Examining the Co-Relation between Posture, Flexibility and General Physical Fitness in Early Adolescents

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Abstract

Background: This study aims to examine the co-relation between general physical fitness, flexibility, and posture in junior high school children.

Objectives: To examine the correlation between posture flexibility and general physical fitness in early adolescent's male children of primary school (8-14 years of age) along with relationship in between all parameters of posture evaluation flexibility and fitness which include anthropometrics measurements relations like age height weight and BMI as well.

Methods:BMI, height(cm) and weight(kg) were measured using standard protocols for children. Physical fitness was determined by PAQ-C. Flexibility was assessed by sit and reach test in trials and posture were assessed by using the APECS. Data analysis was done by SPSS IBM software.

Results: Results suggest children with greater height have significant greater flexibility where $r=0.398$, $p<0.05$. No children are underweight and among all 84% have normal weight. Trials of sit & reach have a significant linear relationship as $r=0.829$ and $p<0.01$. Children show lower scoring in Q1 and in total activity frequency Q8 and Highest scorers were for Q4, Q6 and Q7. Body alignment is often associated with positive relationship with head shoulder and pelvis and often negatively associated with knee and foot.

Conclusions: There is a correlation which is significant ($p<0.05$) between knee alignment and sit and reach flexibility measures for male participants. Male children who are good in PE classes associated with high activity frequency and often enjoy spare time activities leads to high active groups.

Keywords: *flexibility, physical fitness, correlation, significant, linear relationship*

1. Introduction

The prevalence of postural insufficiency raises from childhood to early adolescence. The present study aims to examine the co-relation between Spinal Posture, Flexibility & Physical fitness in early adolescents.

Changes in spinal posture or positioning are associated with flexibility, joint mobility & physical fitness but evidence of this relationship is still not evident enough to prove the corelation between them in early adolescents of primary schools who start working in their early lives under the various circumstances. The main objective is to identify evidences of correlation between these parameters regarding spinal posture in male children and flexibility of hamstring & lower back muscles along with General physical fitness measures by some specific tests, measuring tools & applications. Postural alignment state importance as deviation from normal alignment leads to excessive stress on musculoskeletal system.[27]

Postural problems are common in this population (early adolescents school going children main factors differentiating posture are age, overweight, obesity, lifestyle as well as the amount of physical activity and fitness, low physical fitness or activity may lead to inappropriate posture.[18]

Longitudinal studies suggest that even in normal weight children there was deterioration of posture which was due to increase in adipocity.[18]

Incorrect posture refers to an abnormal state of body which is unable to maintain the stable position & normal function of tissues & organs in upright position of state. During adolescence posture changes because of hormonal influence with the onset of puberty & musculoskeletal growth. It is during this period that body differences arise between males & females with males tending towards longer leg & arm length, wider shoulders, smaller hip width & greater overall skeletal size & height than females. Because of the rapid growth spurt, individuals specially males may appear ungainly & poor postural habits & changes are more likely to occur at this stage.

Evaluation of posture for sagittal plane defined as bone and vertebral column orientation as from lateral view.[27] Maintenance of correct posture requires muscles that are strong & flexible & easily adaptable to environmental change. These muscles should work against gravity & should be in harmony with one another to maintain an upright posture. Muscles must be flexible enough to maintain the good state of spine.

Complex system of spinal posture consisted of ligaments musculature control system for neurological processes. As posterior pelvis rotation can cause future back pain and can be a risk factor too, prolonged sitting can get serious ailments of head and spine alignment.[28] Frontal plane deformities are there along with sagittal plane posture misalignment.[28]

Data indicate that rural children have less body fat than their urban counterparts.[17]

While in some cases there is no difference seen in between motor skills measures and fitness in children.[17]

Adequate physical activities significantly proved to be the bases for fitness in children, Improved fitness is associated with higher physical activities and vigorous or moderate physical activities.[21] In the early adolescents, during rapid growth period, sitting habits often deteriorate, making postural insufficiency which get their parents, teachers worried about faulty posture that may be lead to back problems and pain in later stages of life.[29] Untreated incorrect posture often associate with cardio insufficiency, LBP, lung capacities get affected along with organs displacement.[3]

Main purpose for establishing this study is to establish a correlation between anthropometrics measurements that include weight height and BMI along with posture general physical fitness and flexibility as it enhances general fitness among early adolescents on how to manage and evaluate the variables which are specific for good posture fitness physical activity and flexibility.

2. Objectives

To examine the correlation between posture flexibility and general physical fitness in early adolescent's male children of primary school (8-14 years of age) along with relationship in between all parameters of posture evaluation flexibility and fitness which include anthropometrics measurements relations like age height weight and BMI as well.

3. Methods

The purpose of study comprised of 50 children of junior high school in rural area between 8-14 years of age. Aim is to develop the co-relation between flexibility, spinal posture & general physical fitness. Simple random sampling done by time duration for the study of research is 5 months.

Inclusion criteria specific: -

1.Male junior high school going children.

2.Age group of 8-14 years.

3. Those willing to participate.

Anthropometrics

Body height is measured using inch tape ruler measure it on a uncarpeted section of floor & a flat section of wall by talking off the shoes, stand your feet flat on floor with heels against corner by making sure that the head, shoulders & buttocks touch the wall. Stand straight with head looking straight ahead. Place the ruler against the wall then lightly mark wall with pencil at point where

ruler meets the head. Take note of measurement. Body weight is determined by electronic weighing machine with loose clothing on. BMI is calculated as division of body weight by height in meters squared by CDC.

Spinal Posture & Spine Flexibility

Spinal posture evaluation is measured by mobile posture screen evaluation application APECS software mobile application tool. An image-based application software which is based on photographs added to the software or by directly marked the anatomical points with help of markers on subject body in static standing posture, which process the images & calculate the distance between body segments and angles formed between them. It uses images or photographs of the subjects with anatomical points marked on the subject with body landmarks with the help of stickers or pointed stickers and it aim to identify misalignments in spinal orientation. It takes pictures of the subjects from different angles; front and back in frontal plane and left and right in sagittal plane. This application calculates postural variables by using individual's anatomical points which are digitally marked which depends on number of variables of interest. Afterwards, it provides an output file with numerical values of posture variables and various images that describe the digitized points and their locations in relation to a neutral posture.

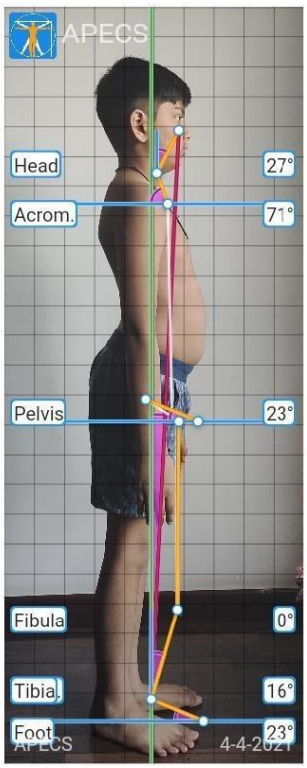


Figure 1: -Digitally marked body alignments & angles

We examine dynamic flexibility with sit-and-reach test. It is probably the most used flexibility test for individuals & it provides flexibility assessment of hamstrings, hip along with lower back muscles. Subjects should perform a little warmup prior to test and after one trial before the other one. Placing the measuring tape on floor with the right-angle line which is made by tape at 15-inch mark. The subjects sit with measuring tape in between the legs, which are extended at right angles to the line formed by tape on the floor. Heels of the subject feet must touch the edge of right-angled taped line which is at the 15-inch mark and be about 10 - 12 inches apart. The subject should slowly reach forward with both the hands as far as possible & hold the position for 2-3 seconds. Be sure that subjects should keep their hands parallel and doesn't lead with the one hand. Then record the most distant point in cm or inches which reached with the fingertips, best of two trials should be recorded after warmup.

Physical Fitness Assessment

The modified PAQ-C is a self-administered, 7-day recall instrument which was developed to assess the general physical activity phase of physical activity throughout the elementary school year for students who are about approximately 8 to 14 years of age. PAQ-C can be performed in the classroom area setting and provides a summary of physical activity score derived from 8 items, each scored on a 5-point scale. To calculate PAQ-C activity scores after once you have a value from 1 to 5 for each of the items which are used in physical activity score, now after this take the mean of items this results in final PAQ-C activity score.

Statistics

Statistical analysis was done using the IBM SPSS Statistics. The descriptive statistics used to analyse the data for all the postural angles, results are presented in tables for each variable in the sagittal plane and frontal plane. The significance level adopted was 0.05. In this the basic descriptive statistics is used for all the parameters were mean and standard deviation. Paired sample statistics done for trials of flexibility measurement parameters for sit and reach. In addition to descriptive statistics bivariate and multivariate regression performed to analyse the relation between variables of a sample along with Pearson correlation coefficient and significance level.

4. Results

Weight and height have a statistically significant linear relationship ($r=0.617$, $p<0.01$). Direction is positive hence weight is positively corelated with height, greater weight is associated with greater height. Male Children with greater height have significant greater flexibility where $r=0.398$, $p<0.05$. There is a weak correlation between BMI and physical

fitness(r=0.103); moreover, a negative association formed between BMI and Flexibility of male children (-0.045).

Plane	Evaluated region	Classification
SAGITTAL	BA	Normal, change (forward aligned, backward aligned)
	HEAD A.	Normal, change (forward aligned, backward aligned)
	SHOULDER A.	Normal, change (forward aligned, backward aligned)
	PELVIS	Normal, change (forward aligned, backward aligned)
	KNEE A.	Normal, change (forward aligned, backward aligned)
	FOOT	Normal, change (forward aligned, backward aligned)
FRONTAL	BA	Normal, change (Left aligned, Right aligned)
	HEAD A.	Normal, change (Left aligned, Right aligned)
	SHOULDER A.	Normal, change (Left aligned, Right aligned)
	TORSO	Normal, change (Left aligned, Right aligned, ribcage tilt)
	PELVIS	Normal, change (Left aligned, Right aligned)
	KNEE A.	Normal, change (Left knee angle, Right knee angle)
	FOOT	Normal, change (Left foot rotation, Right foot rotation)

Table 4.1 Baseline characteristics of posture evaluation given in table for sagittal and frontal plane.

Physical fitness questionnaire and flexibility sit and reach test trial one and trial two both have a significant strong correlation linear relationship as r=0.829 and p<0.01. Trial 2 performed after a session of warmup for the participants hence provided better flexibility scores for sit and reach than trial one before the warm-up session. However, range is similar but average differ for both the trials of test. See Table 4.2.

		Age	Weight	Height	Trial I	Trial II
N	Valid	50	50	50	50	50
	Missing	0	0	0	0	0
Mean		12.14	34.54	140.68	14.62	15.18

Median	12.00	34.50	142.00	15.00	15.00
Std. Deviation	1.262	2.451	4.312	1.008	.962
Range	4	10	16	4	4
Minimum	10	30	132	12	13
Maximum	14	40	148	16	17

Table 4.2 Trial 1&2 (sit & reach test)

After calculating and analysing the data we discovered that among 50 children few showed high physical activity and others categorised into low active based on the cut off values (2.9 for male children). Children show lower scoring in Q1 which states spare time activities (sports), and in total activity frequency Q8. Highest scorers were for Q4, Q6 and Q7.

As mostly children are healthy weigh participants there is no association formed between BMI and PAQ-C. It is seen that children who are good in PE often enjoy spare time activities leads to high active groups. There is a strong association between different activities of PAQ-C which leads to a significant linear relationship ($p<0.05$). Moreover, there is weak association which is considered to be negligible in terms of correlation coefficient and significant value.

		PAQ-C		FLEX BS
PAQ-C	Pearson Correlation	1		.077
	Sig. (2-tailed)			.594
	Sum of Squares and Cross-products	3.957		1.035
	Covariance	.081		.021
	N	50		50
FLEX BS	Pearson Correlation	.077		1
	Sig. (2-tailed)	.594		
	Sum of Squares and Cross-products	1.035		45.380
	Covariance	.021		.926
	N	50		50

Paired Samples Correlations

			N		Correlation		Sig.	
Pair 1		Trial I & Trial II	50		. 829		.000	

Table 4.3 co-variance between activity & flexibility

Variations in pelvis knee and foot alignment form a positive linear relationship as tend to increase in one affect another linearly showing strong correlation in between. ($p<0.05$) body alignment is often associated with positive relationship with head shoulder and pelvis and often negatively associated with knee and foot forming a significant linear relationship ($p<0.05$) Relatively torso is positively associated with knee and foot with level significant at $p<0.05$. trunk inclination leads to increase in knee and foot alignments in frontal plane. In sagittal plane BA is not forming any association neither positive nor negative with other posture alignments however HA is significantly forming a strong relationship with pelvis and foot and a weak relationship with knee.

Body alignment head alignment shoulder alignment torso pelvis and foot alignment have negligible correlation effect on physical fitness and flexibility; they are at the same level for both the measurements in male participants with negligible variability accounted for by variability in the fitness and flexibility measurement. Since trace doesn't show significant results for these alignments in frontal plane results suggest there is no impact of BA HEAD SA TORSO PELVIS AND FOOT on both the other variables flexibility and fitness of male children. However, trace shows significant results for knee alignment variations in frontal plane for flexibility in male participants it concludes that there is a correlation which is significant ($p<0.05$) between knee alignment and sit and reach flexibility measures for male participants. Test between the subjects also showed the negligible effect of posture alignment in both the planes except knee ranges from frontal plane with a variability of 9.6% ($f=4.43$).

Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Powerc
Intercept	Pillai's Trace	.996	5078.04	2.000	43.000	.000	.996	10156.090	1.000

			5b						
	Wilks' Lambda	.004	5078.045b	2.000	43.000	.000	.996	10156.090	1.000
	Hotelling's Trace	236.188	5078.045b	2.000	43.000	.000	.996	10156.090	1.000
	Roy's Largest Root	236.188	5078.045b	2.000	43.000	.000	.996	10156.090	1.000
B.A	Pillai's Trace	.001	.015b	2.000	43.000	.985	.001	.031	.052
	Wilks' Lambda	.999	.015b	2.000	43.000	.985	.001	.031	.052
	Hotelling's Trace	.001	.015b	2.000	43.000	.985	.001	.031	.052
	Roy's Largest Root	.001	.015b	2.000	43.000	.985	.001	.031	.052
HEAD	Pillai's Trace	.033	.723b	2.000	43.000	.491	.033	1.446	.164
	Wilks' Lambda	.967	.723b	2.000	43.000	.491	.033	1.446	.164
	Hotelling's Trace	.034	.723b	2.000	43.000	.491	.033	1.446	.164
	Roy's Largest Root	.034	.723b	2.000	43.000	.491	.033	1.446	.164
PELVIS	Pillai's Trace	.004	.078b	2.000	43.000	.925	.004	.156	.061
	Wilks' Lambda	.996	.078b	2.000	43.000	.925	.004	.156	.061

	Hotelling's Trace	.004	.078b	2.000	43.000	.925	.004	.156	.061
	Roy's Largest Root	.004	.078b	2.000	43.000	.925	.004	.156	.061
KNEE	Pillai's Trace	.016	.347b	2.000	43.000	.708	.016	.695	.102
	Wilks' Lambda	.984	.347b	2.000	43.000	.708	.016	.695	.102
	Hotelling's Trace	.016	.347b	2.000	43.000	.708	.016	.695	.102
	Roy's Largest Root	.016	.347b	2.000	43.000	.708	.016	.695	.102
FOOT	Pillai's Trace	.008	.163b	2.000	43.000	.850	.008	.326	.074
	Wilks' Lambda	.992	.163b	2.000	43.000	.850	.008	.326	.074
	Hotelling's Trace	.008	.163b	2.000	43.000	.850	.008	.326	.074
	Roy's Largest Root	.008	.163b	2.000	43.000	.850	.008	.326	.074

a. Design: Intercept + B.A + HEAD + PELVIS + KNEE + FOOT

b. Exact statistic

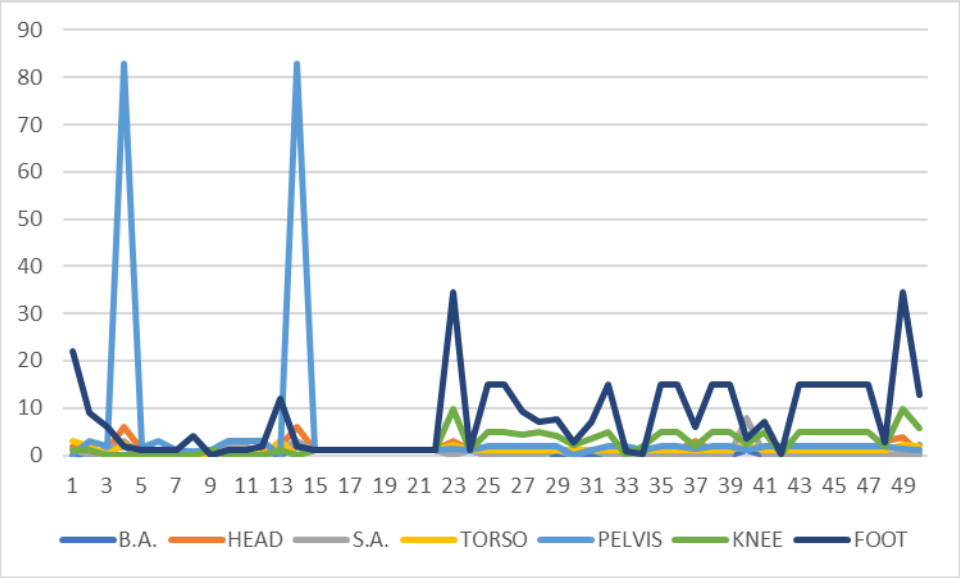
c. Computed using alpha = .05

Table 4.4 multivariate tests of variances

5. Discussion

Main aim of the study was to examine the correlation between general physical fitness, flexibility and spinal posture in early adolescents or older male children. In this study certain variables considered to find correlation in between them. Differences were formed in between these variables demonstrating relationship in between some of them. A total of 50 male children aged between 8-14 years from Bisrakh, India completed this study which involved PAQ-C questionnaire for general physical fitness, posture evaluation through anatomical landmarks and digital photographs, and flexibility through sit and reach test by measuring scores in 2 trials.

BMI is negatively concerned with head alignment in sagittal plane, weak negative relationship association formed between the two of them and BMI is negatively concerned with other postural alignment which tends to form a negative association or correlation between them which is not significant at facts.



Graph 5.1 shows the variations in between alignments

In western countries most students suffered from posture related problems may be insufficiency or concerned with certain degree of inclination from normal alignment and only few have corrected posture. Study shows that participants body alignment, head alignment shoulder alignment, torso, pelvis and foot alignment have negligible correlation effect on physical fitness and flexibility and they are at the same level for both the measurements in male participants with negligible variability accounted for by variability in the fitness and flexibility measurement. Study concludes that there is a correlation which is significant ($p<0.05$) between knee alignment and sit and reach flexibility measures for male participants. Test between the subjects also showed the negligible effect of posture alignment in both the planes except knee ranges from frontal plane with a variability. Postural changes occurred to find balance with new growth body proportions.

Furthermore, our comparison in trials for sit and reach showed that prevalence of more flexibility in male children is higher after the warm up session done prior to the trial 2, which is of 20 minutes. Regression models, Pearson correlation and paired sample test used to explore the differences and cross-sectional correlation between these variables of sample of 50 male children. Positive associations were found between trials of sit and reach test.

Differ in alignments shown by evaluating the angles measured by posture screen mobile application tool APECS which evaluate the deviation in body alignments by assessing the anatomical points. It

indicates changes with high probability of postural deviations and positioned markers according to landmarks mentioned and digitally made through markers. It showed the detail angled overview for results analysis and evaluation.

A study showed that children with a higher BMI higher weight and waist circumference are having less flexible spinal inclination, however our study suggests that children with high BMI high weight have higher height and they formed a linear positive relationship with flexibility. A longitudinal study suggest that flexibility is an indispensable component of physical fitness, the previous literature suggest the association between flexibility and physical fitness as surprisingly limited so as like our study which suggests there is a negligible association between them, r= 0.267 which is likely close to 0 and significance is 0.061 (p> 0.05).

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