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NORMATIVE VALUE OF TANDEM STANCE AND UNIPEDAL STANCE IN SCHOOL CHILDREN, AGE GROUP BETWEEN 6 TO 12 YEARS

Physiotherapy

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ABSTRACT

INTRODUCTION: Balance is very important and it is said to be an integral part of all movements. Physical therapist has historically placed high priority on the treatment of the patients with postural control problems. With regards to unipedal and tandem stance in children of 6-12-year school going children, there seems to be lack of literature with regards to reference values.

METHODS: There were eight school 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 on child's dominant leg. 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: Range of Unipedal stance (right and left) for 2^{nd} – 8^{th} standard was: 9.00 sec – 28.33 sec on the lower side while ranged from 115.33 to 239.00 sec on the higher side. Mean value of tandem stance for 2^{nd} -5^{th} standard was: 118.34seconds.Mean value of tandem stance for 6^{th} – 8^{th} standard was: 282.28seconds.

CONCLUSION: There is significant difference in mean of tandem stance and unipedial stance (right and left) students from standard 2-8. In unipedal stance the girls outperformed the boys. There was no significant different of dominance on both the static test (tandem and unipedal).

KEYWORDS

Balance, Balance testing, Gender differences, single limb stance, tandem stance.

INTRODUCTION:

All the human motor behaviour and developmental motor skills are developed in the preschool and school period. School age children are faced with the daily responsibility of transporting a variety of items to, from and around the school. Balance is thought to be of great significance as it is an integral part of all movements. The process by which humans maintain the integrity of their postural control is referred to as balancing. [1,2,3,4]

Postural control / balance is a complex process requiring integration of sensory Information (somatosensory, visual and vestibular feedback) and execution of appropriate posture. [1,3]

Balance is usually divided into two basic components: the **STATIC** and **DYNAMIC**. Static balance is the ability to maintain a posture in a resting position. Static balance can be developed by simple activities, such as standing on one foot, balancing on both knees, or balancing with moving on a narrow line or fallen log. While dynamic balance is the ability to maintain postural control during the performance of functional tasks and this develops as the child walks & runs. [1,2,5]

There are studies done previously about the normal values of functional reach test in children of age group of 3- to 5-Year-old children without disabilities.[6]and of 7 to 16 years also[7] and normative values for the 'Unipedal Stance Test' with Eyes Open and Closed of 18years or older.[8]

The aim of the present study was to establish normative value of tandem stance and unipedal stance in school children of our city (stratified random sampling), age group between 6 to 12 years of our population.

MATERIAL AND METHODS

Study Design: Cross-sectional, observational.

INCLUSION CRITERIA:

School going children – age group 6-12 years

EXCLUSION CRITERIA:

- Children with any neurological, musculoskeletal problem in lower limbs, and cardiovascular deficit.
- History of balance impairment.
- Loss of vision or uncorrected reduced visual acuity.

METHODOLOGY:

After 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) were to be selected from each area (from the total number), were decided by lottery method. The principals of the selected schools were explained about study and for official permission.

The total numbers of schools to be included in the survey from all four zones were eight, 560 normal school going subjects in the age group between 6-12 years were recruited.

Total 10 students (5 boys & 5 girls) were selected from each class (i.e. from standard 2 to standard 8), randomly, selected by class teacher, who was requested to select 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 participants completed a written informed consent form. Each participant was enquired of baseline questions regarding previous history of injury, etc. Following this each child was explained about the complete procedure. This study was carried out in School's class room, where source of light was good and also in secured place so that risk of fall during tests was prevented. 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 trials set to avoid fatigue. For all trials, the participants placed their hands across the chest and time started upon elevation of the opposite foot from the floor. Participants were asked to focuses on a target placed at eye level, the measurements were timed using a stopwatch.

At first the anthropometric measurements of the subjects were taken. Prior to balance testing, participants were familiarized with the 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. Dominant limb was selected by asking the child to kick a ball placed on the floor in front of him. [8,9]

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 1). 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 any foot, (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.

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 2). 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 was recorded.

Figure 1: TANDEM STANCE

Figure 2: 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.
Students Government school 278, private school 278.
Total male students 282, female students 274.
Total right dominant 518 and left dominance 38
Total mean of BMI: 15.42

(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 which is given as follows.

Table 1: Independent t-test for comparison of BMI of standard 2nd to 5th and 6th to 8th standard of government school.

Type_School	Std_C	N	Mean	Std. Deviation	Std. Error Mean	T value	P value
Govt. BMI	2-5 Std.	159	13.8119	2.32800	.18462	-5.480	.000
	6-8 Std.	119	15.5105	2.83458	.25985		

Table 2: Independent t-test for comparison of BMI of standard 2nd to 5th and 6th to 8th standard of private school.

Type_School	Std_C	N	Mean	Std. Deviation	Std. Error Mean	T value	P value
Private BMI	2-5 Std.	159	15.1714	3.52037	.27918	-5.597	.000
	6-8 Std.	119	17.8492	4.45487	.40838		

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

	Sex	N	Mean	Std. Deviation	Std. Error Mean	T value	P value
lnTS	Male	282	5.1157	.74019	.04408	-.982	.326
	Female	274	5.1766	.72109	.04356		

(TS – Tandem stance).

Table 4: Independent t-test for comparison of unipedal stance of right and left leg amongst male and female combined of government and private schools.

	Sex	N	Mean	Std. Deviation	Std. Error Mean	T value	P value
lnUSR	Male	282	4.0024	.67033	.03992	-3.421	.001
	Female	274	4.1960	.66351	.04008		
lnUSL	Male	282	4.0029	.63925	.03807	-2.432	.015
	Female	274	4.1321	.61318	.03704		

USR- Unipedal stance right. USL- Unipedal stance left.

DISCUSSION

It is said that the balance reaches an adequate level during pre-school age but the development is completed in later life. [1-4, 10, 11] Although sophisticated methods are available to measure the balance, two test of static balance were selected in the present study to establish the normative values in school children of age 6 – 12 years. The two tests were tandem stance, unipedal in right and left leg. The study was performed on both the children of government and private schools.

In the present study mean of total BMI was 15.4. As expected, significant difference in mean of BMI between students from standard 2nd-8th standard was seen. Similarly, also Mean BMI was significantly higher in private school compared to government school (Table 1&2). Several studies support this finding. [12-16] The various reasons put forward by these studies are that children attending private schools probably enjoy a higher socioeconomic status, also change in the life style, motorized transport, high caloric junk food, and eating habits could be contributing factor for rising obesity among children these days.[12-16] there was no significant difference found between BMI and gender (male & female) in contrast to this several studies have recorded overweight and obesity more among boys than girls (more in private than government school). [12-15]

The influence of age and gender on balance has been studied by several researchers. [3, 4, 11 ,17, 18] Tandem stance reflects degree of postural steadiness when the BOS in the medial/lateral direction is narrow.[10] F. Figura et al [11] showed that age had more evident relationship with postural ability than gender their results demonstrated an improvement in static balance in the 6-10 year age range, showing no significant differences in balancing activities between boys and girls, the author further states that sporadically statistical differences have been shown by some studies between genders, indicating that there is not a clear cut boy – girl difference in static balance performances. In the said study significant gender differences occurred only in tandem stance for 6 to 8 year age groups indicating that girls are significantly superior in performing the tandem stance compared to boys of same age group .[11] The present study found no significant difference in tandem stance between gender & dominance (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.[10] Well in agreement with the literature the present study too found both the static balance tests (tandem stance and unipedal stance) significantly related to age.

In present study in Unipedal stance, girls outperformed the boys (Table 4). Andrew W. Smith et al state the females as having better balance and postural stability as compared to boys, probably as the girls are more capable of integrating their sensory inputs, whereas boys treat each sensory input somewhat separately and rely more on somatosensory feedback.[3] Also that girls at the age of 7-8 years have better use of vestibular information and consequently reduce the body sway as compared to boys of the same age.[3]

However, in several studies one or two balance items are only included, and it is well known that balance is task-specific (Ulrich & Ulrich, 1985) and as a result, a high score on one balance task does not necessarily correlate with a high score on another one. Consequently, it is obvious that the performance on a couple of items cannot provide a sufficient overall picture of balance. [2-9]

Apparently as author F. Figura et al states that rather large inter individual 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 sole factor. The use of a single factor like age alone to predict balancing ability may lead to high error of prediction. [11]

Thus, although the present study establishes reference values for two static balance tests in school children of 6 to 12 years age which are significantly different compared to Dhanani et al [1] It is essential to evaluate in details to avoid error of prediction and / or refute proficiency in balance.

CONCLUSIONS:

1. Mean value of tandem stance for 2^{nd} -5^{th} standard was: 118.34seconds and for 6^{th} – 8^{th} standard was: 282.28seconds.
2. Range of Unipedal stance (right and left) for 2^{nd} – 8^{th} standard was: 9.00 sec – 28.33 sec on the lower side while ranged from 115.33 to 239.00 sec on the higher side. In unipedal stance the girls outperformed the boys.
3. There was no significant different of dominance on both the static test.

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CONFLICT OF INTEREST:

This study has NO conflict of interest.

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