of health-related fitness are low among school children and reasons attributed to this trend were increasing affluence, and academic competitiveness, which forces the child to devote very little time to physical activity *(Gupta et al, 2014).* In the current decade the television and video game use has become the most popular leisure activity. As 'couch potato' hypothesis states time spent with these media activities result in deleterious affects on the physical activity and the diet *(Vandewater et al, 2004).* Although in the current study their basic physical activity level, hours of television viewing and video game activity were not measured, this may be responsible for the increased failure rate in minimum physical fitness. Maximum failure percentage was seen in test item 4 that measures the upper back muscles (93.8%) and test item 1 (Strength of abdominal plus psoas muscles) (87.5%). This result is in contrast to a previous study which has shown that the test item number 6 that measures the flexibility of Back and Hamstrings as the weak areas *(Gharote & Ganguly, 1975).* The overall failure rate in boys was 71.9 % while in girls it was 70.5% with no significant difference between the two genders. This result is in contrast to a previous study from India which reported higher failure rates in females than males *(Gharote, 2000).* The observation that the group of students who succeeded on minimum muscular fitness had significantly higher PEFR, points to a positive relationship between muscle fitness and lung functions.

Limitations: Potential limitations of this research must also be considered. The sample included was healthy young children in a yoga camp environment which may be difficult to generalize for all children and adults. Secondly, we have used only PEFR using a mini PEFR instrument; it would have been ideal to

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compare all measures of lung function using a spirometer. To our knowledge, this is the first study that has looked at both minimum muscular fitness and PEFR in south Indian children. The benefits of physical fitness are widely acknowledged and extend across many domains of wellness and health. Previous findings have shown a positive relationship between physical fitness, during adolescence and arterial properties later in life *(Twisk et al, 2002)*. Further reports have shown consistent positive relationship between physical fitness and academic achievement *(Chomitz et al., 2009)*. Furthermore, results support the possible link between physical fitness and improved emotionality *(Folkins, 1981)*. Physical fitness can be enhanced by training. One of the effective strategies for enhancement of physical fitness is yoga practice. Many earlier studies have shown positive effects of Yoga training in reducing the failure rate in K-W tests *(Gharote, 1975)*. Studies have also shown that yoga based breathing practices can increase pulmonary function *(Vedala et al, 2014)*.

Conclusion: A failure rate of 71% on KW test in urban children (10-16years) of both genders points to an urgent need of physical fitness training programs for the enhancement of the strength in areas that shape their physical fitness.

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