

A comparative study of minimum muscular fitness in students with visual impairment and normal vision

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The protective effects of fitness on several health related outcomes have clearly been shown among normal sighted students. However, currently there is a dearth of data pertaining to children with visual impairment regarding their fitness. The purpose of the study was to examine differences in minimum muscular fitness among students with visual impairment and normal vision. Two hundred thirty six students; visually impaired (n=125) and sighted (n=111); of South India matched on age, height, weight, and gender participated in this study. Participants were evaluated for minimum muscular fitness through Kraus -Weber test. Chi - square test was used to calculate the frequency and percentage of failure and success in both the groups. The results demonstrated that sighted students had significantly greater levels of muscle fitness than students with visual impairment. It appears that students with visual impairment are deficient in muscle strength as compared to sighted students. Inclusion of physical activities such as yoga in the regular curriculum of the school is suggested for the improvement of the failures status.

Keywords: visual impairment, minimum muscles fitness, Kraus-Weber test

Vision is the prime source to acquire knowledge about the surroundings and lack of this affects the regular activities of the individual. Visual impairment (VI) refers to the partial loss of vision or total loss of vision (World Health Organisation, 2009) which restricts the functional abilities resulting the lower fitness level. Fitness is essential for growth and development which is associated with prospective benefits for various health consequences. Especially, muscular fitness is the most imperative aspect of function, mobility, exercise, independence, and activities of daily living, as well as preventing diseases (Wolfe, 2006).

Limited research showed that individuals who are visually challenged have reduced levels of health related fitness than their sighted peers (Lieberman & McHugh, 2001). Previous studies have demonstrated that those with VI are deficient in motor control (Reimer, Cox, Boonstra, & Smits-Engelsman, 2008), gross motor skills (Haibach, Wagner, & Lieberman, 2014), minimum muscular fitness (Seelye, 1983), strength and power (Horvat, Ray, Croce, & Blasch, 2004) compared to sighted counterparts.

In the present study, muscle fitness refers to the first category where the strength and flexibility of different groups of muscles was measured by using Kraus Weber test (K-W test). K-W test, a technique that was developed by Kraus and Hirschland (1954) after 18 years of clinical experience that involves a sequence of exercises to assess the fitness levels for different groups of muscles; back, abdominal, psoas and hamstring muscles. The test was selected for this population due to the advantages that it offers such as simplicity of administration, low risk, minimal use of equipment and quick testing of each participant (Macáková & Burianová, 2007). However, it can also be used as an indicator of overall health in similar age groups. Several studies have measured the minimum muscular fitness in normal sighted children using K-W test (Kulkarni

& Desai, 2010; Macáková & Burianová, 2007; Rawat, Rajesh, & Nagarathna, 2014). To the best of our knowledge, there was no study available that measured the minimum muscular fitness of individuals with VI compared to normal sighted in Indian population though one-fifth of the world's visually impaired people are in India (Khanna, Raman, & Rao, 2007). Therefore, this study was proposed to evaluate the muscular fitness status of children and adolescent with VI and to compare the same with normal sighted.

Method

Participants

Total of 236 students were recruited for this study, out of which 125 (49 girls, 13.04 ± 2.72 years) were visually-impaired and 111 (45 girls, 12.73 ± 2.43 years) had normal vision. The source of participants was from special educational school for the blind and different mainstream schools of Bangalore. Participants were recruited through convenience sampling technique because of their accessibility and proximity to the research institution. Observations and tests were carried out at the school premises. Both groups were matched on age, gender, height, and weight. Students of both genders, aged 9 to 20 years with various degrees of blindness were included in this study. Exclusion criteria were: multiple impairments, recent muscular-skeletal injury and other physical disabilities.

Procedures and methods used in the present study were approved by SVYASA's Institutional Ethical Committee (IEC). Each participant agreed to participate and signed informed consent was obtained from students, their parent or legal guardian and school authorities as well.

Research design

This study was a comparative study. Each participant was assessed only once. The data of students with VI were compared with normally sighted.

Assessments

The K-W test is reliable and valid (Babalola, Awolola, & Hamzat, 2008) which consists of six different components to measure different muscle groups with regard to their strength and flexibility. The six tests are

- 1: Test of the strength of abdominal and psoas muscles.
- 2: Test of abdominal muscles without psoas.
- 3: Test for the strength of psoas and lower abdominal muscles.
- 4: Test for the strength of the upper back muscles.
- 5: Test for the strength of the lower back muscles.
- 6: Tests the flexibility of back and ability to stretch the hamstring muscles.

Procedure

The K-W test was administered to the participants in their school, according to the procedure described below. The procedure of each test-item was explained to the students in detail and then they were asked to perform the same. For the better understanding of the students, the tactile model was also used for each step. The test was performed as follows.

Test 1: The participants lied supine with hands behind the neck. The feet were held by the examiner. On command the participants rolled up into a sitting position.

Test 2: The participants lied supine with hands behind neck and knees bent. The feet were held. On command the participant rolled up into a sitting position.

Test 3: The participants lied flat on their back with the hands behind his neck. They were instructed to lift both the legs 10 inches off from the floor keeping the knees straight. This position was maintained for 10 seconds.

Test 4: The participants lied with a pillow under his lower abdomen and groin. The examiner held their feet down. The participants were asked to lift head, shoulders and chest off from the floor and maintained this position for 10 seconds.

Test 5: The participants lied in prone with a pillow under their lower abdomen and groin hands behind the neck. The examiner holds the chest down. The participants were asked to lift legs with knee straight off floor and maintained this position for 10 seconds.

Test 6: The participants were made to stand erect with their hands at sides and feet together. They were instructed to lean down slowly to touch the floor with their fingertips. The knees were kept straight and then leaning down position was maintained for 10 seconds. No bouncing was allowed to touch the floor.

If a participant fails in any one out of the above mentioned six tests, then it was considered as fail. Pass in this test was considered only when participant successfully passes in the entire six tests.

Blinding and masking

Each student was given a unique code and treated anonymously, ensuring that the statistician was blind to the source of the data. The trained research assistants were masked to participants' group assignment during analysis. All test personnel were trained and were given detailed instruction related to the data collection.

Data analysis

All the statistical analyses were performed using SPSS version 20.0. Since all variables were categorical and nominal levels of measurement, no assumptions for parametric test were checked. Descriptive statistics was performed to examine the frequency and percentage to compare successes and failures in K-W test items in each group based on age and gender. Independent sample t-test was performed to determine the significance differences in physical characteristics.

Results

Baseline demographic characteristics are presented in Table 1. There were no significant difference between VI and normal sighted students in age ($p = 0.358$), height ($p = 0.838$), weight ($p = 0.104$) and gender ($p = 0.834$). Groups were different only in terms of body mass index ($p < 0.05$).

Table 1: Demographic data

	Variables	VI (n=125)	Normal Sighted (n=111)	P value
Gender	Boys	76 (60.8%)	66 (59.5%)	0.834*
	Girls	49 (39.2%)	45 (40.5%)	0.834*
Anthropometric parameters	Age	13.04±2.72	12.73 ±2.43	0.358**
	Height	144.35±13.82	144.70±12	P=0.838**
	Weight	36.65±12.87	34.28±8.79	P=0.104**
	BMI	17.14±3.95	16.09±2.11	P=0.013**

Legend: *- Chi 2 test, **- Ind t' test, BMI- Body Mass Index

Result of the study indicated the success and failure rate of students in both the groups in K-W test stratified by group, gender and age

(Table 2). Performance on individual items for both the groups were also evaluated (Table 3).

Table 2: Analysis of success and failure rates with respect to Group, Gender and Age in the K-W test for VI and sighted group

Comparison	Group	K-W Test		value
		Success	Failure	
Group wise	VI	30 (24%)	95 (76%)	P<0.001
	Sighted	61(55%)	50 (45%)	

Gender wise	Girls	VI	10 (20.4%)	39 (79.6%)	P=0.002
		Sighted	23 (51.1%)	22 (48.9%)	
Age wise	Boys	VI	20 (26.3%)	56 (73.7%)	P<0.001
		Sighted	38 (57.6%)	28 (42.4%)	
	Pre-pubertal	VI	18 (19.4%)	75 (80.6%)	P<0.001
		Sighted	50 (54.3%)	42 (45.7%)	
Pubertal	VI	12 (37.5%)	20 (62.5%)	P=0.157	
	Sighted	11 (57.9%)	8 (42.1%)		

Table 3: Performance on Individual Items of K-W Test for both groups

Items	Group	K-W Test		P value
		Success (%)	Failure (%)	
Abdomen with psoas	VI	98 (78.4)	27 (21.6)	0.026
	Sighted	99 (89.2)	12 (10.8)	
Abdomen without psoas	VI	86 (68.8)	39 (31.2)	0.004
	Sighted	94 (84.7)	17 (15.3)	
Psoas and lower abdomen	VI	56 (44.8)	69 (55.2)	P<0.001
	Sighted	100 (90.1)	11 (9.9)	
Upper back	VI	92 (73.6)	33 (26.4)	P<0.001
	Sighted	107 (96.4)	4 (3.6)	
Lower back	VI	58 (46.4)	67 (53.6)	P<0.001
	Sighted	81 (73)	30 (27)	
Back and hamstring	VI	78 (62.4)	47 (37.6)	P<0.001
	Sighted	100 (90.1)	11 (9.9)	

Group wise results of K-W test: There was significant difference observed between the groups in failure rates ($p = 0.001$). The overall failure percentage of VI group was 76% (95 students of 125). Out of this, 16% of students (20) failed in single test item, 18.4% (23) failed in double test items, 17.6% (22) failed in 3 test items while 7.2% (9) failed in 4 test items and 9.6% (12) failed in 5 items. Moreover, 7.2% of students (9) could not pass in any test.

The failure percentage of normal sighted group was 45% (50 students of 111). Out of this, 25.2% (28) failed in single test item, 10.8% (12) failed in double test items, 7.2% (8) failed in 3 test items while 0.9% (1) failed in 4 test items and 0.9% (1) failed in 5 items.

Gender wise results of K-W test: Significant difference was found between the groups with respect to genders, boys ($p < 0.001$) and girls ($p = 0.002$) on the K-W test. The failure percentage observed in boys was 73.7% (56 of 76) in VI group whereas in sighted group it was 42.4% (28 of 66). Similarly, the failure percentage of girls in VI group was 79.6% (39 of 49) while in sighted group was 48.9% (22 of 45).

Age wise results of K-W test: Based on the age, total students of each group were divided into two categories; pre-pubertal (aged 914 yrs) and pubertal (aged 1520 yrs). There was a significant difference ($p < 0.001$) in minimum muscular fitness for pre-pubertal group, whereas no difference ($p = 0.157$) was observed in the pubertal group between the VI and sighted students. The failure percentage observed in pre-pubertal category was 80.6% (75 of 93) and 45.7% (42 of 92) in VI and sighted group respectively. The failure rate of pubertal category of VI group was 62.5% (20 of 32) while the sighted group was 42.1% (8 of 19).

Results of both groups on Individual test items of K-W test: The results of VI group in individual test items of K-W test were as follows; maximum failure percentage of 55.2% (69 of 125) was

found in test 3 (psoas and lower abdominal muscles) followed by 53.6% (67) in test 5 (lower back muscles), 37.6% (47) in test 6 (flexibility in abdominal, back and hamstring muscles), 31.2% (39) in test 2 (abdominal muscle without psoas), 26.4% (33) in test 4 (upper back muscles) and test 1 (Abdominal muscle with psoas) showed lowest percentage of failure of 21.6% (27).

In sighted group, total number of students was 111. Maximum failure percentage of 27% (30) was found in test 5 followed by 15.3% (17) in test 2, 10.8% (12) in test 1. Test 3 and test 6 showed 9.9% (11) of failure whereas test 4 showed lowest percentage of failure 3.6% (4).

Discussion

In support to the hypothesis, the current study found that the minimum muscular fitness level is significantly lower in students with VI than normal sighted. Group wise comparison demonstrated that, in VI group only 30 of 125 (24%) students succeeded in all the tests while 61 of 111 (55%) passed in sighted group. In line to this, a previous study found that 46 percent of the blind students passed the test as compared to 95 percent of the normally sighted out of 111 Detroit elementary school students who were examined on minimum muscle fitness using the K-W test (Seelye, 1983). In accordance to these findings, numerous other studies demonstrated that children who are visually impaired consistently exhibited lower levels of fitness than their sighted peers (Horvat et al., 2004; Lieberman & McHugh, 2001; Wagner, Haibach, & Lieberman, 2013).

In gender comparison, despite the insignificant difference between the number of boys and girls, the differences in failure scores are worth noting. It was observed that failure percentage is higher in VI group for both boys (73.7%) and girls (79.6%) as

compared to boys (42.4%) and girls (48.9%) of sighted group. A study by Lieberman & McHugh (2001) showed poorer performance of boys and girls of VI group as compared to the boys and girls of sighted group in various health related fitness. In contrast to this, another study showed that there were no differences in most isometric and concentric strength measurements of the lower limb muscles between the blind and sighted women (Giagazoglou et al., 2009).

In age comparison, there was significant difference observed in pre-pubertal group ($p < 0.001$), whereas no difference was observed in the pubertal group ($p = 0.157$) between the students of VI and sighted. In VI and sighted group, the failure rate of pre-pubertal students was 80.6% and 45.7% while in pubertal group it was 62.5% and 42.1% respectively. This indicates that in both the groups the pubertal students have enhanced fitness levels than the pre-pubertal students.

Maximum failure percentage in VI group was 55.2% in the lower abdominal test (test 3) and in sighted group 27% in lower back muscles test (test 5). No other reports were available till date to compare the maximum failure rate in specific K-W tests for students with VI. Previous studies on normal sighted students demonstrated maximum failure rate in flexibility test (Kulkarni & Desai, 2010), upper back muscles test (Prasad, 2013; Rawat et al., 2014), abdominal, back and hamstrings tests (Gharote, 2000). The observation of this study was not similar with the above findings.

The above observations may be explained by the fact that vision loss has a negative impact on an active lifestyle, which adversely affects the physical functioning of individuals with VI (Ray & Wolf, 2008). VI is thought to be associated with decrease in leisure activities as a result of compromised mobility and social functions (Crews & Campbell, 2001). Moreover, they are unable to produce adequate amount of force for the performance of any task quickly as they are vigilant to each of their movement (Horvat et al., 2004). These could be the reasons of the deteriorating performance of the VI group in comparison with sighted counterparts.

Physical deficiencies that one acquires early in adulthood may persist as one ages, resulting in frailty (Sowers et al., 2005). Amalgamation of yoga practices in the physical activities program in the schools is suggested for the improvement of minimum muscular fitness and health status of students with VI. No adverse events were reported during the trial.

Strength and limitations of the study

To the best of our knowledge, this is the first study to compare the minimum muscular fitness in students with VI and normal vision on Indian population. The variability of the participants' visual status can be viewed as a limitation in this study. We acknowledge that it may be more appropriate to analyze the data using subgroups of individuals with VI. Students were not familiarized with the data collectors at the beginning so some students did not participate to the best of their ability.

Applications of the Study

The result of the current study revealed the obvious need of an evidence-based interventional research on students with VI which may improve their independence by increasing physical functioning and reducing the intrinsic factors that contribute to increased fall risk and reduced health.

Suggestions for future research

Future studies may be conducted considering the following

suggestions. The present study is limited to muscles fitness. Some other variables like psychological, Quality of life and cognitive abilities can be compared with normal sighted and students who are visually impaired. A similar study may be conducted by drawing samples from other states making it more comprehensive. A multi-center RCT is recommended for confirming the results of this study.

Conclusion

In this present study, the sighted students have the highest percentage of pass in K-W tests as compared to VI students which indicates to an urgent need of regular physical fitness training programs for the enhancement of their health related fitness.

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