Assessment Of Muscular Fitness In School Children Using Kraus-Weber Tests

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Abstract: Objective of the study: The present study was carried out to assess muscular fitness in healthy Indian school children between 9 to 12 years of age (older pediatric age-group) using Kraus-Weber Tests. The aim was to compare the results of this study with similar studies that have been carried out in India, Europe and America previously. Methods: Kraus-Weber Tests don't require sophisticated equipment and are much easier to administer than traditional tools for analyzing muscular fitness like Electromyogram (EMG). Earlier studies have proven these tests to be excellent screening devices not only for physical but also psychosocial incompetence. They can actually be used as indicators of overall health in this older pediatric age-group. Results: The present study found more number of fitness and flexibility failures as compared to the last such study in India. In stark contradistinction to previous studies, girls have fared poorly than boys on the fitness front.Conclusion: These findings could be attributed to increased stress in school children especially in female students. A sharp dip has been observed in muscular fitness just prior to puberty (most probably due to hormonal causes).

Key words: Kraus-Weber Tests, Electromyogram, Flexibility, Tai Chi Yoga, Stress, Muscular Fitness

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INTRODUCTION: A level of strength and flexibility of particular key muscular groups is necessary for the function of the body below which the health of the individual seems to be in danger[1]. Kraus and Hirschland prepared a battery of 6 muscular strength tests after 18 years of clinical experience[1]. These **Kraus-Weber Tests** can be easily administered anywhere to anybody (without much pre-procedure preparation) by anyone (with a little training) with no apparent cost. They do not require any special equipment and the subject does not have to undergo a long and painful ordeal as in other more sophisticated tests like **Electromyogram**[2]. Each of these tests is a pass or fail test with a 'fail' in any of the 6 test items constituting a whole test failure[3].

- Test 1 (A + P) is a test of the strength of Abdominal and Psoas muscles.
- Test 2 (A - P) is a further test of Abdominal muscles without Psoas.
- Test 3 (P) is a test for the strength of Psoas and Lower Abdominal muscles.
- Test 4 (UB) is for the strength of the Upper Back muscles.
- Test 5 (LB) is the test for the strength of the Lower Back muscles.
- Test 6 (B +H) tests the length of Back and Hamstring muscles and is a test of flexibility.

In fact, it was also reported that those who failed in these tests appeared to be sick, emotionally imbalanced and having constant strain in them[4]. These Kraus-Weber Tests have been proved as an effective screening device to mark unfit subjects (especially in the pediatric age-group) by earlier studies[5,6,7,1,8]. The suspected cases can then be investigated further using more exhaustive procedures.

The aim of the present study is to assess muscular fitness using Kraus-Weber Tests in healthy school-going children between 9 to 12 years of age (older pediatric age-group) and to compare the same with results of previous studies.

MATERIALS AND METHODS: The study was conducted on 320 randomly selected students (studying in standards 3rd to 8th) of a Government School in India. Half of the selected students i.e. 160 were male and the other half female. The area and school were chosen keeping in mind the composition of Indian society with due consideration given to various parameters (like socio-economic status[9,10]) so as to get an unbiased representative sample. Out of the 160 boys (or girls), 40 each were 9, 10, 11 and 12 (completed) years of age. This is the age group in which the rate of growth and development is maximal. Confirmation of age was done from school registers. The selected children were subjected to general clinical medical examination to rule out any major mental or physical illness or disability. Informed consent was taken from the principal and parents after explaining them the aim and nature of the study and their wards' role in it.

Kraus-Weber Tests[2,3] were performed on the participating children after proper explanation and alleviating their anxiety. Tests were carried out in a well lighted and ventilated room. Participants were instructed to remove their belts or any other tight clothing. Female students were tested in the presence of a female attendant. There was no warming-up before the children underwent the tests. Tests were administered on an adequately large table covered by a clean table cloth. The subjects were shown how to do each test item correctly and then they were asked to perform the same.

Observations were recorded after taking due care to reduce instrument and observer errors to a minimum. Only if a child could perform all the above test items successfully was he declared as having passed the Kraus-Weber Tests. Failure in even one test item was deemed as failure in the Kraus-Weber Tests. Successes and failures in the Kraus-Weber Tests were compared amongst themselves on the basis of gender and age using **Chi-Square Test**[11]. Results were compared with preceding studies and conclusions were drawn.

RESULTS: Result of the test is tabulated in following table showing age wise and gender wise success and failure rate for the test

Table no. 1 showing number of successes and failures of Kraus-Weber Tests in each sex at different ages

		Success	Failure in no. of Kraus-Weber (Test)items				Total
			1 Item	2 Items	3 Items	4 Items	
9 Y	B	36 (90 %)	3 (7.5 %)	1 (2.5 %)	0	0	40
	G	34 (85 %)	5 (12.5 %)	1 (2.5 %)	0	0	40
	T	70 (87.5 %)	8 (10 %)	2 (2.5 %)	0	0	80
10 Y	B	27 (67.5 %)	9 (22.5 %)	3 (7.5 %)	1 (2.5 %)	0	40
	G	18 (45 %)	17 (42.5 %)	3 (7.5 %)	1 (2.5 %)	1 (2.5 %)	40
	T	45 (56.25 %)	26 (32.5 %)	6 (7.5 %)	2 (2.5 %)	1 (1.25 %)	80
11 Y	B	34 (85 %)	4 (10 %)	2 (5 %)	0	0	40
	G	29 (72.5 %)	9 (22.5 %)	1 (2.5 %)	1 (2.5 %)	0	40
	T	63 (78.75 %)	13 (16.25 %)	3 (3.75 %)	1 (1.25 %)	0	80
12 Y	B	29 (72.5 %)	8 (20 %)	3 (7.5 %)	0	0	40
	G	21 (52.5 %)	15 (37.5 %)	2 (5 %)	2 (5 %)	0	40
	T	50 (62.5 %)	23 (28.75 %)	5 (6.25 %)	2 (2.5 %)	0	80
Total	B	126 (78.74 %)	24 (15 %)	9 (5.63 %)	1 (0.63 %)	0	160
	G	102 (63.74 %)	46 (28.75 %)	7 (4.38 %)	4 (2.5 %)	1 (0.63 %)	160
	T	228 (71.25 %)	70 (21.88 %)	16 (5 %)	5 (1.56 %)	1 (0.31 %)	320
Y : Years, B : Boys, G : Girls, T : Total							

Table no. 2 showing number of successes (S) and failures (F) in individual items of Kraus-Weber Tests in each sex at different ages

		A + P		A – P		P		UB		LB		B + H	
		S	F	S	F	S	F	S	F	S	F	S	F
9 Y	B	40 100%	0 0%	38 95%	2 5%	37 92.5%	3 7.5%	40 100%	0 0%	40 100%	0 0%	40 100%	0 0%
	G	40 100%	0 0%	36 90%	4 10%	37 92.5%	3 7.5%	40 100%	0 0%	40 100%	0 0%	40 100%	0 0%
	T	80 100%	0 0%	74 92.5%	6 7.5%	74 92.5%	6 7.5%	80 100%	0 0%	80 100%	0 0%	80 100%	0 0%
10 Y	B	40 100%	0 0%	35 87.5%	5 12.5%	35 87.5%	5 12.5%	40 100%	0 0%	40 100%	0 0%	32 80%	8 20%
	G	39 97.5%	1 2.5%	32 80%	8 20%	32 80%	8 20%	40 100%	0 0%	40 100%	0 0%	27 67.5%	13 32.5%
	T	79 98.75%	1 1.25%	67 83.75%	13 16.25%	67 83.75%	13 16.25%	80 100%	0 0%	80 100%	0 0%	59 73.75%	21 26.25%
11 Y	B	40 100%	0 0%	39 97.5%	1 2.5%	38 95%	2 5%	40 100%	0 0%	40 100%	0 0%	35 87.5%	5 12.5%
	G	40 100%	0 0%	35 87.5%	5 12.5%	37 92.5%	3 7.5%	40 100%	0 0%	40 100%	0 0%	34 85%	6 15%
	T	80 100%	0 0%	74 92.5%	6 7.5%	75 93.75%	5 6.25%	80 100%	0 0%	80 100%	0 0%	69 86.25%	11 13.75%
12 Y	B	40 100%	0 0%	36 90%	4 10%	36 90%	4 10%	40 100%	0 0%	40 100%	0 0%	34 85%	6 15%
	G	40 100%	0 0%	33 82.5%	7 17.5%	33 82.5%	7 17.5%	40 100%	0 0%	40 100%	0 0%	29 72.5%	11 27.5%
	T	80 100%	0 0%	69 86.25%	11 13.75%	69 86.25%	11 13.75%	80 100%	0 0%	80 100%	0 0%	63 78.75%	17 21.25%
To tal	B	160 100%	0 0%	148 92.5%	12 7.5%	146 91.25%	14 8.75%	160 100%	0 0%	160 100%	0 0%	141 88.12%	19 11.88%
	G	159 99.37%	1 0.63%	136 85%	24 15%	139 86.87%	21 13.13%	160 100%	0 0%	160 100%	0 0%	130 81.25%	30 18.75%
	T	319 99.69%	1 0.31%	284 88.75%	36 11.25%	285 89.06%	35 10.94%	320 100%	0 0%	320 100%	0 0%	271 84.69%	49 15.31%
Y : Years, B : Boys, G : Girls, T : Total													

Table no. 3 : Distribution with respect to Gender of Kraus-Weber Tests Successes (S) and Failures (F):

SEX	**KRAUS-WEBER TESTS**	
	S	**F**
MALES	126	34
FEMALES	102	58
TOTAL	228	92
P **<0.01 (Significant)**		

Table no. 4: Distribution with respect to Age of Kraus-Weber Tests Successes (S) and Failures (F):

AGE	**KRAUS-WEBER TESTS**	
	S	**F**
9 YRS	70	10
10 YRS	45	35
11 YRS	63	17
12 YRS	50	30
TOTAL	228	92
P **<0.01 (Significant)**		

DISCUSSION:

Overall Failures in Kraus-Weber Tests: Overall failure percentage in the present study was observed to be 28.75% (92 subjects out of 320). Out of this, 21.88% (70 subjects out of 320) were single test item failures, 5% (16 subjects out of 320) were double test item failures, 1.56% (5 subjects out of 320) failed in 3 test items while 0.31% (1 subject out of 320) failed in 4 test items. Thus, 6.88% (22 subjects out of 320) failed in more than 1 test items.

The early work of Kraus and Hirschland[3] showed that 56.6% of 4458 American children and 8% of 1987 European children failed in one or more of the 6 items of the Kraus-Weber Tests. Repeat study by the same workers[2] revealed that 57.7% of 4264 American children and 8.7% of 2870 European children failed in one or more of the 6 test items. The first such study in India on 375 school children was conducted by Gharote and Ganguly[6]. The failure percentage reported by them was 40.3%. Another study conducted by Gharote et al[7] reported still higher percentage of failures to the extent of 63.9%. Moorthy[8] observed highest percentage of failures to the extent of 84.8%. Thereafter, a study of 250 school children in India by Gharote[1] revealed a failure percentage of 20.8%. Percentage of failures in more than 1 test item as found by Gharote[1] in 1999 – 2000 was 4.8%. Out of this, 3.6% failed in 2 items and 1.2% in 3 items.

Thus, the overall trend before this study had been towards a decline in failure percentage[3,2,6,7,8,1]. Gharote[1], in the last recorded study conducted in India in 1999-2000, had attributed this to the growing promotion and popularity of sports and physical activities in schools.

An increase in failure percentage from 20.8% in his study to 28.75% in this one could be a result of increasing mental stress on school children due to expectations from family and growing competition[12,13]. This argument is based on the observation that those who failed in these tests appeared to be sick, emotionally imbalanced and having constant strain in them[4]. Multiple test item failures have also increased from 4.8% reported by Gharote to 6.88% in this study. Failure in more than 1 test items has been shown to be a sign of **maladjustment**[14]. Studies at regular intervals in various different parts of the world are required to substantiate these arguments. Counseling sessions by trained psychologists in schools can help bring the failure percentage down[15].

Failures in individual test items of Kraus-Weber Tests: Maximum failure percentage of 15.31% (49 subjects out of 320) was found in the Flexibility Test (Test 6) followed by 11.25% (36 subjects out of 320) in Test 2, 10.94% (35 subjects out of 320) in Test 3 and 0.31% (1 subject out of 320) in Test 1 (Abdominal Muscle Tests) in that order. This is consistent with previous studies[14,16,17,18,7,8,1,19,5,6] which had earmarked Abdominal Muscle Fitness and Muscle Flexibility (Abdominal, Back and Hamstring muscles) as weak areas. In fact in previous studies, most strength failures have been caused by abdominal weakness[19,16,17]. Gharote[1] also found a high percentage of failures in these tests.

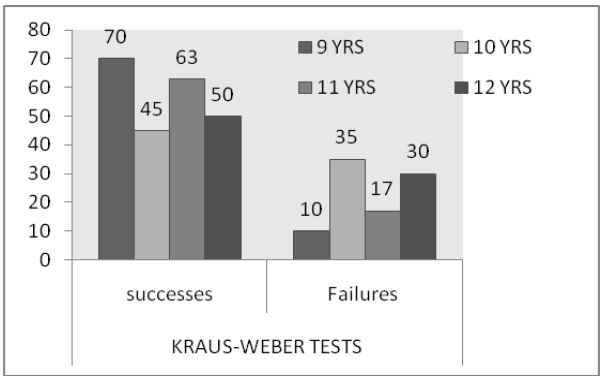
In previous studies, Flexibility Test (Test 6) caused the greatest percentage of failures[14,16,17,18]. Flexibility failures increased as age increased[14,17]. Flexibility failures reported in the first study by Gharote and Ganguly[6] was 20.3%. Next study by Gharote et al[7] reported flexibility failures to the extent of 45.9%. Moorthy[8] observed 42.4% flexibility failures. Gharote[1] in 1999 – 2000 at Lonavla found 11.6% flexibility failures. He noted greatest flexibility failures of 34.5% in the age group of 15 years. An increase in Flexibility failures from 11.6% by Gharote in the last study to 15.31% in this study is noteworthy. Training in relaxation techniques, aerobic maneuvers, **Tai Chi** and **Yoga** could be the answer to decreasing Flexibility failures[5]. Effect of these practices on muscular fitness needs to be further evaluated in detail.

The first Indian study by Gharote and Ganguly[6] reported very low percentage of failures as 0.5% and 2.9% respectively in the tests of Upper and Lower Back. Gharote[1] in 1999 – 2000 found no failures in these tests. In the present study also, no failures were found in Tests 4 and 5 (Back Muscle Tests). These tests continue to be non-

discriminative and non-specific as has been concluded by earlier workers[17].

Age evaluation : (Table 4 and Graph I) Maximum failure percentage of 43.75% (35 subjects out of 80) was found at age 10 years. At this age, 55% (22 subjects out of 40) girls and 32.5% (13 subjects out of 40) boys failed in the tests. Minimum failure percentage of 12.5% (10 subjects out of 80) was found at age 9 years. At this age, 15% (6 subjects out of 40) girls and 10% (4 subjects out of 40) boys failed in the tests.

Graph I

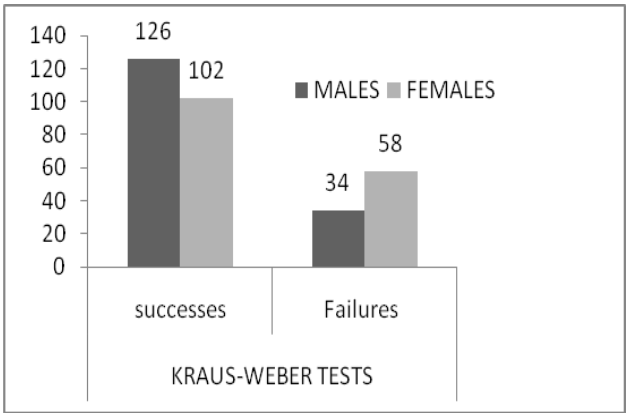


Analysis of individual Abdominal (Tests 1, 2 and 3) and Flexibility (Test 6) Tests also shows poorest performance at age 10 years in both sexes. In Test 1 (Abdominal and Psoas Muscles Test), the only failure was a female aged 10 years. Noteworthy is the fact that no flexibility failures were found in either sex at age 9 years. Gharote[1] had found maximum failure percentage of 53.85% (7 subjects out of 13) at age 10 years and no failures (0 out of 4) at age 9 years. The most likely reason for these differences is a smaller (<30 subjects) sample size used by Gharote. Thus, one observes that muscular fitness is at its lowest just before puberty sets in. The explanation could lie in the pre-pubertal preparatory changes taking place in the body in general and muscles in particular during this phase of life[20]. However, more work needs to be done to understand the exact nature of etiology being proposed here.

Gender evaluation: (Table 3 and Graph II) Failure percentage in boys was observed to be 21.25% (34 subjects out of 160) while that in girls was 36.25% (58 subjects out of 160). Flexibility Test failure percentage in girls was found to be 18.75% (30 subjects out of 160) while that in boys was 11.88% (19 subjects out of 160).

In fact, girls have fared poorly as compared to boys in Abdominal Tests also at all ages. The above conclusions are in stark contrast to the findings in studies of previous workers[14,16,17] who stated that girls were more muscularly fit and flexible than boys. However, it should be remembered that such gender evaluation has not previously been attempted in this country and all these earlier studies were done outside India. In this country, such results are to be expected what with discrimination rampant against 'The Girl Child'. The average Indian male child is taken better care of socially, economically and emotionally than his female counterpart. It is unfortunate that the scenario has not changed much since Independence despite numerous social campaigns for 'Equality of the Sexes'[21].

Graph II



The author wishes to take this opportunity to reiterate the appeal made to Indian Society to treat 'The Girl Child' at par with her male counterpart. This statement notwithstanding, other factors like endocrinal differences, genetic and climactic variations which could also influence this result should also be taken into consideration in this context[20].

CONCLUSION:

- Total percentage of failures in Kraus-Weber Tests in general and the Flexibility Test (Test 6) in particular has increased in this study as compared to the last recorded study by Gharote. This should be attributed mainly to an increase in **stress** (especially mental stress) being experienced by school children nowadays.
- Healthy Male school-going children between 9 years to 12 years of age (older pediatric age-group) have been found to have better **Muscular Fitness** (as measured by Kraus-Weber Tests) than their Female counterparts. More stringent efforts should be made by the society to protect rights of 'The Girl Child'.
- Healthy school-going children of Age 10 years have been found to have the highest percentage of failures in Kraus-Weber Tests followed sequentially by Ages 12, 11 and 9 years. This most probably is a consequence of hormonal changes taking place in the body during this phase of life.

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