International Journal of Science and Healthcare Research
Vol.5; Issue: 3; July-Sept. 2020
Website: ijshr.com
Original Research Article *ISSN: 2455-7587*

Comparison of Balance in Children With and Without Knee Joint Hypermobility of Age 4-8 Years

Abhijeet Arun Deshmukh[1], Amit D. Mandlik[2]

[1]Associate Professor, [2]Post graduate student,
Department of Neuro-Physiotherapy, VSPM's College Of Physiotherapy, Digdoh Hills, Hingna, Nagpur, Maharashtra, India.

Corresponding Author: Abhijeet Arun Deshmukh

ABSTRACT

Introduction: Balance, plays an important role in children's daily activities but children's with knee joint hypermobility (KJH) scored less in paediatric balance scale (PBS) score. As there is a scarcity of the studies in India which showed KJH affects PBS score. Hence present study proposes to compare the values of PBS score in children with and without KJH of age 4-8years.
Material and Methods: Total 841 typically developing children were screened from schools by using Beightons' scale, 192 were found and included in a group with KJH and 192 were included in group without KJH Total 384 children of both genders were included and divided into 8 subgroups. Balance was evaluated by using PBS in both groups.
Data analysis and Results: Statistical software, STATA Version 10.1, 2011 was used. The *t*-test was used for comparing difference in mean in typically developing children and children with knee joint hypermobility. *Chi* square test was used to compare difference in proportion and for group comparison. P<0.05 was considered statistical significance (95% Confidence interval).There was statistically significant correlation of PBS score in children with KJH of age 4-8years in both gender compared to children without KJH.
Conclusion: In children of age 4-8years KJH contributes significantly to the PBS score in both gender.
Key words: Typically Developing Children, Pediatric Balance, Knee Joint, Hypermobility, Beighton's Scale.

INTRODUCTION

Balance is the ability to maintain centre of mass in respect to base of support to orient and align the body in space.[1-5] It is a complex process which involves visual, vestibular, somatosensory system as well as musculoskeletal system, working together.[2,3,6-8] Shumway-Cook and Woollacott[9] reported that transition from immature to mature balance responses occurs between the age of 4 to 10 years whereas from 4 to 6 years they start using somatosensory system to control various balance strategies.[3,10]

The somatosensory system consists of receptors such as touch, temperature, proprioception and nociception.[2,8-10] It was proposed that children with joint hypermobility have altered proprioceptive acuity.[2,6,8-11] Joint proprioceptive feedback is important component to maintain balance, both static and dynamic.[2,6,8] Balance impairments results in frequent falls, joint instability and soft tissue injuries, hence balance assessment is important.[2,6,8]

Hypermobility is a common condition in childhood among both girls and boys.[12-17] A study (2018) conducted in India, found that selective joint hypermobility was 54.31% in boys and 45.69% in girls in which prevalence of knee joint hypermobility was 20.19%.[6] The study performed in India showed prevalence of 58.8% (2014)[18], 58.7% (2008)[19] and 17.2% (1996)[13].The Beighton's scale is considered to be the gold standard test for diagnosis of joint hypermobility.[6,20] Studies (2011 and 2014) stated that height and knee joint hypermobility affects score of the functional

reach and lateral reach test of balance in children in both gender.[2,6]

An Indian study (2011) established the normative values in south Indian population and found that scores of Paediatric Balance scale (PBS) increases with age.[21] A study (2015) in India, found that placing the alternate foot and reaching forward with outstretched arm of PBS were more affected in children with increased BMI.[22] The PBS is a unique, standard measure of functional balance for children.[2,3,5,8,22-25] There is scarcity of literature evaluating effect of knee hypermobility on paediatric balance scale score in Indian children. Thus there is a need to compare paediatric balance scale score in typically developing children with children with knee joint hypermobility of age 4 to 8 years and to find correlation of height, gender and BMI on paediatric balance score in both groups among 4to8 year children.

MATERIAL AND METHODS

An analytical cross sectional study was performed over the 1 year period in the schools on normal children of 4-8 years (both boys and girls). Permission from the Institutional head and ethical committee was taken. Three schools were selected randomly by using random number table. Permission from the school authority was taken and children with knee joint hypermobility were selected as per the Beighton's criteria.[2] Children having ability to stand independently,[26] co-operative and able follow verbal commands[3,27] were included in the study and divided into 8 sub groups as per age (i.e. 4-4.5, 4.5-5, 5-5.5, 5.5-6, 6-6.5, 6.5-7, 7-7.5, 7.5-8). Children with any history of musculoskeletal complaints or trauma or surgery,[3,20] diagnosed with connective tissue disorders,[2,20,28] any neurological disorders[3], children with physical and intellectual disability[3] were excluded from the study. Written, informed consent was obtained by parents or guardian.

Total 841 children were screened for joint hypermobility syndrome of lower extremity and scored as per the Beighton's grade using universal half circle goniometer. Total 192 children were found and included in a group with KJH (22.82%) and 192 were included in a group without KJH. Total 384 children of both genders were included by Simple random sampling technique and divided into 8 subgroups (12 boys and 12 girls). Balance was evaluated by using peadiatric balance scale[23] in both groups. Goniometric measurements were recorded for Knee joint using half circle universal goniometer[29] (Figure).

Figure 1: Passive Hyperextension of Knee Joint Beyond 10 Degrees Using Half Circle Universal Goniometer.

DATA ANALYSIS

Statistical software, STATA Version 10.1, 2011 was used. Descriptive Statistics like mean, standard deviation (±SD) was calculated for quantitative variables (Age, Height, PBS, Beighton's scale). Frequency and variable was used to summarize categorical variables (Gender, severity). Inferential Statistics, test of significance was used to compare difference in mean paediatric balance scale (PBS) score in typically developing children and children with knee joint hypermobility. Two independent sample *t*- test was used for comparing difference in mean in typically developing children and children with knee joint hypermobility. Chi square test was used to compare difference in proportion and for group comparison. $P<0.05$ was considered statistical significance (95% Confidence interval).

RESULT

The demographic data i.e. height (cm), weight (Kg), body mass index(Kg/m^2) of children of both genders of age 4 -8 years participated in study (Table 1) suggest that children belongs to typically developing and knee joint hypermobility group showed nearly similar and comparable demographic data values.

Table 1: Mean And Standard Deviation (SD) Of Demographic Data (Height, Weight, Body Mass Index) Of Boys And Girls In Typically Developing And Knee Joint Hypermobility Groups.

Demographic data	TD Boys	TD Girls	KJH Boys	KJH Girls
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Height (cm)	108.89 ± 7.83	109.32 ± 6.75	109.05 ± 7.72	110.60 ± 7.38
Weight (Kg)	16.66 ± 3.42	16.87 ± 2.64	17.01 ± 2.80	17.02 ± 3.49
BMI (Kg/m^2)	13.97 ± 1.87	14.07 ± 1.68	14.35 ± 1.80	13.82 ± 1.76

SD-Standard Deviation, TD- Typically Developing, KJH- Knee joint Hypermobility, BMI- Body Mass Index

The mean values of paediatric balance scale (PBS) score showed highly significant difference among both boys and girls when compared typically developing subjects with knee joint hypermobility subjects of age 4 to 8 years in all 8 age subgroups i.e. 4.0-4.5, 4.5-5, 5-5.5, 5.5-6, 6-6.5, 6.5-7, 7-7.5, 7.5-8 years.(Table 2)

Table 2: Comparison of Paediatric Balance Scale Score Between Typically Developing Versus Knee Joint Hypermobility Children In 4-8 Years.

Age (years)	Gender	TD		KJH		t-value	*p*-value
		Mean	±SD	Mean	±SD		
4 – 4.5	B	53.25	0.86	49.91	1.56	6.45	<0.0001**
	G	52.33	0.98	49.67	1.72	4.65	0.0001**
4.5 – 5	B	53.33	1.66	50.16	1.33	5.12	<0.0001**
	G	52.58	2.35	50.0	1.20	3.38	0.0027**
5 – 5.5	B	53.41	1.44	50.33	1.49	5.13	<0.0001**
	G	52.75	2.34	50.08	1.31	3.44	0.0023**
5.5 – 6	B	53.5	2.02	51.0	1.80	3.19	0.0042**
	G	53.08	2.10	50.75	1.65	3.01	0.0064**
6 – 6.5	B	54.41	1.97	51.91	1.03	3.84	0.0009**
	G	54.16	2.24	51.67	1.30	3.33	0.0030**
6.5 – 7	B	54.83	1.33	52.0	2.08	3.95	0.0007**
	G	54.75	1.35	51.83	1.26	5.44	<0.0001**
7 – 7.5	B	55.0	1.12	52.16	1.11	6.18	<0.0001**
	G	54.91	0.99	51.91	1.50	5.75	<0.0001**
7.5 – 8	B	55.16	0.93	52.32	0.98	7.21	<0.0001**
	G	55.08	1.16	52.16	1.33	5.69	<0.0001**

B-Boys, G-Girls, TD- Typically developing, KJH- knee joint hypermobility, p-value<0.05- Significance*, <0.001-High Significance**

Table 3: Comparison Of Paediatric Balance Scale Score Between Boys And Girls In Typically Developing And With Knee Joint Hypermobility In 4-8 Years.

Age Group (year)	Groups	Gender				t-value	*p*-value
		Boys		Girls			
		Mean	±SD	Mean	±SD		
4 – 4.5	TD	53.25	0.86	52.33	0.98	2.42	0.02*
	KJH	49.91	1.56	49.67	1.72	0.37	0.71
4.5 – 5	TD	53.33	1.66	52.58	2.35	0.90	0.37
	KJH	50.16	1.33	50.0	1.20	0.32	0.75
5 – 5.5	TD	53.41	1.44	52.75	2.34	0.83	0.41
	KJH	50.33	1.49	50.08	1.31	0.43	0.66
5.5 – 6	TD	53.5	2.02	53.08	2.10	0.49	0.62
	KJH	51.0	1.80	50.75	1.65	0.35	0.72
6 – 6.5	TD	54.41	1.97	54.16	2.24	0.28	0.77
	KJH	51.91	1.03	51.67	1.30	0.51	0.61
6.5 – 7	TD	54.83	1.33	54.75	1.35	0.15	0.88
	KJH	52.0	2.08	51.83	1.26	0.23	0.81
7 – 7.5	TD	55.0	1.12	54.91	0.99	0.19	0.84
	KJH	52.16	1.11	51.91	1.50	0.46	0.64
7.5 – 8	TD	55.16	0.93	55.08	1.16	0.19	0.84
	KJH	52.32	0.98	52.16	1.33	0.34	0.73

TD- Typically developing, KJH- knee joint hypermobility, SD-Standard Deviation, p-value: <0.05- Significance*, <0.001-High Significance**

The mean values of paediatric balance scale (PBS) showed significant difference among typically developing boys and girls only in age 4.0-4.5 years out of 8 age subgroups whereas age groups i.e. 4.5-5, 5-5.5, 5.5-6, 6-6.5, 6.5-7, 7-7.5, 7.5-8 years of typically developing boys and girls showed no significant difference. This indicates that at early age of 4.0-4.5 years, typically developing boys showed significantly better balance compared to typically developing girls and as age advances from 4.5 to 8 years balance response equals among both gender on PBS. The mean values of paediatric balance scale (PBS) showed no significant difference among boys and girls with KJH in all 8 age subgroups.(Table 3)

Correlation and significance of height and BMI with PBS among typically developing children (Boys and Girls) of age 4 to 8 years (Table 4):

(IA) Correlation and significance of height with PBS in typically developing boys (Table 4): Correlation: Typically developing boys showed poor negative correlation between height and PBS values among age group (4-4.5, 5.5-6, 7-7.5 and 7.5-8 years). Age group 4.5-5 showed mild negative correlation. Age group 5-5.5 showed moderate negative correlation. Whereas, age group of 6-6.5 year and 6.5-7 year had showed poor positive correlation.

Significance: Among all age groups only 5-5.5 years sub group of typically developing Boys showed significant difference when compared height with PBS values (p = 0.0198*) whereas other age groups showed no significant values.

(IB) Correlation and significance of BMI with PBS in typically developing boys (Table 4): Correlation: Typically Developing Boys showed poor negative correlation between BMI and PBS values among age group (4-4.5, 5-5.5, 5.5-6, 6-6.5 and 6.5-7 years). Age group 4.5-5 showed moderate negative correlation whereas age group 7-7.5 and 7.5-8 years showed poor positive correlation.

Significance: All age groups from 4-8 years of Typically Developing Boys showed no significant difference when compared BMI with PBS values.

(IC) Correlation and significance of height with PBS in typically developing girls (Table 4): Correlation: Typically developing girls showed poor positive correlation between height and PBS values among age group (4-4.5, 4.5-5, 5.5-6, 6.5-7, 7-7.5 and 7.5-8 years). Age group 5-5.5 showed mild negative correlation whereas age group 6-6.5 showed poor negative correlation.

Significance: All age groups from 4-8 years of typically developing Girls showed no significant difference when compared height with PBS values.

(ID) Correlation and significance of BMI with PBS in typically developing girls (Table 4): Correlation: Typically developing girls showed poor negative correlation between BMI and PBS values among age group (4-4.5, 5-5.5 and 5.5-6 years). Age group 6.5-7 year showed moderate and 6-6.5, 7-7.5, 7.5-8 years showed mild negative correlation, whereas age group 4.5-5 year showed moderate positive correlation.

Significance: All age groups from 4-8 years of typically developing Girls showed no significant difference when compared BMI with PBS values.

Correlation And Significance Of Height And BMI With PBS Among Children With Knee Joint Hypermobility Of Boys and Girls of Age 4 To 8 Years (Table 4)

(IIA) Correlation and significance of height with PBS in Boys with knee joint hypermobility(Table 4): **Correlation:** Boys with knee joint hypermobility showed

poor positive correlation between height and PBS values among age group (4-4.5, 4.5-5, 5-5.5, 5.5-6 and 7-7.5 years) whereas age group 6-6.5, 6.5-7 and 7.5-8 years showed poor negative correlation.

Significance: All age groups from 4-8 years sub group of Boys with knee joint hypermobility showed no significant difference when compared height with PBS.

(IIB) Correlation and significance of BMI with PBS in Boys with knee joint hypermobility (Table 4): Correlation: Boys with knee joint hypermobility showed poor negative correlation between BMI and PBS values among age group (4-4.5, 4.5-5 and 7.5-8 years) whereas age group (6.5-7 and 7-7.5 years) showed poor positive correlation. Age group 5-5.5 year showed moderate negative correlation. Age group 5.5-6 and 6-6.5 years showed mild positive correlation.

Significance: All age groups from 4-8 years of Boys with knee joint hypermobility showed no significant difference when compared BMI with PBS values.

(IIC) Correlation and significance of BMI with PBS in girls with knee joint hypermobility (Table 4): Correlation: Girls with knee joint hypermobility showed poor positive correlation between height and PBS values among age group (4-4.5 and 7-7.5 years) whereas age group (4.5-5, 5.5-6 and 6-6.5 years) showed poor negative correlation. Age group 5-5.5, 7.5-8 years showed strong positive correlation and 6.5-7 year moderate negative correlation.

Significance: All age groups from 4-8 years sub group of Girls with knee joint hypermobility showed no significant difference when compared height with PBS.

(IID) Correlation and significance of BMI with PBS in Boys with knee joint hypermobility (Table 4): Correlation: Girls with knee joint hypermobility showed poor positive correlation between BMI and PBS values among age group (4.5-5, 7-7.5 and 7.5-8 years) whereas age group 5-5.5 year showed poor negative correlation. Age group 4-4.5 year showed mild positive correlation. Age group 5.5-6 year showed mild negative correlation. Age group 6-6.5 year showed moderate negative and age group 6.5-7 strong negative correlation.

Significance: All age groups from 4-8 years of Girls with knee joint hypermobility showed no significant difference when compared BMI with PBS values whereas age group 6-6.5 year showed significant difference when compared BMI with PBS in Girls with knee joint hypermobility.

Table 4: Correlation and Significance Of Height And BMI With Paediatric Balance Scale Score In Typically Developing And children with Knee Joint Hypermobility Among Boys And Girls In 4-8 Years.

Age group (years)	Gender	TD children				Children With KJH			
		Height		BMI		Height		BMI	
		r-value	p-value	r-value	p-value	r-value	p-value	r-value	p-value
4 – 4.5	B	-0.13	0.67	-0.18	0.56	0.10	0.74	-0.11	0.71
	G	0.19	0.54	-0.27	0.39	0.06	0.83	0.39	0.20
4.5 – 5	B	-0.33	0.28	-0.47	0.11	0.05	0.86	-0.14	0.65
	G	0.11	0.73	0.49	0.12	-0.12	0.70	0.28	0.36
5 – 5.5	B	-0.65	0.01*	-0.27	0.38	0.24	0.44	-0.52	0.07
	G	-0.45	0.13	-0.06	0.84	0.77	0.003*	-0.21	0.50
5.5 – 6	B	-0.06	0.83	-0.20	0.53	0.26	0.40	0.40	0.18
	G	0.16	0.60	-0.03	0.92	-0.13	0.68	-0.42	0.17
6 – 6.5	B	0.16	0.61	-0.07	0.82	-0.10	0.74	0.34	0.44
	G	-0.03	0.91	-0.33	0.28	-0.12	0.70	-0.59	0.04*
6.5 – 7	B	0.23	0.45	-0.03	0.92	-0.22	0.49	0.16	0.60
	G	0.16	0.61	-0.53	0.07	-0.49	0.09*	-0.82	<0.0001**
7 – 7.5	B	-0.10	0.73	0.009	0.97	0.24	0.43	0.19	0.55
	G	0.13	0.68	-0.32	0.30	0.06	0.83	0.15	0.61
7.5 – 8	B	-0.19	0.53	0.29	0.35	-0.20	0.51	-0.25	0.42
	G	0.24	0.42	-0.32	0.30	0.70	0.18	0.22	0.48

B- Boys, G-Girls, TD-Typically developing, KJH- knee joint hypermobility, BMI- Body Mass Index, p-value: <0.05- Significance*, <0.001-High Significance**

Correlation and Significance Of Goniometric Measurement Of Knee Joint Angle Of Right And Left knee With PBS In 4 to 8 years Age Groups Of Typically Developing And Knee Joint Hypermobility Boys And Girls (Table 5).

(IIIA) Correlation and significance of Goniometric measurement of knee joint (Right and Left) with PBS in typically developing boys (Table 5): **Correlation :**Typically developing boys showed mild negative correlation between goniometric measurement of knee joint (Right and Left) with PBS values among age group (4-4.5, 4.5-5 and 5-5.5 years) and age group 5.5-6, 6.5-7 showed moderate negative correlation in both (right and left) goniometric measurement of knee joint with PBS whereas age group 6-6.5 and 7.5-8 years showed poor negative correlation.

Significance :Age group (4-4.5, 4.5-5, 5-5.5, 6-6.5, 7-7.5 and 7.5-8 years) showed no significance when goniometric measurement of knee joint both right and left in typically developing boys compared with PBS score whereas age group 5.5-6 and 6.5-7 showed significant value.

(IIIB) Correlation and significance of Goniometric measurement of knee joint (Right and Left) with PBS among typically developing girls(Table 5): **Correlation:** Age group of 4-4.5 year of typically developing girls showed poor positive correlation in goniometric measurement of knee joint (Right and Left) with PBS. Age group 4.5-5, 6-6.5 years showed strong negative correlation, age group 5-5.5, 5.5-6, 7-7.5, 7.5-8 years showed moderate negative correlation. Age group 6.5-7 showed mild negative correlation in both right and left goniometric measurement of knee joint with PBS.

Significance :Age group (4-4.5, 5-5.5, 6.5-7 years) showed no significance when goniometric measurement of knee joint (right and left) in typically developing girls compared with PBS score whereas age group 5.5-6, 7-7.5 and 7.5-8 years showed significant value and age group 4.5-5, 6-6.5 years showed high significance value.

(IIIC) Correlation and significance of Goniometric measurement of knee joint (Right and Left) with PBS among Boys with knee joint Hypermobility: Boys with knee joint Hypermobility showed poor negative correlation between goniometric measurement of knee joint (Right and Left) with PBS values in age group (4-4.5, 5-5.5 and 7.5-8 years). Age group 4.5-5 year showed mild negative correlation whereas age group (5.5-6 and 6-6.5 years) showed moderate negative correlation. Age group 6.5-7 and 7-7.5 years showed strong negative correlation between goniometric measurement of knee joint (Right and Left) with PBS values in boys with knee joint hypermobility.

Significance :Age group (4-4.5, 4.5-5, 5-5.5, 5.5-6 and 7.5-8 years) showed no significant value when goniometric measurement of knee joint both right and left in Boys with knee joint hypermobility compared with PBS score whereas age group 6-6.5 showed significant correlation and age group 6.5-7, 7-7.5 showed high significance.

(IIID) Correlation and significance of Goniometric measurement of knee joint (Right and Left) with PBS among girls with knee joint Hypermobility(Table 5): **Correlation:** Girls with knee joint Hypermobility showed strong negative correlation between goniometric measurements of knee joint (Right and Left) with PBS values in age group (4-4.5 and7-7.5 years). Age group (4-4.5 and 5.5-6 years) showed poor negative correlation whereas age group 5-5.5 year showed moderate negative correlation between goniometric measurement of knee joint (Right and Left) with PBS in Girls with knee joint hypermobility. Age group 6-6.5 year showed mild positive correlation

whereas age group 7.5-8 year showed poor positive correlation between goniometric measurements of knee joint (Right and Left) with PBS in children with knee joint hypermobility.

Significance: Age group (4.5-5, 5-5.5, 5.5-6, 6-6.5, 6.5-7 and 7.5-8 years) showed no significant value when goniometric measurement of knee joint both right and left in Girls with knee joint hypermobility compared with PBS score whereas age group 4-4.5 year showed significant correlation and age group 7-7.5 year showed high significance.

Table 5: Correlation and Significance Of Goniometric Measurement Of Knee Joint Angle Of Right And Left knee With PBS In 4 to 8 years Age Groups Of Typically Developing And Knee Joint Hypermobility Boys And Girls.

Age group (years)	Gender	Goniometric Measurements Of Knee Joint Angle			
		TD children		Children With KJH	
		r-value	p-value	r-value	p-value
4 – 4.5	B	-0.34	0.27	-0.12	0.68
	G	0.13	0.66	-0.69	0.02*
4.5 – 5	B	-0.30	0.32	-0.41	0.14
	G	-0.79	0.002**	-0.27	0.38
5 – 5.5	B	-0.34	0.27	-0.06	0.83
	G	-0.55	0.06	-0.46	0.12
5.5 – 6	B	-0.58	0.04*	-0.50	0.09
	G	-0.62	0.02*	-0.04	0.89
6 – 6.5	B	-0.14	0.66	-0.63	0.02*
	G	-0.76	0.003**	0.32	0.30
6.5 – 7	B	-0.63	0.02*	-0.72	0.008**
	G	-0.33	0.28	-0.43	0.15
7 – 7.5	B	-0.08	0.80	-0.81	0.001**
	G	-0.63	0.02*	-0.71	0.008**
7.5 – 8	B	-0.19	0.55	-0.18	0.55
	G	-0.60	0.03*	0.24	0.43

B-Boys , G- Girls, TD-Typically developing, KJH-knee joint hypermobility, p-value: <0.05- Significance*, <0.001-High Significance**

From the results, it was observed that height, BMI and knee hypermobility angle correlated negatively with PBS score among both genders, which indicate that as height, BMI and KJH angle increases ,the balance score of children of age 4 to 8 years decreases.

DISCUSSION

The current study was intended to analyze the effect of knee joint hypermobility in balance and correlation of height, BMI, angle of knee joint range of motion in 384 school going children from age group 4-8 years of both gender with 8 sub groups (4.0-4.5, 4.5-5, 5-5.5, 5.5-6, 6-6.5, 6.5-7, 7-7.5 and 7.5-8 years) . The present study is an analytical cross sectional study where comparison of paediatric balance scale (PBS) score of typically developing children without knee joint hypermobility were done with the PBS score of children with knee joint hypermobility. Total 841 children were screened out of which 192 children were present with knee joint hypermobility i.e. 22.82%. In present study reference values of PBS total score for 4 to 8 years children ranges from 52.39 to 56.0 and 51.35 to 56 among typically developing boys and girls respectively, whereas among boys and girls with knee joint hypermobility, PBS reference values ranges from 48.35 to 53.3 and 47.95 to 53.49 respectively. This showed that there is significant decrease in reference values of PBS score in children with knee joint hypermobility as compared to the reference values of PBS score in typically developing children of age 4 to 8 years (P=<0.0001).

The somatosensory system consists the receptors and processing centers to integrate the sensory modalities such as touch, temperature, proprioception (body position, movement sensation and amount of force generation), and norciception (pain).[10] Proprioceptive feedback is used by the central nervous system for conscious and unconscious appreciation of the position, movement, and force generated by

the body and limbs.[2,10] It is also found that, proprioceptive acuity and Joint proprioceptive feedback is altered in children with joint hypermobility.[2,10-12]

Hjalmarsson ES et al(2012) concluded that pain appears to affect activity and participation in children with hypermobility syndrome.[30] Balance is decreased in children with hypermobility syndrome compared to healthy controls of age group 8-16 years.[20] Shumway-Cook and Woollacott[4] stated that in children balance matures between the ages of 4 to 10 years. A study performed in Karnataka, India (2011) on 563 children (2.6-8 years) established the normative data in their geographical region and also found that as the age advance the PBS values showed increased values in both genders and suggested that scores of PBS increases with age in accordance to the present study.[22] PBS is a gold standard scale to evaluate the balance in children. [2, 3, 5, 8, 22-25] The study established the normative score of PBS in typically developing children of both the gender from age 5-12 years and found total score increases as the age advances.[3] The TUG (timed up and go test) values decreases as age increases in children from age 5-12 years of both the gender, The PRT (paediatric reach test) values also showed positive correlation with the age.[3] Few studies on functional reach test (FRT) and lateral reach test (LRT) showed similar patterns (2014, 2011)[2,8] in typically developing and in children with knee joint hypermobility of 6 -12years in both genders i.e. balance values increases as age advances in children.[2, 6-8]

Hypermobility is a common condition in childhood among both girls and boys.[15-18, 21,29] A study in India of (2014) on 140 children of age group 6-12 years suggest that knee joint hypermobility affects score of the functional reach and lateral reach test of balance in children,[2] which supports the findings of present study that showed significant relationship of knee joint hypermobility with PBS score in children of age group 4-8 years of both the gender.[2] In current study, BMI and height has no correlation with PBS score in most of the age groups among the children of age group 4-8 years in both the gender, this could be because the BMI in typically developing children and children with knee joint hypermobility of both the gender were in normal limits. The study of (2015)[19] concluded that the children with increased BMI were found with difficulty in making the adjustments in response to external disturbances in orthostatic position and increased postural instability, which suggest that increase in BMI affects the balance in school going children which showed that as the BMI increases the PBS score decreases.[19]

The present study showed that goniometric measurement has a negative correlation with the PBS score in children of age group 4-8 years in both the gender with and without knee joint hypermobility which is in accordance with the result of the studies who stated that knee joint hypermobility affects balance in children of various age groups which showed that as the goniometric measurement of knee joint hyperextension increases the PBS score decreases.[2,8, 20,24]

The present study also showed that height has no correlation with the 14th component of PBS score (i.e. forward reach test) which is contradictory finding to the studies (2011 and 2014) on functional reach test (FRT) and lateral reach test (LRT) which showed that score of FRT and LRT increases as the height of children from age group 6-12 years increases in both the gender.[2,8] In present study children of age 4-8 years in both gender showed less score of components of PBS (i.e. turning to look behind, standing on one foot and forward reach test) out of 14 components of PBS this can be explained on the basis that in this age group balance is in a developing stage and matures till the age of 4-10 years and this component demands better level of understanding the commands, physical and proprioceptive demands.

In present study prevalence of knee joint hypermobility is 22.8% which follows the result of previous study(2018).[6] The normative values established in current study can be used to evaluate balance in children from age 4-8 years among both genders with and without knee joint hypermobility.

Normative values of PBS score in children of age 4-8 years with and without knee joint hypermobility can be used as comparative data for assessment of balance in school going children of age 4-8 years. Children should be evaluated on the regular basis for hypermobility at school level and can be followed for Beighton's score to avoid musculoskeletal injuries and to assess before specific sports activities. The study focused on the selective knee joint hypermobility whereas there can be hypermobility of ankle as well as hip joint along with knee which was not a part of Beighton's evaluation score this might affect performance of children in PBS.

CONCLUSION

The paediatric balance scale score obtained in study can be used to evaluate balance in children with selective knee joint as well as generalized joint hypermobility, hypotonic cerebral palsy, Down's syndrome or other connective tissue disorder with knee joint hypermobility etc for similar age group of 4to8 years among both gender.

REFERENCES

1. Sibley KM, Beauchamp MK, Ooteghem K Van, Paterson M, Wittmeier KD. Components of Standing Postural Control Evaluated in Pediatric Balance Measures : A Scoping Review. *Arch Phys Med Rehabil.*2017;98(10):2066–2078.
2. Deshmukh AA. Normal values of functional reach and lateral reach tests in children with knee hypermobility. *Pediatr Phys Ther*. 2014;26(2):230–6.
3. Butz SM, Sweeney JK, Roberts PL. Relationships Among Age, Gender, Anthropometric Characteristics, and Dynamic Balance in Children 5 to 12 Years Old. *Pediatr Phys Ther.*2015;27(2):126-133.
4. Shumway-Cook A, Woollacott MH. Motor Control: Theory and Practical Applications. 4th ed. Baltimore, MD: Williams & Wilkins; 2010.
5. O'Sullivan SB, Schmitz TJ. Physical Rehabilitation. 5th ed. F.A. Davis 2007;249-258.
6. Deshmukh AA, Humne R. Correlation of generalized joint hypermobility and selective joint hypermobility with physical activity in school going children of age 6 to 12 years. *Panacea Journal of Medical Sciences*, 2018;8(2):59-65.
7. Westcott SL, Lowes LP, Richardson PK. Evaluation of postural stability in children: current theories and assessment tools. *Phys Ther.*1997;77:629-645.
8. Deshmukh AA, Ganesan S, Tedla JS. Normal values of functional reach and Lateral reach tests in Indian school children. *Pediatr Phys Ther* 2011;23-23-30.
9. Shumway-Cook A, Woollacott MH. The growth of stability: postural control from a developmental perspective. *J Motor Behav.* 1985;17(2):131-147.
10. Largo R, Caflisch J, Hug F, et al. Neuromotor development from 5 to 18 years. Part 1: timed performance. *Dev Med Child Neurol.* 2001; 43:436-443.
11. Norris RA, Wilder E, Norton J. Functional Reach Test in 3 to 5 year old children without disabilities. *Pediatr Phys Ther.* 2008;20:47-52.
12. Smits-Engelsman B, Klerks M, Kirby A. Beighton score: A valid measure for generalized hypermobility in children. *J Pediatr.*2011;158(1).
13. Subramanyam V, Janki KY. *Joint hypermobility* in south Indian *children. Indian Pediatr.1996*;33(9):771-2.
14. Murray KJ, Woo P. Benign joint hypermobility in childhood. *Rheumatol.* 2001; 489–91.
15. Clinch J, Deere K, Sayers A, Palmer S, Riddoch C, Tobias JH, et al. Epidemiology of Generalized Joint Laxity (Hypermobility) in Fourteen-Year-Old Children From the UK A Population-Based Evaluation. *Arthritis Rheum.*2011; 63(9):2819–27.
16. Terry RH, Palmer ST, Rimes KA, Clark CJ, Simmonds JV, Horwood JP. Living with joint hyper-mobility syndrome: Patient experiences of diagnosis, referral and self-care. *Fam Pract.*2015;32(3):354-8.doi: 10.1093/fampra/cmv026.

17. Van der Giessen L, Liekens D, Rutgers K, Hartman A, Mulder P, Oranje A. Validation of Beighton score and prevalence of connective tissue signs in 773 Dutch children. *J Rheumatol.* 2001;28(12):2726–30.
18. Abujam B, Aggarwal A. Hypermobility is related with musculoskeletal pain in Indian School children. *Clinl And Experi Rheumatol*.2014;32(4):610-3.
19. Hasija RP, Khubchandani RP, Shenoi S. Joint hypermobility in Indian children. *Clinl And Experi Rheumatol*,2008; 26:146-150.
20. Czaprowski D, Kotwicki T, Pawlowska P, Stolinski L. Join hypermobility in children with idiopathic scoliosis: SOSORT award 2011 winner. *Scoliosis J*.2011;6:1:22.
21. Tiwari D, Rao BK, Solomon J. Normative scores on pediatric balance scale. *Indian J Physiother Occupa Ther*.2011;5(2) 45-48.
22. Malawade M, Jerome A, Khatri S. Correlation between balance and body mass index in school going children. *Indian J Of Phys Ther*.2015;1(1):25–8.
23. N Adib, Davies K, Grahame R, P. Woo, Murray KJ . Joint hypermobility syndrome in childhood. A not so benign multisystem disorder?*Rheumatol.* 2005;44:744-750.
24. Junge T, Wedderkopp N, Thorlund JB, Søgaard K, Juul-Kristensen B. Altered knee joint neuromuscular control during landing from a jump in 10-15year old children with Generalised Joint Hypermobility. A substudy of the CHAMPS-study Denmark. *J ElectromyogrKinesiol*.2015;25(3):501–7. http://dx.doi.org/10.1016/j.jelekin.2015.02.011
25. Yasemin U, Yesim A, Berna T, Dilek D, Ayhan B, Omer K. Is there a balance problem in hypermobile patients with fibromyalgia? *Turk J Rheumatol.* 2013; 28(1): 10-15.
26. Azma K, Mottaghi P, Hosseini A, Abadi HH, Nouraei MH. Benign joint hypermobility syndrome in soldiers; what is the effect of military training courses on associated joint instabilities? *J Res Med Sci.* 2014;19:639-43.
27. Cheng J & Chan P. Joint laxity in children. *J Pediatr Orthop.*1991;11(6):752-6.
28. Hiemstra LA , Kerslake S, Kupfer N, Lafave MR. Generalized joint hypermobility does not influence clinical outcomes following isolated MPFL reconstruction for patellofemoral instability. *Knee Surg Sports Traumatol Arthrosc.2019*;27(11):3660-3667. doi: 10.1007/s00167-019-05489-0.
29. Norkin CC, White DJ. Measurement of joint motion, a guide to goniometry. 4th ed. 2011; 449-3.
30. Schubert-hjalmarsson E, Ohman A, Beckung E. Pain, balance, activity, and participation in children with hypermobility syndrome. *Pediatr Phys Ther*. 2012;24(4): 339-44.doi: 10.1097/PEP.0b013e318268e0ef.

How to cite this article: Deshmukh AA, Mandlik AD. Comparison of balance in children with and without knee joint hypermobility of age 4-8 years. International Journal of Science & Healthcare Research. 2020; 5(3): 214-223.

******