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An Exploratory Study Of Back And Hamstring Flexibility Of Female School Students Studying In Upper Primary Classes

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Abstract

The purpose of the present study was to compare the sit and reach test outcomes out comes by class of study amongst girls. A cross-sectional study design using ANCOVA was used to evaluate girls 10 to 13 years who completed sit and reach test (score). The outcome test results were descriptively examined and compared by class. The study participants consisted of 90 girls of government schools of Delhi, India, with a mean age of 11.47 years). Upon inter-group comparisons, the girls showed insignificant differences in their back and hamstring flexibility upon class wise comparison while controlling for body mass index (covariate) using IMB SPSS software (p = >.05). These data might serve as a guide to future longitudinal research projects to evaluate normative measures of back and hamstring flexibility and guide targeted training interventions to promote sustained back and hamstring flexibility fitness measure in young girls with deficits relative to their body composition factors.

Keywords: Sit and reach, BMI, Fitness, ANCOVA.

I. Introduction:

The sit and reach test is a commonly used measure of hamstring and lower back flexibility (Wells, Katharine & Dillon, Evelyn., 2013). It involves sitting on the floor with legs stretched out and reaching forward as far as possible to measure the distance between the fingertips and a designated point (Committee on Fitness Measures and Health Outcomes in Youth; Food and Nutrition Board; Institute of Medicine; Pate R, Oria M, Pillsbury L, editors. Fitness Measures and Health Outcomes in Youth. Washington (DC, 2021). Research has shown the

sit and reach test has reasonable validity and reliability when used in school settings to assess flexibility. A meta-analysis examined the criterion-related validity of sit and reach tests for estimating hamstring and lumbar extensibility. The analysis found the sit and reach test is a valid and reliable measure of hamstring and lower back flexibility (Mayorga-Vega et. al., 2014).

A study compared three different sit and reach tests in 102 female university students. The traditional sit and reach, back saver sit and reach, and modified sit and reach were compared. All three tests were found to be valid measures of hamstring flexibility in female students (Baltaci, Gul & Un, N & Tunay, Volga & Besler, A & Gerçeker, S., 2003).

While the evidence is not yet conclusive, flexibility may be linked to various health outcomes in youth, such as prevention of back pain, injury, and posture-related problems. Schools may wish to include flexibility testing to help educate students and parents about flexibility as a component of overall musculoskeletal health, function, and performance.

There are several key factors that can affect sit and reach test scores for female students in upper primary classes:

- Flexibility: Hamstring and lower back flexibility are the primary factors measured by the sit and reach test (Jankowicz-Szymańska A, et. al., 2022). Greater flexibility in these areas results in higher test scores.
- Body Weight Status: A study found that children with normal and poor flexibility did not differ in height, weight, or BMI. However, overweight children tended to have lower sit and reach scores compared to those with normal weight status.
- Spinal and Joint Posture: In children with normal flexibility, a greater range of flexion was observed in the thoracic and lumbar spine, with less flexion in the hip, knee and ankle joints during the sit and reach test. Proper spinal and joint positioning is important for maximizing test scores.
- Age and Sex: Sit and reach scores tend to increase with age in both boys and girls. Girls generally score higher than boys on the sit and reach test, likely due to differences in flexibility between the sexes.
- Training and Physical Activity: Participation in sports and regular stretching programs can improve sit and reach scores by increasing hamstring and lower back flexibility. The type of sport may also impact flexibility, with some sports like artistic gymnastics requiring greater flexibility.

In summary, the key factors affecting sit and reach test performance in female upper primary students are hamstring and lower back flexibility, body weight status, spinal and joint posture, age, sex, and physical activity levels. Despite the absence of any conclusive evidence, especially in the Indian context, the sit and reach test is a valid and reliable measure of hamstring and lower back flexibility in female students, including those in upper primary classes. The present study can play a significant role in designing, talent identification, screening, incorporating flexibility testing in schools that can provide valuable information

about overall musculoskeletal health and function. Take remedial actions accordingly to avoid burnout.

Objectives of the study:

1. To measure and study the back and hamstring flexibility as a measure of physical fitness.
2. To analyze the data class wise
3. To compare the differences in sit and reach test scores of classes 6, 7, and 8.

Hypothesis:

1. H_0 = There will not be a significant difference in the mean score of demographic variables of girls of classes 6, 7 and 8. Tested through the Levene's test of equal variances assumed.
2. H_0 = There will not be a significant difference in the sit and reach score between classes 6, 7 and 8 when accounted for "Body Mass Index".

II. Methodology:

Informed consent ahead of this study was taken from parents and the teachers of school girls from various Delhi schools was taken. Following procedure.

This test involved sitting barefoot on the floor with legs stretched out straight ahead. Shoes should be removed. The soles of the feet to be placed flat against the box. Both knees should be locked and pressed flat to the floor. By keeping the hands on top of each other or side by side, palms facing downwards, the subject reaches forward along the measuring line as far as possible. The final position shall be held for one or two seconds while the distance reached is recorded. The score is recorded to the nearest centimeter as the distance reached by the hand. Just one trail is given to each participant. IBM SPSS statistical package was used to analyze the data.

Exclusion criteria:

1. No prior physical discomfort or pain
2. Should not have undergone surgery or chronic back pain in the last 1 year.
3. BMI over 23
4. Active sports person

Inclusion criteria:

1. Only females in the age group of 10 to 13 years
2. Studying in a regular in Delhi, NCT school

III. Results and discussion:

Table-1 shows the demographic variables of the girls (N=90) studying in classes 6 to 8. Mean age is 11.47 ± 1.15 years. Mean BMI 19.88 ± 1.16. the sit and reach test score mean value was 23.20 ± 5.00.

Table-1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age (In years)	90	10	13	11.47	1.153
Body Mass Index	90	18	23	19.88	1.160
Sit and Reach Test Score (in cms)	90	10.0	34.0	23.207	5.0008
Valid N (listwise)	90				

Table 2 shows class wise break up of sit and reach test scores. It was observed that mean values of each class did not show much variation from the total mean value (23.02 ± 5.00)

Table-2: Descriptive Statistics

Dependent Variable: Sit and Reach Test Score (in cms)

Class of study	Mean	Std. Deviation	N
6	23.033	3.9405	30
7	23.400	4.0052	30
8	23.187	6.7165	30
Total	23.207	5.0008	90

The table-3 shows whether the different class girls were statistically significantly different on sit and reach test scores having adjusted for the covariate, BMI (Body Mass Index). Put another way, whether there was an overall statistically significant difference in flexibility between the three groups once their means had been adjusted for body mass index.

Table-3: Tests of Between-Subjects Effects

Dependent Variable: Sit and Reach Test Score (in cms)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	34.739[a]	3	11.580	.455	.715	.016
Intercept	49.096	1	49.096	1.927	.169	.022
BMI	32.705	1	32.705	1.284	.260	.015

Class_group	3.362	2	1.681	.066	.936	.002
Error	2191.017	86	25.477			
Total	50695.200	90				
Corrected Total	2225.756	89				

a. R Squared = .016 (Adjusted R Squared = -.019)

A one-way ANCOVA was conducted to compare the back and hamstring flexibility of three groups whilst controlling for BMI. Levene's test and normality checks were carried out and the assumptions met. There was no significant difference in mean sit and reach test score [F(2,86)=3.362, p=.936] between the three groups while adjusting for BMI. In view of the above finding, therefore, there was no need for running or interpreting the post hoc tests.

The partial Eta Squared value indicates the effect size and it was compared with Cohen's guidelines (0.2 – small effect, 0.5 – moderate effect, 0.8 – large effect). It can be seen that for group, the effect size is small (0.02). This value describes that only 0.2% of the variance in the dependent variable (sit and reach test score) is explained by the independent variable (class of study).

To get a better understanding of how the covariate has adjusted the original group means, the **Estimates** table-4, is shown below:

Table-4: Estimated Marginal Means

Dependent Variable: Sit and Reach Test Score (in cms)

			95% Confidence Interval	
Class of study	Mean	Std. Error	Lower Bound	Upper Bound
6	22.987[a]	.922	21.153	24.821
7	23.458[a]	.923	21.623	25.293
8	23.175[a]	.922	21.343	25.007

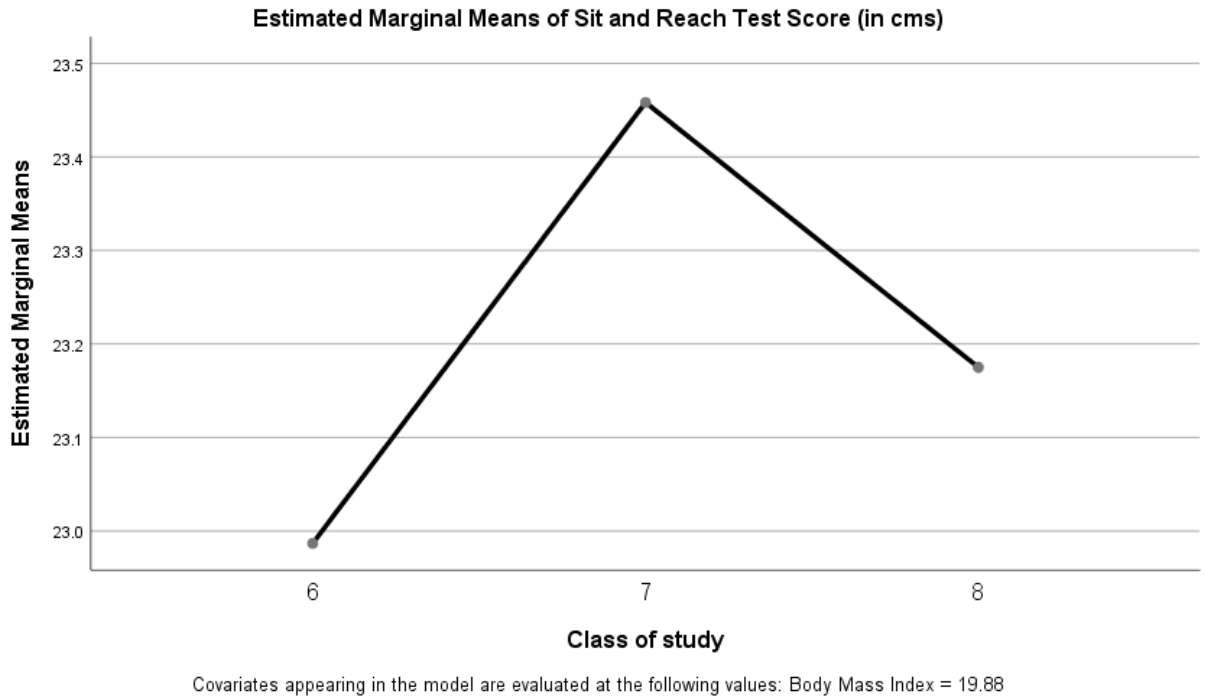
a. Covariates appearing in the model are evaluated at the following values: Body Mass Index = 19.88.

The estimated marginal means section of the output gives the adjusted means (controlling for the covariate 'BMI') for each "class of study". This simply means that the effect of 'BMI' has been statistically removed. From these adjusted means, the girls of neither of the 3 classes were different on average flexibility after adjusting for body mass index.

The current research on this topic is limited. The available studies have primarily focused on evaluating overall physical fitness and motor skills in children, rather than specifically examining back and hamstring flexibility in girls during this age range. One such cross-sectional study design (Sugimoto, Dai, 2023) was used to evaluate five physical fitness variables of children in the age group of 6–11 years. The outcome measures including test

results were descriptively examined and compared by gender. Girls showed superior sit and reach performance (p = 0.002) compared with boys.

Fig-1: Profile Plots



IV. Conclusion:

The current study found no significant differences between class 6, 7 and 8 girls in the measure of sit and reach test while controlling for health-related physical fitness competent BMI. Both the null hypothesis stands accepted. Future research is needed to further investigate how the back and hamstring flexibility test parameters in early childhood and in adulthood may influence physical activity participation, health, and overall well-being as children transition from adolescence to adulthood. In summary, while no class wise differences were found in back and hamstring flexibility, additional studies are warranted to understand the long-term implications training, lifestyle, diet and nutrition, correlation with other similar physical fitness factors like, leg strength, shuttle run etc.

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