



Correlation of Body Mass Index and Balance in Healthy School Going Children

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ABSTRACT

All the human motor behavior and developmental motor skills are developed in the preschool and school period. The process by which humans maintain the integrity of their postural control is referred to as balancing. The ability to control static and dynamic balance is important and necessary for participation in physical exercise and sports. Similarly, participation in physical activity plays an important role in the prevention and management of overweight in children. It is not clear what effects excess body mass has on postural stability of overweight children. To date, only a limited number of studies have investigated postural stability or balance control in overweight or obese children. Methods: There were eight Government & Private schools were selected from Vadodara city. Total 10 students were selected from each class randomly; the anthropometric measurements of the students were taken. Each participant then completed timed unipedal balance test on both right and left foot, and tandem stance. For two balance test, each subject completed 3 trials on each leg. A 60 second rest was given between trials set to avoid fatigue. Result: Data collected from total 556 school children from 2nd to 8th standard. Mean BMI: 15.42, Total 278 students selected from each Government & Private school. The results of present study show the significant difference in mean of BMI between students from standard 2 -8th standard students. In the present study clear difference was seen in BMI between students of both school (Private > Government) But there was no statistically significant difference found between BMI and gender (male & female). In Tandem stance difference was found in Government and Private school children, private school children have less balance as compare the Government school children, with regards to Unipedal standing there was no statistically significant difference found in between Government and Private school children. Conclusion: children with higher BMI has lower Balance and Postural control as compare to normal BMI healthy school going children.

Keywords: Balance, Overweight, BMI, children

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INTRODUCTION

Childhood is the most important period of any human's life. All the human motor behavior and developmental motor skills are developed in the preschool and school period. This early year of life is crucial for future. School age children are faced with the daily responsibility of transporting a variety of items to, from and around the school which requires good amount of postural control. The process by which humans maintain the integrity of their postural control is referred to as balancing [1,2,3].

Balance is of great significance as it is an integral part of all movements. It works on making and maintaining connections between the brain and the muscles that control movement. At the preschool age, balance plays a significant role in the performance of several fundamental motor skills [1, 2, 3]. Balance is usually divided into two basic components: Static and Dynamic. Ability to maintain a posture in a resting position is known as Static balance. While dynamic balance is the ability to maintain postural control during the performance of functional tasks [1, 2, 4, 5]. The ability to control posture in steady position or while performing of functional task is important and necessary for participation in physical exercise and sports. Similarly, participation in physical activity plays an important role in the prevention and management of overweight in children [6].

The prevalence of overweight and obesity is rapidly increasing worldwide, in children as well as adults [6]. In our country, in the past decade increase in the percentage of overweight and obese children in affluent

urban families. BMI in childhood changes substantially with age [7]. The factors attributing to increasing childhood obesity are increased intake of high-calorie foods that are low in vitamins, minerals and micronutrients coupled with decreased physical activity [8]. Due to overweight children may experience difficulties in performing daily living activities such as rising from a chair or toilet, getting out of the car or bed, stair-climbing etc[6].

Few studies [9,10,11] have suggested that while examining gait parameters in prepubertal children, obese children may result in extended periods of double support and lower preferred walking speed compared to normal weight children while walking [9,10,11]. There is some evidence that increase in BMI influences balance during the gait cycle and postural control during standing and balance performance. For example, McGraw *et. al* [11] reported decreased mediolateral stability during standing in obese prepubertal boys compared with non-obese boys. Other studies have found that overweight adolescents had poorer performances in static [12, 13] and dynamic balance skills compared with normal-weight counterparts.

It is not clear what effects excess body mass has on the postural stability of overweight children. There are only a few studies that have investigated postural stability or balance control in overweight or obese children. Therefore, the purpose of the present study was to investigate the effect of BMI on balance in healthy school children. To see the correlation of Body Mass Index (BMI) and Balance in healthy school going children.

MATERIAL AND METHODS

Study Design: Cross-sectional, observational.

INCLUSION CRITERIA:

Healthy School going children – age group 6-12 years

EXCLUSION CRITERIA:

Children with any neurological, musculoskeletal problem in lower limbs, and cardiovascular deficit.

1. History of balance impairment.
2. Loss of vision or uncorrected reduced visual acuity

METHODOLOGY:

After receiving approval by Institute Ethical Committee, the number of schools from each area of the city was selected on the basis of the stratified randomized sampling; for selection of schools, city was divided into four zones according to directions. The two schools (one government, one private) from the total number of schools, were selected from each area by lottery method. The principals of the selected schools were approached. They were explained in detailed about the objective, methodology and the societal benefits of the study to seek their permission to conduct the study on their schoolchildren.

The total numbers of schools to be included in the survey from all four zones were eight, Total 560 healthy school going students aged between 6-12 years were recruited for this study. The class teacher from their respective classes were requested to randomly select 10 students (5 boys & 5 girls) without any bias and include subjects with all the different characteristics i.e. subjects of different height and weight equally included. The selected subjects from each school were explained about the nature & purpose of the study.

The complete procedure was explained in detail to the participant's and written informed consent was taken from each. Each participant was screened for inclusion. This study was carried out in School's classroom, where source of light was good and also in secured place so that risk of fall during tests was prevented. At the start anthropometric measurements of the subjects were taken (figure 1&2). Prior to balance testing, participants were familiarized with two balance test and provided practice sessions on the testing procedures to decrease the chance of learning effect occurring during testing. Each participant then completed timed unipedal balance test on both right and left foot, and tandem stance on child's dominant leg. The tests were performed barefoot on floor surface. The order of leg examination (right/left) for each subject was same, for each test. For two balance tests, each subject completed 3 trials on each leg. A 60 second rest was given between sets of trials to avoid fatigue. For all trials, the participants were instructed to place their hands across the chest. Time started upon elevation of the opposite foot from the floor. Participants were asked to focus on a target placed at eye level; the measurements were timed using a stopwatch.

Tandem stance: Participants were made to stand with feet in heel-to- toe position on straight line drawn with chalk stick on the floor, arms across chest, with eyes open (figure 3). Three trials of this test were timed with stopwatch till subject could hold position. Time commences when the subject place dominance foot in front of non- dominance foot on the straight line and time ends when the subject either: (1) use his arms (i.e., uncrossed arms), (2) displace anyfoot, (3) movement of foot from original position/ stepping. [1] The procedure was repeated 3 times and for each trial time was recorded on the data collection sheet. The mean of 3 trials was recorded [14].

Unipedal stance: Participants were asked to stand barefoot on the limb of their choice, with other limb

raised so that the raised foot is near but not touching ankle of their stance limb. Prior to raising the limb, subject was instructed to cross his arms over chest (figure 4). The investigator used a stopwatch to measure the amount of time subject was able to stand on one limb. Time commencing when the subject raised foot off the floor and time ending when the subject either: (1) use his arms (i.e., uncrossed arms), (2) use raised foot (moved it toward or away from the standing limb or touched the floor), (3) move weight-bearing foot to maintain his balance (i.e., rotated foot on the ground). [1, 8] The procedure was repeated 3 times and for each trial time was recorded on the data collection sheet. The mean of the 3 trials were recorded[14].



Anthropometric measurements of the subjects were taken (figure1&2).

Figure 3: Tandem stance



Figure 4 Unipedal stance

STATISTICAL ANALYSIS:

All the data were entered in the Microsoft excel sheet. All statistical analyses were performed with SPSS (Statistical Package for Social Science), Epi Info and STATA/IC-13 software.

RESULTS

Data collected from total 556 school children.

(Record of four students was drastically different from rest, so instead of 560 only 556 students were considered for analysis).

From the descriptive statistics it can be seen that all variables don't have satisfied normality assumptions. In addition to that from normality plots it is confirmed that there are large no. of outliers and skewed observations in given data. Hence the data needed to be refined so that they follow normality assumptions. Here looking at the raw data it is decided that log transformation is the best option to get normality assumptions. Hence researcher had done the said transformation. After transformation again, normality check is done)

Mean BMI: 15.42

Total 278 students in each Government & Private school.

Total male students 282, female students 274, and In Government school 142 & 136 male & female students, In Private school 140 & 136 male & female students.

RESULT

TABLE 1: shows the comparison of BMI value in total students of standards 2nd - 8th.

Standard	N	Mean	Std. Deviation	Std. Error
BMI 2	80	13.8204	2.17952	.24368
3	80	13.5682	2.25341	.25194
4	79	14.3739	2.51720	.28321
5	79	16.2243	4.15738	.46774
6	80	16.0100	3.95839	.44256
7	78	16.2967	2.71252	.30713
8	80	17.7234	4.60671	.51505
Total	556	15.4283	3.60892	.15305

ANOVA

		Sum of Squares	Df	Mean Square	F	P-value
BMI	Between Groups	1128.774	6	188.129	16.932	.000
	Within Groups	6099.696	549	11.111		

Table 2: Independent t-test for comparison of BMI in total (combined students) and in between male and female students of Government & Private school students:

Type_School	N	Mean	Std. Deviation	Std. Error Mean	t value	P value
BMI Govt.	278	14.5390	2.68756	.16119	-5.990	.000
Private	278	16.3177	4.15753	.24935		
Govt. BMI Male	142	14.4782	2.55186	.21415	-.385	.701
Female	136	14.6025	2.83040	.24271		
Private BMI Male	140	16.4976	4.37731	.36995	.726	.468
Female	138	16.1351	3.92956	.33451		

Table: 3 Independent t-test for comparison of Tandem stance test in total (combined) between government and private schools:

Type_School	N	Mean	Std. Deviation	Std. Error Mean	t value	P value
InTS Govt.	278	5.2065	.68772	.04125	1.966	0.05
Private	278	5.0849	.76795	.04606		

(TS - Tandem stance)

Table 4: Independent t-test for comparison of unipedal stance of right and left leg between government and private schools:

Type_School	N	Mean	Std. Deviation	Std. Error Mean	t value	P value
InUSR Govt.	278	4.1370	.64037	.03841	1.372	.171
Private	278	4.0587	.70382	.04221		
InUSL Govt.	278	4.1023	.61840	.03709	1.340	.181
Private	278	4.0308	.63915	.03833		

USR- Unipedal stance right. USL- Unipedal stance left

DISCUSSION

BMI plays an important role in balance. Balance is an integral part of all the movements. It is said that the balance reaches an adequate level during pre-school age, but the development is completed in later life. [1, 2, 3, 4, 15, 16] there are many sophisticated methods available to measure the balance. In this study, static balance was tested using tandem stance and unipedal stance in test for both the right & Left side.

In the present study mean BMI was 15.4283 of normal school going children. The results of present study show the significant difference in mean of BMI between students from standard 2 -8th standard students. (P-value<0.01) Table 1.

Also Mean BMI was significantly higher in private school as compare to government school (p value <0.05) TABLE 2. Several studies support these findings. The various reasons as put forward by these studies are that children attending private schools probably enjoy a higher socio-economic status, therefore they are better nourished. Also change in the lifestyle, motorized transport, high caloric junk food, and eating habits could be contributing factor. These studies also state similar reasons for rising obesity among children these days .[7, 8, 17, 18, 19]. In the present study there was no statistically significant difference found between BMI and gender (male & female) TABLE 2. In contrast to this several studies have recorded overweight and obesity more among boys than girls. In Indian context this is probably said to be attributed to the cultural advantages that males enjoy in India, some studies report increased BMI amongst girls [7, 8]. However these days even amongst government school the prevalence is on significant rise in obesity and overweight. [18] Tandem stance is the ability to stand in a heel to toe position; this reflects degree of postural steadiness when the BOS in the medial/lateral direction is narrow [15]. In the present study mean tandem stance were 5.1457 in normal school going children in 6 to 12 years. The results of present study show the significant difference in mean of tandem stance between students from standard 2 -8. (p value < 0.01) well in agreement with the literature. The difference was found in Government and Private school children, private school children have less balance as compare the Government school children (p value<0.05) Table 3.

Task of standing on one leg requires voluntary shift of COM to the standing leg, followed by maintenance of postural orientation in space by controlling weight, supporting the vertical alignment of different segments of the body and equilibrium[15]. There was no statistically significant difference found in Unipedal standing between Government and Private school children (p value>0.05) Table 4. Apparently as author F. FIGURA et al[16] the rather large interindividual variants of the postural parameters of each age level suggest that proficiency in balancing activities is dependent on various factors and age may not be the most relevant factor. The use of a single factor like age to predict balancing ability may lead to a considering high error of prediction [16].

CONCLUSION

The present study establishes influence of BMI on two static balance tests in school children of 6 to 12 years age. It is essential to evaluate in details of avoid error of prediction and/or refuting proficiency in balance. This study suggests that children with higher BMI has lower Balance and Postural control as compare to normal BMI healthy school going children.

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