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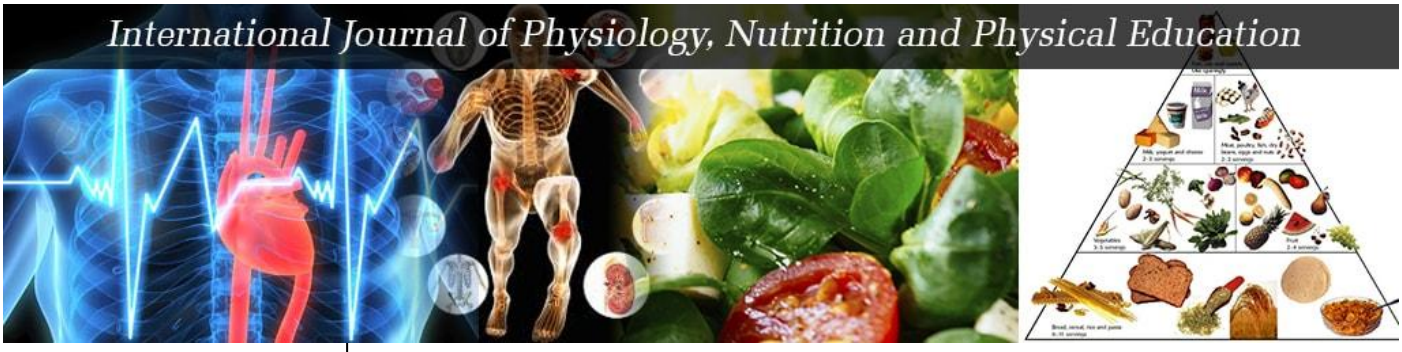

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Tulu Biswas
Lecturer, Sayan Memorial Primary Teachers Training Institute, West Bengal, India

Dr. Rajarshi Kar
Assistant Professor, State Institute of Physical Education for Women, West Bengal, India

Correspondence
Tulu Biswas
Lecturer, Sayan Memorial Primary Teachers Training Institute, West Bengal, India

A cross-sectional study of static and dynamic balance among school children

Tulu Biswas and Dr. Rajarshi Kar

Abstract
The aim of the study was to assess static and dynamic balance in children age 5 – 12 years. A cross sectional study was used to compare children among the age groups of 5 – 6 years, 7 – 8 years, 9 -10 years, and 11 - 12 years. Data was collected from children of Alipur Multipurpose Govt. Girls' School who were tested on static and dynamic balance. Stork test was used to measure static balance and four square step test was used to measure dynamic balance. The result indicated that the static & dynamic balance ability improves as with age and after 7-8 years there is a sharp increase in both static & dynamic balance.

Keywords: Cross-sectional, dynamic balance

Introduction
Balance is the ability to maintain equilibrium (Schroder & McGuire, 1998) [3]. It can be also termed as the ability to maintain the Center of Gravity over the Base of Support. Concept of Stability is little different from balance. Stability is the ability to return to a desired position or motion after a disturbance.
Balance can be static (non-moving) or dynamic (while moving). Static balance is the ability to balance while stationary. Dynamic balance is the ability to maintain total body balance while moving (Cissik and Barnes, 2011) [1]. Different tests are used to measure Static balance and Dynamic balance. Beam walking, stepping stone tests are used to assess Dynamic balance whereas stick balance, balanciometer, stabilometer tests are used to check static balance.
Many studies over a period of time have found that balance development is influenced by age of children. Condon K *et al* (2014) [4] in their research found that the static balance timing improve with age. Rival *et al*. (2005) [2] suggested that the processes underlying the maintenance of an optimal postural stability are mature at least as soon as 6 years of age. The purpose of the study was to investigate static balance & dynamic balance among different age group children.

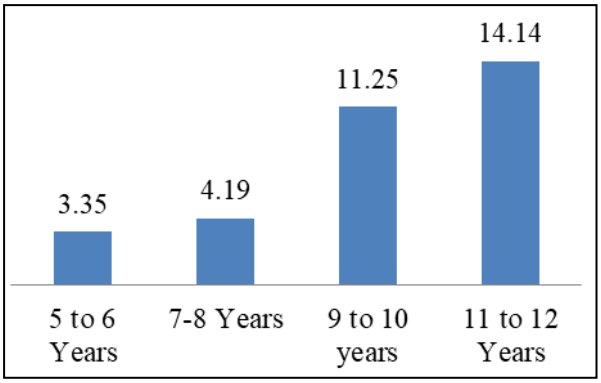
Methods
Data was collected from four different age group children. From the age group 5- 6years 39 children , 48 children from 7- 8years age group, 33 children from 9- 10years group and 31 children from 11- 12 years participated in the study. Static balance and Dynamic balance were variables for the study. Static balance was tested with Stork test and Dynamic Balance was tested with four square step test. Participants from all the groups were from Alipur Multipurpose Govt. Girls' School.

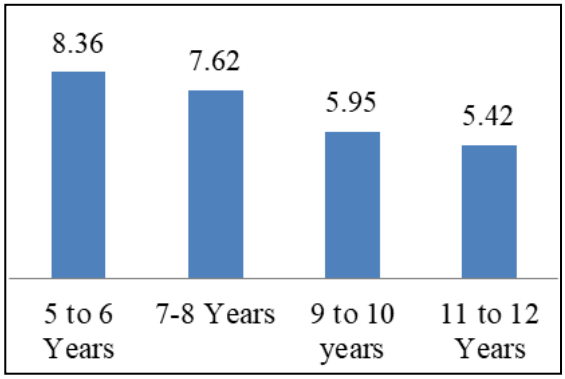
Results
Means and Standard deviations of Static & Dynamic balance were calculated. One way ANOVA was used to find significance in difference among groups.

Table 1: Descriptive statistics of static & dynamic balance in different age groups

		Static Balance		Dynamic Balance
	N	Mean	Std. Deviation	Mean
5 to 6 Years	39	3.35	2.36	8.36
7-8 Years	48	4.19	3.65	7.62
9 to 10 years	33	11.25	7.77	5.95
11 to 12 Years	31	14.14	6.16	5.42

Mean values of Static & Dynamic Balance in different groups are graphically presented below.





*A higher score in Stork test indicates better static balance whereas a lower score in Four square step test indicates better dynamic balance performance.

Fig 1: Static Balance in Different Age Groups

Fig 2: Dynamic Balance in Different Age Groups

As mean value of static balance was different between various age group school children, One Way Analysis of Variance was computed to investigate the significance of mean difference.

Table 2: One Way ANOVA of Static and Dynamic Balance in Different age groups

	Static Balance					Dynamic Balance				
	Sum of Squares	**df**	**Mean Square**	**F**	**p value**	**Sum of Squares**	**df**	**Mean Square**	**F**	**p value**
Between Groups	3026.42	3	1008.81	37.99	.000	203.699	3	67.9	21.368	.000
Within Groups	3903.53	147	26.555			467.104	147	3.178		
Total	6929.95	150				670.803	150			

There is a significant difference between the groups as F value is significant ($p<0.05$) in both Static and Dynamic Balance. Thus null hypothesis of no difference is rejected at 5% level. Scheffe post hoc test was used to compare means of unequal sample size groups.

Table 3: Post Hoc test (Scheffe) of Different age groups for Static and Dynamic Balance

		Static Balance			Dynamic Balance		
(I) Group	**(J) Group**	**Mean Difference (I-J)**	**Std. Error**	**p-value**	**Mean Difference (I-J)**	**Std. Error**	**p-value**
5 to 6 Years	7-8 Years	-0.83917	1.1109	0.903	0.74013	0.3843	0.299
	9 to 10 years	-7.89303*	1.21884	.000	2.40436*	0.4216	.000
	11 to 12 Years	-10.78989*	1.23996	.000	2.93737*	0.4289	.000
7-8 Years	5 to 6 Years	0.83917	1.1109	0.903	-0.74013	0.3843	0.299
	9 to 10 years	-7.05386*	1.16529	.000	1.66423*	0.4031	0.001
	11 to 12 Years	-9.95073*	1.18736	.000	2.19724*	0.4107	.000
9 to 10 years	5 to 6 Years	7.89303*	1.21884	.000	-2.40436*	0.4216	.000
	7-8 Years	7.05386*	1.16529	.000	-1.66423*	0.4031	0.001
	11 to 12 Years	-2.89686	1.28891	0.173	0.53301	0.4459	0.699
11 to 12 Years	5 to 6 Years	10.78989*	1.23996	.000	-2.93737*	0.4289	.000
	7-8 Years	9.95073*	1.18736	.000	-2.19724*	0.4107	.000
	9 to 10 years	2.89686	1.28891	0.173	-0.53301	0.4459	0.699

*. The mean difference is significant at the 0.05 level.

Scheffe Post Hoc test shows that there is no significant difference between the 5 - 6 years and 7-8 years group children and between the 9 – 10 years and 11 – 12 years age children group in static and dynamic balance. But there is a significant difference in static and dynamic balance between the 5 – 6 years group with 9 -10 years and 11 – 12 years group children and 7 – 8 years group with 9 -10 years and 11 – 12 years group children.

Discussion

The purpose of the study was to compare different age group children on Static and Dynamic Balance. The results indicated that there is no significant difference between the 5 – 6 years and 7 – 8 years group children in static balance. It was interesting that there is a sharp increase in static balance after 7 – 8 years and the difference between 7 – 8 years children and 9 – 10 years old children was significant. But there was no significant difference in static balance between 9 – 10 years and 11 – 12 years children. In case of dynamic balance a similar pattern of development could be found as static balance where scores improved significantly after 7 – 8 years of age.

Previous researchers have concluded that age have some relation with development of balance. Condon C. *et al* (2014) [4] investigated static balance in five age groups of children i.e. 4 -5, 6-7, 8-9, 10-11, 12+. Their finding was also similar where they found there is noticeable improvement in balance performance after 7 to 8 years of age. Karen D. Deoreo *et al* (1971) [5] in his study on preschool children aged 3, 4, and 5 years found Age was highly significant for both dynamic and static balance. Older children walk farther and faster than younger children on beam-walking tasks. Use of multivariate

ANOVA indicated significant sex differences on the static balance tasks.

This research included only four age groups and each age group was of a range of two years. More conclusive results might have been attained if 6 to 9 year age children are studied intensively.

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