



ESTIMATION OF MUSCULAR FITNESS OF URBAN SCHOOL CHILDREN BELONGING TO DIFFERENT SOCIO-ECONOMIC STRATA

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ABSTRACT

Introduction: Kraus-Weber Tests check the fitness of the most important muscle groups of our body; the muscles which are indispensable for a smooth and healthy life. Those who failed in these tests appeared to be sick, emotionally imbalanced and having constant strain in them. These tests have been proved as an effective screening device to mark unfit subjects (especially in the pediatric age-group) by earlier studies. Socio-economic status depends not only on the per capita income but also on the academic qualification and occupation of the head of the family. It could be hypothesised that socio-economically backward children are more likely to fail in Kraus-Weber Tests as a less favorable socio-economic condition puts greater physical and emotional stress. **Aim of the Study:** To assess fitness of today's urban school children using Kraus-Weber Tests and to compare muscular fitness (as measured by Kraus-Weber Tests) of healthy school-going children between 9 years to 12 years of age (older pediatric age-group) with the socio-economic strata of society to which they belong. **Materials & Methods:** The study was conducted on 320 healthy children (between 9 years to 12 years of age) studying in an urban government school belonging to different socio-economic strata. Participating children were made to perform maneuvers as per the 6 Kraus-Weber Tests after proper explanation and alleviating their anxiety. Failure in even one test item was deemed as failure in the Kraus-Weber Tests. Successes and Failures in 'The Kraus-Weber Tests' across various socio-economic strata were compared using Chi-Square Test. **Observations & Conclusions:** Prevalence of unfit children was significantly higher in lower socio-economic strata as compared to higher socio-economic strata. Efforts should be made by the Government and NGOs to ensure that all school children enjoy a healthy socio-economic and cultural environment at their homes and in school. Overall failure percentage was observed to be 28.75%. An increase in failure percentage in this study could be a result of increasing mental stress on school children due to expectations from family and growing competition. Maximum failure percentage of 15.31% was found in the Flexibility Test. Training in relaxation techniques, aerobic maneuvers and Yoga could be the answer to decreasing Flexibility failures.

KEYWORDS

Muscular Fitness, Kraus-Weber Tests, Socio-economic status, Flexibility

INTRODUCTION:

The Musculoskeletal System of our body helps us to search food and flee from danger. Needless to say, any affliction of this system signals dire consequences for our body. Thus, muscular fitness is one of the most important components of physical fitness¹.

Since times immemorial, we have been trying to understand the Musculoskeletal System better and devise ways of diagnosing diseases affecting it. We have succeeded to a large extent but the diagnostic and prognostic procedures we have invented like the Electromyogram (E.M.G) are too cumbersome and costly².

Need of the hour is a simple test which can help us to accurately and effectively screen the function of this system in the field before the suspected cases are subjected to more exhaustive procedures. Many of the health hazards and most of the disorders could be checked by maintaining a certain level of fitness. A level of strength and flexibility measure of particular key muscular groups is necessary for the function of the body below which the health of the individual seems to be in danger¹.

Keeping these views in mind, a battery of 6 muscular strength tests was prepared by Kraus and Hirschland after 18 years of clinical experience¹. These **Kraus-Weber Tests** fit the bill as they 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 tests³. Each of these tests is a pass or fail test with a 'fail' on any of the 6 test items constituting a whole test failure⁴.

- **Test 1** is a test of the strength of Abdominal and Psoas muscles.
- **Test 2** is a further test of Abdominal muscles without Psoas.
- **Test 3** is a test for the strength of Psoas and Lower Abdominal muscles.
- **Test 4** is for the strength of the Upper Back muscles.
- **Test 5** is the test for the strength of the Lower Back muscles.
- **Test 6** tests the length of Back and Hamstring muscles and is a test of flexibility.

Thus, it is apparent that these tests encompass the most important muscle groups of our body; the muscles which are indispensable for a smooth and healthy life. 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^{1,5,6,7,8}. In fact, it was also reported that those who failed in these tests appeared to be sick, emotionally imbalanced and having constant strain in them⁹.

According to Kuppuswamy, socio-economic status depends not only on the per capita income but also on the academic qualification and occupation of the head of the family. After years of experience, he devised a scoring system for determining the socio-economic status of a family based on the above 3 criteria (for details, see 'Materials and Methods'). The latter two determine the social status while the former indicates the economic condition of the family⁹.

A person belonging to lower socio-economic status is more likely to suffer from physical and mental stress¹¹. So it can be hypothesised that children coming from lower socio-economic strata are more likely to be unfit and fail in the Kraus-Weber Tests.

So the aim in this study is to assess fitness of today's urban school children using Kraus-Weber Tests and to compare muscular fitness (as measured by Kraus-Weber Tests) of healthy school-going children between 9 years to 12 years of age (older pediatric age-group) with the socio-economic strata of society to which they belong.

MATERIALS & METHODS:

The study was conducted on 320 randomly selected students (studying in standards 3rd to 8th) of a Central Government School in Surat, half of whom were of either sex. The area and school were chosen keeping in mind the composition of Surat city with due consideration to various parameters so as to get an unbiased representative sample. Approval of the Institutional Ethics Committee was taken for the study.

The selected students were between 9 and 12 (completed) years of age. This is the age group in which the rate of growth and development is maximal. Also, dynamic conclusions have been drawn in this age

group in earlier studies^{1,5,6,7,8}. Confirmation of age was done from school registers.

Out of the 320 selected students, 64 belonged to each of the 5 different socio-economic classes as determined by the amalgamation of modified Kuppuswamy's¹⁰ and Prasad's¹² classification. The criteria for classification are elaborated as under:

Items:

A. Education of head of household

Items:	Weightage
Professional degree, PG and above	7
BA or BSc degree	6
Intermediate or post-high school diploma	5
High school certificate	4
Middle school completion	3
Primary school or literate	2
Illiterate	1

B. Occupation of head of household (last occupation in case of retired persons)

Professional	10
Semi-professional	6
Clerk, shop-owner, farm-owner etc.	5
Skilled worker	4
Semi-skilled worker	3
Unskilled worker	2
Unemployed	1

C. Per-Capita income (Rs/month^{*})

> 100	12
50 – 99	10
30 – 49	7
15 – 29	4
< 15	1

*Current slabs can be obtained by multiplying the above slabs by a factor which can be derived as follows:

Multiplying factor = $4.93 \times (\text{Consumer Price Index}) / 100$

In any individual case the summation of scores in the above 3 categories can be used to derive the socio-economic status of the concerned family in the following way:

Score	Socio-economic status
26 – 29	Upper
16 – 25	Upper middle
11 – 15	Lower middle
5 – 10	Upper lower
Below 5	Lower

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.

The following tests were performed on the participating children after proper explanation and alleviating their anxiety. Observations were recorded after taking due care to reduce instrument and observer errors to a minimum.

Kraus-Weber Tests^{3,4}: 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. 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 to confirm their capacity on that performance. There was no warming-up before the children underwent the tests. Following is a short description of the 6 Kraus-Weber Tests:

Test 1: "Abdominals Plus Psoas" – The subject was made to lie supine with hands behind the neck. The feet were held by the examiner. The subject was instructed (on command) to roll up into a sitting position.

Test 2: "Abdominals Minus Psoas" – The subject was made to lie supine with hands behind the neck and knees bent. The feet were held by the examiner. The subject was instructed (on command) to roll up into a sitting position.

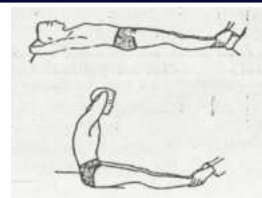


Figure # 1: Kraus-Weber Test no. 1: "Abdominals Plus Psoas"

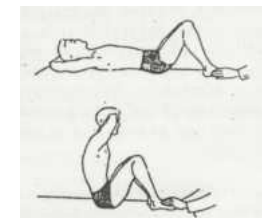


Figure # 2: Kraus-Weber Test no. 2: "Abdominals Minus Psoas"

Test 3: "Psoas (Lower Abdomen)" – The subject was made to lie supine with hands behind the neck and legs extended. He was instructed (on command) to lift the feet 25 cm (10 inches) above the ground and maintain this position for 10 seconds.



Figure # 3: Kraus-Weber Test no. 3: "Psoas (Lower Abdomen)"

Test 4: "Upper Back" – The subject was made to lie prone with hands behind the neck and a pillow under the abdomen (far enough down to give a see-saw effect). He was instructed to raise his chest, head and shoulders and maintain them in this position for 10 seconds while the examiner holds down the feet.



Figure # 4: Kraus-Weber Test no. 4: "Upper Back"

Test 5: "Lower Back" – The subject was made to lie prone over a pillow with head resting on his hands. He was instructed to lift his legs up without bending in the knees and maintain this position for 10 seconds while the examiner holds down his chest.

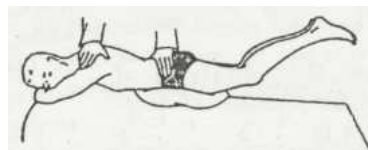


Figure # 5: Kraus-Weber Test no. 5: "Lower Back"

Test 6: "Back and Hamstrings" – The subject was made to stand erect with his hands at sides and feet together. He was instructed (on command) to lean down slowly to touch the floor with his fingertips. The knees were kept straight and the leaning down position was maintained for 10 seconds. No bouncing was allowed to touch the floor.



Figure # 6: Kraus-Weber Test no. 6: "Back and Hamstrings"

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' across various socio-economic strata were compared using **Chi-Square Test¹³**.

Results were compared with preceding studies and conclusions were drawn.

RESULTS & OBSERVATIONS:

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.

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.

Distribution with respect to Socio-Economic Status of Kraus-Weber Tests Successes and Failures:

Table # 1: Statistical Analysis of data obtained

SE status	KRAUS-WEBER TESTS		TOTAL	Prevalence of unfitnes s (%)	EXPECTED VALUES		CHI-SQUARE VALUES			P VALUE
	S	F			S	F	S	F	TOTAL	
"5"	54	10	64	15.625	45.6	18.4	1.55	3.83	33.2	<0.001 (Highly Significant)
"4"	54	10	64	15.625	45.6	18.4	1.55	3.83		
"3"	50	14	64	21.875	45.6	18.4	0.42	1.05		
"2"	40	24	64	37.5	45.6	18.4	0.69	1.7		
"1"	30	34	64	53.125	45.6	18.4	5.34	13.23		
TOTAL	228	92	320							

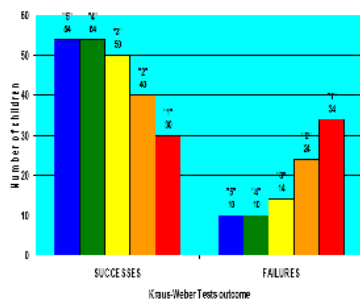


Figure # 7: Graphical Representation of data obtained

DISCUSSION:

Overall Failures in Kraus-Weber Tests:

The early work of Kraus and Hirschland⁴ 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 workers⁴ 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 in Lonavla was conducted by Gharote and Ganguly⁶. The failure percentage reported by them was 40.3%. Another study conducted by Gharote et al⁷ reported still higher percentage of failures to the extent of 63.9%. Moorthy⁸ observed highest percentage of failures to the extent of 84.8%. Thereafter, a study of 250 school children in Lonavla by Gharote¹ revealed a failure percentage of 20.8%. Failures in 3 test items indicated signs of maladjustment¹⁴. Percentage of failures in more than 1 test item as found by Gharote¹ in 1999 – 2000 was 4.8%. Out of this, 3.6% failed in 2 items and 1.2% in 3 items.

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 overall trend before this study had been towards a decline in failure percentage^{1,3,4,6,7,8}. Gharote¹, in the last recorded study conducted at Lonavla 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^{11,15}. 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 them⁹. 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 maladjustment¹⁴. Studies at regular intervals in various different parts of the country are required to substantiate these arguments. Counseling sessions by trained psychologists in schools can help bring the failure percentage down¹⁶.

Failures in individual test items of Kraus-Weber Tests:

Flexibility Test (Test 6): Flexibility Test (Test 6) caused the greatest percentage of failures^{14,17,18,19}. Flexibility failures increased as age increased¹⁴. Flexibility failures reported in the first study by Gharote and Ganguly⁶ was 20.3%. Next study by Gharote et al⁷ reported flexibility failures to the extent of 45.9%. Moorthy⁸ observed 42.4% flexibility failures. Gharote¹ 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.

Tests of Abdominal Muscle Fitness (Tests 1, 2 and 3): Most strength failures have been caused by abdominal weakness. Gharote¹ also found a high percentage of failures in these tests. Thus, Abdominal, Back and Hamstring muscles have been singled out as weak areas by most workers^{1,5,6,7,8}.

Tests of Upper and Lower Back Muscle Fitness (Tests 4 and 5): The first Indian study by Gharote and Ganguly⁶ reported very low percentage of failures as 0.5% and 2.9% respectively in the tests of Upper and Lower Back. Gharote¹ in 1999 – 2000 found no failures in these tests. These 2 strength tests have not been considered to be discriminative, since practically no failures have been observed in them by other workers.

It has been reported that those who failed in Kraus-Weber tests appeared to be sick, emotionally imbalanced and having constant strain in them⁹. So it can be inferred that a failure is more likely to get poorer grades in class.

In present study, 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^{1,5,6,7,8,14} which had earmarked Abdominal Muscle Fitness and Muscle Flexibility as weak areas. 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. 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 and Yoga could be the answer to decreasing Flexibility failures⁵. Effect of these practices on muscular fitness needs to be further evaluated in detail.

Socio-Economic Status:

Socio-economic status also has a very strong statistically significant effect on success in Kraus-Weber Tests. Children coming from lower socio-economic strata are more likely to fail in Kraus-Weber Tests as a less favorable socio-economic condition puts greater physical and emotional stress¹¹. School children coming from higher socio-economic strata are more likely to pass these Tests than those coming from lower strata. A child coming from a socio-economically sound family gets a proper upbringing. Adequate attention is given to his education. Resources are provided to encourage extra-curricular activities which give him a wider experience of society. He is brought up with the right morals and possesses a strong value system. He can differentiate between right and wrong and take care of himself. He interacts with the 'right' kind of people from his birth. Such a child is healthier physically, mentally and spiritually than someone coming from a lower stratum who might be under various stresses and strains. Socio-economic condition thus has an effect on physical, mental, social and emotional make-up of a child which in turn determines success or failure at Kraus-Weber Tests¹⁴. Kuppuswamy theorized that socio-economic status depends as much on education and occupation of head of the family as on per-capita income. One should not forget to consider this fact while determining the socio-economic status of a

particular subject¹⁰. The Government and NGOs should join hands to take more stringent steps to ensure that children coming from lower strata of society especially destitute and orphans get a proper upbringing if not an ideal one so that tomorrow's future is in safe hands.

CONCLUSION:

Increased failures to clear the Kraus-Weber Tests have been noted in this study indicating increasing mental stress on school children due to expectations from family and growing competition. Counseling sessions by trained psychologists in schools can help bring the failure percentage down.

An increase in Flexibility failures is noted in this study as compared to previous studies. Training in relaxation techniques, aerobic maneuvers and Yoga could be the answer to decreasing Flexibility failures.

Muscular fitness (as measured by Kraus-Weber Tests) has been found to have a positive correlation with Socio-Economic Status of healthy school-going children between 9 years to 12 years of age (older pediatric age-group). Better the Socio-Economic Status; more are the chances of passing in Kraus-Weber Tests and vice versa. Efforts should be made by the Government and NGOs to ensure that all school children enjoy a healthy socio-economic and cultural environment at their homes and in school.

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